Request for Proposals

Alameda Corridor
Maintenance Services

To be submitted to:

Alameda Corridor Transportation Authority
3760 Kilroy Airport Way, Suite 200
Long Beach, CA 90806

September 30, 2024

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1.0 Introduction

The Alameda Corridor Transportation Authority ("ACTA") is soliciting proposals from qualified contractors to provide rail and non-rail maintenance and capital construction services on the Alameda Corridor (Rail Corridor). The Rail Corridor is a triple-track, heavy freight rail line that extends 20 miles from downtown Los Angeles to the Port of Los Angeles (POLA) and Port of Long Beach (POLB) collectively ("Ports"). The two largest Class 1 railroads in the United States, the Union Pacific Railroad ("UP") and the BNSF Railway ("BNSF"), collectively ("Railroads"), and to a limited extent the Ports' short-haul provider Pacific Harbor Line (PHL), all use the Rail Corridor to serve the largest port complex in the country. ACTA is a joint-powers authority created by the Cities of Los Angeles and Long Beach in 1989 to develop, finance, construct, and operate the Rail Corridor, which commenced operations on April 15, 2002.

ACTA intends to enter into an agreement commencing approximately in June 2025 with one firm or team ("Contractor") for a five-year period (with a five-year extension option) to perform the maintenance services as summarized in this Request for Proposals (RFP). A draft of the Maintenance Agreement ("Agreement") is included in **Appendix A** of this RFP.

Capitalized terms in the RFP are defined in the Agreement.

2.0 Rail Corridor Description

Currently, the Railroads dispatch trains on the Rail Corridor from the San Bernardino, California Joint Dispatch Center, and the Railroads' Police Department provides security on the Rail Corridor. The Ports own all the rail rights-of-way upon which the Rail Corridor is located. In addition, the Ports individually, and in some cases jointly, own properties within each Port's jurisdiction. The Rail Corridor was built to accommodate the anticipated increase in port container activity. The Railroads, and in some cases PHL, operate their respective trains on the Rail Corridor using their own crews.

The Rail Corridor is comprised of three segments referred to as the North End, the Mid-Corridor, and the South End. The one-mile long North End segment and nine-mile long South End segment are standard at-grade railroad facilities with highway grade separations over or under the railroad. The Mid-Corridor segment is a 10-mile long below-grade trench located directly adjacent to Alameda Street. There are approximately a total of sixty highway and railroad bridges throughout the three Rail Corridor segments.

Appendix B contains the Rail Corridor track charts showing the locations of bridges, mileposts, storm drain facilities in the trench, control points, signal locations, maintenance limits, and other significant features. The rail right-of-way varies in width from 30 to 100 feet along the Rail Corridor.

North End

The North End extends east of Santa Fe Avenue in Los Angeles and provides connections to the transcontinental rail network of each Railroad. In addition, there are connections to other Railroad branches, industries, and rail yards. The Rail Corridor is grade separated at Santa Fe Avenue, Washington Boulevard, and the BNSF/Amtrak/Metrolink line at Redondo Junction. The Railroads maintain all tracks, structures and other facilities east of the Rail Corridor connections with their own or contract forces.

Mid-Corridor

The Mid-Corridor segment, between Santa Fe Avenue at the north and the Artesia Freeway (SR-91) at the south, is below grade in a trench about 33 feet deep and 51 feet wide. Thirty-two east-west streets cross above the trench via roadway bridges. In addition, two rail bridges cross the trench carrying the BNSF's Harbor Subdivision at Slauson Avenue and the UP La Habra Branch at Randolph Street. Both rail bridges remain active with minimal daily train activity.

Paralleling the trench for about six miles between Firestone Boulevard at the north and SR-91 at the south is UP's at-grade Santa Ana Bypass Track. The track and grade crossings, although on the Ports' right-of-way, are maintained by the UP or its designee (PHL) under a separate agreement.

South End

South of the SR-91 Freeway, the ACTA mainline tracks are at-grade, and most streets crossing the Rail Corridor are raised above the tracks and Alameda Street. Exceptions to this are two locations where the ACTA main tracks are constructed on railroad bridges over Alameda Street.

Between Laurel Park Road and Carson Street, there are two 7,500 foot-long storage tracks for use by either Railroad. In this area, the Corridor occupies from 60 to 80 feet of the westerly portion of a 250-foot wide railroad right-of-way. The remaining right of way is UP's Dolores Yard, which stretches about 6 miles from Laurel Park Road to Lomita Boulevard. UP or PHL maintains the Southerly Drill Track on the Ports' property west of ACTA's three main lines for local industry service.

Numerous rail connections exist in the southerly portion of the Rail Corridor. These include but are not limited to:

1) the Dolores Yard Lead Track at MP 10.65 and the UP Wilmington Branch at MP 11.6
2) two leads connecting Dolores Yard to the UP Intermodal Container Transfer Facility (ICTF)
3) several oil refinery industrial tracks, and
4) the BNSF lead track to its Watson Yard and the south end of the BNSF's Harbor Subdivision.

In addition to the Railroads' operation, PHL shuttles trains to and from Dolores Yard and Watson Yard for both Railroads. PHL also operates trains to local industries on the South Drill Track for UP and BNSF and the Santa Ana Bypass Track for UP. Although the Railroads maintain the tracks located on their property, the selected maintenance contractor will be required to coordinate their services periodically with the Railroads.

South of Pacific Coast Highway, the ACTA's three main lines split into four tracks: two to POLB and two to Terminal Island. The Rail Corridor ends several hundred feet east of Anaheim Street in POLB and at the north side of Cerritos Channel at the Badger Avenue Bridge to Terminal Island.

The southerly end of the South End segment is within the Ports' jurisdictional boundaries and within PHL's zone of operations. PHL, a subsidiary of Anacostia Rail Holdings Company, is a short line railroad established in 1998 that currently provides rail services within the Ports' complex, including maintenance and dispatching of train movements.

3.0 RESERVED

4.0 Request For Proposals Schedule

Proposals shall be submitted in-person, and as otherwise set forth herein, by 3:00 p.m. (Pacific Daylight Time) on **November 13, 2024** to:

Graham Christie
Chief Operating Officer
Alameda Corridor Transportation Authority
3760 Kilroy Airport Way, Suite 200
Long Beach, CA 90806

Electronic delivery of Proposals by email or fax will not be accepted. All Proposals will be date-stamped upon receipt. The opening of the Proposals will not be a public event.

Proposers are solely responsible for the timeliness of their submittals. Proposers are advised to allow adequate time to ensure timely delivery at the location designated at or before the deadline set forth above. Proposers are encouraged to consider conditions such as, but not limited to, traffic congestion, parking, and/or events in and around the ACTA office that might increase the amount of time necessary to deliver the Proposal in person.

ACTA reserves the right to reject any and all Proposals, and to waive or correct any irregularity in a Proposal at its sole discretion, including but not limited to irregularities related to mathematical computation errors and missing information. ACTA also reserves the right to receive any necessary clarification from proposers to assist in correcting irregularities in a Proposal. Failure to meet the Small Business Enterprise or Good Faith Effort requirements set forth in this RFP is not waivable and such Proposals shall be deemed non-responsive.

Proposers are advised that all documentation submitted in response to this RFP will be considered property of ACTA and may become available to the public as a public record and be released without further notification. Any information that a Proposer considers confidential should not be submitted with the Proposal.

A Pre-Proposal Meeting will be held on **October 7, 2024** at 09:00 a.m. at the Port of Long Beach Maintenance Facilities Building at 725 Harbor Plaza, Long Beach, CA 90802. While not mandatory, Prime Contractors are strongly encouraged to attend the pre-proposal meeting.

All questions and requests for clarification regarding the RFP will be accepted in two phases, and requests shall be submitted to the following email address MOWRFP@acta.org.

The first phase of written questions will be accepted up until 3:00 p.m. on **October 14, 2024.** Written responses to the first phase of questions will be posted on ACTA's website on **October 21, 2024**. The second phase of questions will be accepted until the 3:00 p.m. on **October 28, 2024.** Written responses to the second phase of questions will be posted to the ACTA website on **November 4, 2024**.

It is expected that interviews with some or all Proposers will be conducted on **December 11, 2024.** This date may be subject to change. Interviews are expected to be approximately one and a half (1 ½) hours in length. Each interviewed Proposer shall make a presentation of its written Proposal, which shall be conducted by their proposed Contract Manager lasting up to 45 minutes followed by questions and answers. Only key members of the Proposer shall attend the interview with no more than 7 people from each firm or team in attendance. No audiovisual equipment shall be provided or allowed during the presentations and interviews.

A review panel comprised of representatives from ACTA, both Ports and one outside public transportation agency (e.g., Metro or Metrolink) will evaluate the written proposals, conduct interviews, and recommend a firm for selection. Refer to Section 6.0 for additional evaluation criteria. ACTA will finalize an Agreement (See **Appendix A**) with the recommended firm and transmit the recommended selection and Agreement terms to the Ports and Railroads for approval. If approved, ACTA staff will submit the final Agreement to the ACTA Governing Board for approval.

Schedule for Selection of a Maintenance of Way Contractor

	Date
Release of RFP:	• Sept 30, 2024
Pre-Proposal Meeting:	• Oct 7, 2024
Close of First Round of Written Questions (Deadline 3:00 p.m.):	• Oct 14, 2024
Response to First Round of Written Questions	• Oct 21, 2024
Close of Second Round of Written Questions (Deadline 3:00 p.m.):	• Oct 28, 2024
Response to Second Round of Written Questions	• Nov 4, 2024
Proposals Due (Deadline 3:00 p.m.):	• Nov 13, 2024
Interviews: *	• Dec 11, 2024
Recommendation for ACTA Board Approval: **	• June 12, 2025
Agreement Effective and Services Begin (approximate)	• July 2025

* *May be subject to change*
** *Follows approval by Railroads and Port Harbor Commissions*

5. Proposal Format and Contents

Each Proposal submission package shall include the following:

1) One (1) original and five (5) copies of
   - the Proposal Cover Letter
   - the firm's Technical Proposal, including the DIR Form set forth in **Appendix D**

the firms' Cost Proposal Forms as set forth in **Appendix P**

2) One (1) original set of the SBE Forms as set forth in **Appendix O** OR evidence showing compliance with the Good Faith Efforts set forth in **Appendix O**
3) One (1) flash drive containing the firm's entire proposal.

Proposals shall be typed using 1.5 line spacing, 12-point font limit, and submitted on single-sided 8-1/2 x 11 inch paper. Tables, charts and graphics may be single spaced with smaller font, but must be readily legible and subject to clear copy capability. Proposals shall not include any promotional materials and shall be limited only to the information requested in this RFP.

Proposals should not exceed 25 single-sided pages in length, **excluding** the following:
- Proposal Letter
- Team member resumes
- Cost Proposal
- SBE Forms/GFE information
- Documents submitted as evidence of insurance and bonding

- Any additional supporting documentation beyond summary information for Safety Violations, Claims History, Denial of Award or Prequalification, Completion by Surety, Assessment of Liquidated Damages, and FRA Violations. Such additional supporting information can be provided in appendices.

5.1 Proposal Cover Letter

The Proposal Cover Letter shall be no longer than three pages and contain the following information:

Provide a brief description of the firm and all proposed subcontractors (include firm names, address, telephone, email address and fax numbers) and identify the entity type for each firm (e.g., corporation, joint venture, partnership, or sole proprietorship).

Provide the name, address, and telephone number of the contact person during the period of Proposal evaluation.

Provide a statement that the Proposal, including costs, shall remain valid for a period of not less than 180 days from the date of submittal.

Provide a statement that the Proposer can comply with the terms of the Maintenance Agreement included in **Appendix A** of this RFP.

Provide a statement confirming that the firm and all subcontractors proposed to perform any public work services are registered with the Department of Industrial Relations as public works contractors.

Provide a statement certifying that the Proposal constitutes Proposer's full and complete written response to the RFP, and acknowledging that additional material outside of such Proposal shall not be considered by ACTA in connection with this RFP, unless ACTA provides a written request for such additional written materials.

The Proposal Letter shall include the following provisions verbatim:

"The undersigned firm acknowledges and accepts that the evaluation selection of the maintenance contractor will not be based on lowest ultimate cost, but rather will be based on evaluation of the qualification of proposed team and staff, understanding and approach to the required services, and pricing considerations as outlined in the RFP."

“The undersigned firm has not prepared this Proposal in collusion with any other proposer. The contents of this Proposal have not been communicated at any time or in any manner by the undersigned firm, its employees, agents, or any interested party of the undersigned firm to any other proposer. This Proposal is genuine, and not a sham or collusive, nor made in the interest or on behalf of any person not herein named; the undersigned firm, its employees, or agents have not directly or indirectly induced or solicited any other proposer to put in a sham proposal, or any other person, firm or corporation to refrain from submitting a proposal; and the undersigned firm, its employees or agents have not in any manner sought by collusion to secure for themselves an advantage over any other proposer.”

Provide a statement that the Proposal cover letter is signed by the person or persons authorized to legally bind the firm.

5.2 Technical Proposal

Firms are requested to submit the following information in their proposal to show the firm’s skills, knowledge, and understanding of the subject matter involved to perform the required services including examples of previous experience in similar or related assignments, staff experience, workload capabilities, and providing client references.

A. Qualification of Team and Proposed Staff

1. *Similar Projects and References* – Provide a description of recently completed or ongoing projects involving work similar in magnitude and scope to that described by this RFP, including any prevailing public works projects in California. In addition, projects performed by parent or sister entities of Proposer may be listed separately, but Proposer shall make clear which parent or sister entity performed each project. Listed projects should detail the Proposer’s specific technical and management experience and explain how it is applicable to the types of work described in this RFP, including but not limited to inspecting, maintaining, repairing, rehabilitating, and constructing track, structures, grade crossings and railroad-related infrastructure.

Provide a narrative describing up to three projects that highlight the firm’s specific experience in implementing safety training and bridge management programs. For each project, include the client firm name, a contact name, phone and email for references, the date range of the work performed, and specific details of the Proposer’s participation and responsibilities on the project. Include information detailing the firm’s railroad-related maintenance tasks, evidence of successful relationships with Class 1 railroads and maintenance of FRA Class 4 or better trackage.

Provide a statement confirming that the proposed team is familiar with and qualified to provide services in compliance with the UP Track and Signal Standards contained in **Appendix F**.

Organization Chart, Staffing Plan, and Key Personnel - Provide an organization chart that identifies the Key Personnel and support and other management personnel that will be assigned to the services, including the Maintenance Contract Manager, Signal and Communications Supervisor, Track Supervisor, Bridge and Structures Supervisor, and other key staff. Indicate whether each position listed is a full or part-time assignment. Include as an appendix to the proposal resumes for Key Personnel, as well as a list of certifications as necessary or required. A description of required Qualifications of Key Personnel can be found in **Appendix N**. ACTA reserves the right to waive the minimum years of experience for Key Personnel.

2. *Subcontracting Plan* – Provide a subcontracting plan describing any work where the firm intends to engage subcontractors. Provide narratives detailing the firm's prior experience with each proposed subcontractor. For each subcontractor, provide the firm's name and address, and a lead staff name, title and contact information.

3. *Safety Violations* - Provide a list detailing any citations issued against the firm by CAL/OSHA or the Federal OSHA for any "serious", "willful", or "repeat" violations of safety or heath regulations in the past five (5) years. For any citations, include the dates of the citations, the nature of the violation, the project on which the citation(s) was/were issued, and the amount of penalty paid, if any. If the citation was appealed to the Occupational Safety and Health Appeals Board and a decision has been issued, list the case number and date of the decision. Where the firm provides project experience for parent or sister entities, the citations issued for these projects shall also be provided.

4. *Federal Railroad Administration (FRA)* Violations - Provide a narrative describing any FRA violations issued to the firm or any proposed team members including subcontractors during the past five (5) years. Explain the nature, date, and reference number of the violations; fines or penalties; and corrective actions. Where a provides project experience of parent or sister entities, the FRA violations for those projects shall also be described.

5. *Licenses* - Provide a list of the firms' and subcontractors' license numbers, classifications and expiration dates of the licenses. List the dates, if any, when any of the firm's licenses have been revoked at any time or if the firm and subcontractors have been debarred from any public works project in the past ten (10) years.

6. *Claims History* - Disclose and explain all litigation, mediation, or arbitration of claims against the firm or brought by the firm seeking payment of money or other relief arising out of construction or maintenance projects during the past five (5) years, including but not limited to claims for compensable delays, conflicts on additional scope of work or contract terms, unforeseen conditions, liquidated damages, and warranty and maintenance issues. Identify each claim by providing the project name, date of claim, parties to the claim, a brief description of the nature of the claim, the court and case number, the original amount of the claim, and whether the claim is pending or a brief description of the resolution including the final amount paid on the claim.

7. *Denial of Award or Prequalification* - Provide a list of any instances where the firm has been denied an award of a public works contract based on a denial of prequalification or a finding by a public agency that the firm was not a responsible bidder. Include the year of the denial, the public agency, the name of the project, and the basis for the finding by the public agency.

8. *Completion by Surety* – Provide a list of any projects where the firm's surety company completed a contract on the firm's behalf, or paid for completion because the firm was default terminated within the past ten (10) years. Include the amount of each claim, the name of each claimant, the date of the claim, the grounds for the claim, the date of resolution of the claim, and the nature and amount of resolution.

9. *Assessment of Liquidated Damages* - Provide a list of any projects for which the firm was assessed and/or paid liquidated damages under a contract. Identify the project by owner, the date of completion of the project, the amount of liquidated damages assessed/paid, and all other information necessary to explain the assessment of liquidated damages.

10. *Experience Modification Rate (EMR)* - Provide the firm's annual EMR issued by the firm's workers compensation insurance carrier for the past three (3) years.

Evidence of Insurance - Provide evidence of the firm's ability to obtain appropriate insurance with an insurer having an AM Best's Guide current rating of not less than A-:VIII, with minimum limits as set forth in Section 17 of the draft Maintenance Agreement in **Appendix A**.

B. Evidence of Bonding Capacity

A performance bond in the amount of $6,000,000, and a payment bond in the amount of $1,500,000 will be required for this Agreement to cover the estimated value of one year of Services under this Agreement. Proposer shall provide with its proposal a notarized statement from a California admitted surety insurer with an AM Best's Guide rating of at least A-:VIII, which states that the Contractor's current bonding capacity is sufficient to cover the Services under the Agreement.

C. Understanding and Approach to Services

Provide a work plan that addresses the Scope of Services set forth in Exhibit 1 and show the firm's understanding of the requirements. Any additional Services that the firm may deem necessary should be identified and discussed in the proposal.

Include in the proposal:

1. Describe the firm's understanding of, and overall approach to, performing the Services and tasks to be accomplished, including a mobilization plan for start-up services.
2. Describe the resources the firm will use for basic maintenance services and supplemental capital improvement work activities, including the firm's ability to mobilize additional forces for emergency or extraordinary planned activities.

3. Describe the firm's understanding of San Pedro Bay Ports' freight rail service and Rail Corridor operations.
4. Describe the firm's familiarity and experience with the UP Track and Signal Standards, and how the organization and staffing plans are designed to meet these requirements.
5. Propose any recommended procedural or technical enhancements and innovations to the Scope of Services that do not create any material deviations from the objectives or requirements.
6. Describe the proposed size and makeup of the full and part-time workforce to provide the Services.
7. Describe the firm's experience and ability to develop a Bridge Management Plan for the Rail Corridor that conforms to FRA standards.
8. Describe the firm's ability to develop a training and safety program for the Rail Corridor that conforms to ACTA, FRA, and Cal OSHA standards.
9. Discuss the equipment that the firm and subcontractors will use and its availability. Describe the firm's and subcontractors' material procurement processes. Describe which equipment will be charged full-time year-round and any equipment that will be charged only as needed for specific maintenance or capital work.
10. Describe the firm's document record keeping process for maintenance and inspection activities. Describe the firm's administrative support process for invoicing, budgeting and inventory control.
11. Provide samples of inspection forms from ongoing or previous maintenance assignments. Sample inspection forms may be submitted as an appendix and will not count toward the proposal page count.

5.3 Cost Proposal Forms

Firms shall submit the Cost Proposal Forms AR-I through AR-V in **Appendix P** as part of the proposal. The Annual Maintenance Budget will contain many variable cost items for both routine and special maintenance, as well as Capital Improvements. The purpose of the Cost Proposal information is not to arrive at a complete estimated total price for the first Annual Maintenance Budget under the Agreement. Rather, the firm's Cost Proposal Forms will be used to evaluate the cost elements of the labor and services to be provided and to obtain a general sense of the following cost elements:

1) the size of the fixed labor force proposed by the firm based on prior maintenance experience and understanding the Rail Corridor operations;
2) the burdened labor rates for the proposed work force;
3) the estimated annual costs for the vehicles and equipment proposed to support the work activities of the labor force;
4) the burdened rates for any supplemental positions to augment the fixed staff for special maintenance or Capital Improvement work.

These cost elements will be used to evaluate the firm's proposals for costs as set forth in Section 6.0 – Evaluation Criteria. In addition, certain of these cost elements will be used in the computation of SBE participation. (See **Appendix O**.) Note that during negotiations of the Annual Maintenance Budget for the first Contract Year, the unit costs contained in the Cost Proposal shall not be increased but may be subject to a negotiated decrease.

By submitting the Cost Proposal Forms, firms grant ACTA the right to examine (for the purpose of verifying the cost and pricing data submitted) those books, records, quotes, documents, and other supporting data, which will permit adequate evaluation of the data, including computations and projections used to generate the Cost Proposal.

5.4 SBE Utilization

The ACTA Governing Board has established the following SBE participation levels for all ACTA contracts awarded after January 1, 2017:

(1) an aggregate average of 25% by contract value, and/or
(2) 25% of all contracts awarded to certified SBE firms.

The minimum required SBE participation level by contract value for this Maintenance of Way Services Agreement is 15%. However, Proposers are encouraged to maximize SBE participation above this level on their the SBE Forms set forth in **Appendix O** to the extent possible.

It is ACTA's objective to provide SBE subcontracting opportunities for all subcontracted activity, as well as to encourage contractors to subcontract activities which might have otherwise been performed by the contractor itself to meet and exceed the 15% minimum participation level.

In order for the Proposal to be deemed responsive, the Proposer must submit the forms in **Appendix O** showing that it meets the established 15% minimum SBE participation level, or complete SBE Form 05 in **Appendix O** showing the Good Faith Efforts that were used to try to meet the minimum participation level and the reduced participation level that will be achieved.

If the Proposer is a certified SBE, the 15% SBE minimum participation level is deemed to have been met provided that the percentage of work performed by the certified SBE meets the 15% minimum participation level.

Details of the required submissions, certifications, forms, and good faith efforts requirements and evaluation are included in **Appendix O.**

6.0 Evaluation Criteria

The Proposals submitted in response to this RFP will be evaluated by a review panel using the following evaluation criteria:

A. QUALIFICATION OF TEAM AND PROPOSED STAFF Weight 0-35 points

Qualifications of the Prime Contractor and key Subcontractors will be evaluated, considering the following:

15 pts	• Experience with similar projects. • Experience implementing safety, training, and bridge management programs. • Experience with California prevailing wage projects; **Appendix D**, DIR Form 01 submitted and complete • Experience with Class 1 railroads and FRA Class 4 track maintenance. • Reference checks.
5 pts	Organization chart, staffing plan, and key personnel. Subcontracting plan, and prior experience with purposed subcontractors.
5 pts	• CAL-OSHA and Federal OSHA violations history. • FRA violations history.
10 pts	• Claims history, denial of award or prequalification, completions by surety, assessment of liquidated damages, and any suspension or debarment. • Experience Modification Rate (EMR) and ability to comply with licensing, insurance, and bonding requirements, as well as financial capacity to provide maintenance and construction services for the term of the contract.

B. UNDERSTANDING AND APPROACH TO SERVICES Weight 0-30 points

The effectiveness of the proposed work plan, including the mobilization plan, shall be evaluated based on the following criteria:

10 pts	• Overall understanding and approach, including mobilization plan. • Resources for basic maintenance and supplemental capital work. • Ability to mobilize additional forces for emergencies and extraordinary planned work. • Understanding of freight rail service and Rail Corridor operations.
5 pts	• Understanding of the scope of services to be provided. • Familiarity of UP Track and Signal Standards. • Any proposed enhancements to the scope of services.
5 pts	• Assessment of the proposed size and makeup of workforce.
5 pts	• Ability to develop relevant i.e. FRA, CPUC, ACTA, etc… compliant training and safety programs and Bridge Management Plan.
5 pts	• Equipment rationalization and material procurement processes. • Maintenance and inspection records process. Sample inspection forms provided. • Administrative support process for budgeting, invoicing and inventory control.

C. COST PROPOSAL FORMS Weight 0-35 points

Firms shall submit the Cost Proposal Forms set forth in **Appendix P**. The cost forms will be reviewed and evaluated according to the following point allocation, indicating the maximum points allowed for each Cost Proposal Form:

16 pts	• Form AR-I, Track, Bridge & Safety Labor Positions
8 pts	• Form AR-II, Signal & Communication Labor Positions; Vehicles & Equipment
2 pts	• Form AR-III, Proposed Contractor Markups
3 pts	• Form AR-IV, Track, Bridge & Safety Vehicles & Equipment
6 pts	• Form AR-V, Additional Estimated Cost Items

D. SBE PARTICIPATION EVALUATION (Responsive/Non-Responsive)

SBE Participation will be used only to assess whether the firm is responsive to the minimum requirements found in Section 5.4 of this RFP. SBE participation will not be scored as part of the weighted evaluation i.e. scoring, process as outlined above in paragraphs A, B and C of this section.

6.1 Evaluation Process

All proposals will be initially reviewed by ACTA for completeness and a determination whether each proposal is responsive or non-responsive. Once this initial review process is complete, all proposals deemed responsive will be distributed to the review panel. Any proposals deemed non-responsive will be returned to the proposer and rejected.

The proposals will be scored independently by each evaluator pursuant to the criteria set forth herein. The average score for each firm will be calculated for an initial ranking for all responsive proposals received. The evaluation panel will decide whether to conduct any interviews or to take other appropriate steps in the selection process. The number of firms to interview, if any, will be at the sole discretion of the evaluation panel, with a recommendation made to ACTA's Chief Executive Officer and Chief Operating Officer for a final decision.

Following interviews, if any are held, evaluators may choose to rescore those areas of the proposals where points are allocated (i.e., the Technical and Cost Proposals) based on the performance of the interviewed firms.

The final scores for the interviewed firms will be averaged, and the highest average scored firm may be asked to negotiate a final Agreement.

As part of negotiations, the highest average scored firm shall provide the following documents for ACTA review:

(1) the firm's audited consolidated balance sheets for the three most recent fiscal years and the related consolidated statements of income, stockholder's equity and cash flows, and

(2) the firm's unaudited consolidated balance sheet for the most recent fiscal quarters after the last fiscal year and the related consolidated statements of income, shareholder's equity, and cash flows.

The selection of the firm must be approved by the parties of the Use and Operating Agreement (UOA) i.e. POLA, POLB, BNSF and UP. Once the 4 parties to the UOA have agreed, the selection can then be taken to the ACTA Board.

All such statements shall be prepared in conformity with GAAP. At all times during the RFP process, ACTA reserves the right to terminate the RFP, and if proposals have been received, to reject any and all Proposals.

Maintenance of Way Services
Request for Proposals

EXHIBIT 1

Scope of Services

Required Services and General Requirements

The Services to be provided under the proposed engagement include the maintenance, inspection, repair, replacement, graffiti removal, and maintenance of ACTA's surface area and other services for the Maintained Facilities. In general, the Maintained Facilities include: 1) track, signal, and communications/security systems; 2) drainage, pump station, and trench emergency ladder systems, and emergency generator located at CP Alameda; 3) bridges, retaining walls, embankments, barriers, sound walls, and fencing; and 4) the Maintenance Facility.

ACTA has a Maintenance Facility located at 1017 Foote Avenue in Wilmington. The facility includes an office building, parking lot, and indoor and outdoor storage areas. ACTA cannot guarantee to the selected contractor that the facility will remain available during the term of the Agreement, and ACTA will reserve the right to provide a substitute facility should a relocation be necessary. See the RFP **Appendix C** for the existing Maintenance Facility location.

The selected contractor will be responsible for payment of all ordinary costs associated with the operation of the Maintenance Facility, including costs associated with HVAC service and repair, utility bills such as electricity, water, and gas, and other similarly associated building costs.

In addition, the Contractor shall perform graffiti and trash removal and vegetation control for the Maintained Facilities, as well as any traffic control including detours and road closures necessary to perform the Services. The Contractor shall also perform inspections and maintain records as required by regulatory agencies and the Agreement, and manage, repair, and replace inventory, as needed.

The Contractor shall operate during normal business hours, Monday through Friday and be on call 24 hours per day, seven days per week, to perform or support planned and emergency work.

The Contractor shall provide all labor, supervision, subcontractors, materials, and equipment necessary for the Services. ACTA shall have the right to accept or reject proposed subcontractors. The Contractor and any subcontractors shall comply with all requirements of the California Contractor's State Licensing Board and the California Department of Industrial Relations.

Prevailing Wage and Apprenticeship Requirements

The services provided under the Agreement will be subject to Labor Code § 1720 et seq. governing payment of prevailing wages on public works, Title 8 of the California Code of Regulations § 16000 et seq., and subject to compliance, monitoring and enforcement by the State of California Department of Industrial Relations. Pursuant to Labor Code § 1771, the Contractor and all subcontractors of any tier shall not pay less than the per diem prevailing rate, and the general prevailing rate for holiday and overtime work, in the locality in which public work is performed for each craft, classification or type of workers needed to execute the services. The selected Contractor shall post a schedule at the Maintenance Facility office building or other appropriate, visible location on the jobsite showing all prevailing wage rates for each craft, classification, or type of worker needed to perform the services. Copies of prevailing rate of per diem wages are available on the Internet at:

http://www.dir.ca.gov/dlsr/DPreWageDetermination.htm

and are on file at ACTA's office located at 3760 Kilroy Airport Way, Suite 200, Long Beach, California 90806 and made available by ACTA upon request.

Pursuant to Labor Code § 1771.4, and as directed by the California Labor Commissioner, the Contractor and subcontractors performing prevailing wage work must furnish electronic Certified Payroll Records (eCPRs) directly to the California Labor Commissioner (aka Division of Labor Standards Enforcement). The Contractor and its subcontractors must also comply with employment and training programs established by the Department of Industrial Relations - Division of Apprenticeship Standards, pursuant to Labor Code §§ 1773 and 1773.1.

Equipment

The Contractor shall provide, operate, and maintain all equipment necessary to perform the Services. Equipment types shall include, but not be limited to, hi-rail vehicles, a bucket truck that extends at least 35 feet, track construction and maintenance machinery and tools, trucks, and vehicles. A detailed list of required equipment is not set forth in the RFP or the Agreement. Proposers are required to provide a proposed equipment list, indicating ownership, availability, and rates in their proposal.

Maintenance by Others

In all three Rail Corridor segments, public roadway elements, such as asphalt or concrete pavement, street lighting, traffic signals, curb, gutters and sidewalks, landscaping, and utilities (sewer, storm drains, oil, gas, water, electrical and others) within the roadways, are maintained by the local cities, Los Angeles County, California Department of Transportation (Caltrans), or utility owners.

These entities also maintain roadway surfaces, curbs, gutters, sidewalks, and fencing on the trench bridges (Roadway Bridge Structures), utilities within the bridges, and utilities lines crossing the trench between the bridges. In some cases, maintenance of these third-party facilities will have to be coordinated by or with the Contractor. The structural elements of the Roadway Bridge Structures are maintained by the Contractor.

The Drill Track and its grade crossing protection (which includes the Santa Ana By-Pass Track) and cantilevered portions of the trench supporting the Drill Track are maintained by UPRR or PHL. Trackage beyond the limits of the Rail Corridor, including mainlines, yard leads, and yards, is maintained by UPRR, BNSF, Metrolink, Amtrak, or PHL. Industry tracks are maintained by their owners.

Maintenance Budget and Meetings

Prior to September 1st of each year, the selected Contractor will be required to submit an "Annual Maintenance Budget" along with a narrative work plan that includes a forecast and schedule of work activities for the next calendar year. The Ports, BNSF and UP will approve the Annual Maintenance Budget by November of each year, in time for it to become effective the following January 1st.

The Annual Maintenance Budget shall contain the costs for all Services including Subcontractors, vendors, labor, equipment, materials, and consumables, as well as the costs for Capital Improvements. Management and supervisory personnel shall be salaried employees. All other hourly public works labor shall not be paid less than prevailing wage rates. All labor rates for salaried and hourly employees of the selected Contractor shall be Fully Burdened Labor Rates including profit and safety and administrative support items.

There are several special meetings each year that the selected Contractor will be required to attend, at which the Contractor will provide a briefing and written narrative detailing the status of ongoing work, a forecast of anticipated activity, and maintenance issues or concerns. The selected Contractor will also be required to attend weekly PHL meetings.

During the budget year, additional services and/or scope may be requested by ACTA or submitted by the Contractor for ACTA approval. In either case, the Contractor is required to submit a proposed cost for such additional services for approval by ACTA. In addition, the Contractor is required to submit written notice of anticipated overruns of any items in the approved Annual Maintenance Budget for ACTA to provide approval prior to the Contractor performing the additional work. ACTA reserves the right to have any Services performed by forces other than the Contractor.

The Selected Contractor will be required to perform services using the rates identified in the Cost Proposal Forms set forth in the Agreement, on a time and material or unit basis if applicable. **Appendix E** contains a sample annual Maintenance of Way (MOW) budget form and **Appendix Q** contains the approved CY2023 Operations & Maintenance (O&M) and MOW Budgets.

Payment for Services

ACTA is the contracting entity and will make payments to the Contractor for all Services rendered under the Agreement within 30 days following receipt of a monthly invoice containing complete backup documentation for the costs therein and as reviewed and approved by ACTA.

Maintenance and Inspection Standards

The selected Contractor will be required to perform all necessary inspections of track, signals, and other facilities as specified by the Federal Railroad Administration (FRA), the California Public Utilities Commission (CPUC), the Occupational Safety and Health Administration (OSHA), and any other applicable regulatory agencies.

Maintenance and inspection of track and signals shall be in accordance with the UP Track and Signal Standards and Exceptions in **Appendix F**. The selected Contractor will be required to maintain facilities to FRA Class 4 standards or better. All welding must be done in conformance to FRA Standards by qualified and certified staff. Current copies of welding certification per individual performing these duties must be provided to ACTA and must be properly updated as necessary.

ACTA-maintained rail bridges shall be maintained and inspected pursuant to a Bridge Management Plan developed by the Contractor in compliance with the requirements set forth in 49 CFR Part 237 et seq. **See Appendix G** for more information on bridge and other structure inspections, as well as a list of all ACTA-maintained bridges along the Rail Corridor. See **Appendix H** for a comprehensive list of all road and rail crossings including private crossings. **Appendix R** contains the latest annual Bridge Inspection Report. **Appendix S** contains the latest Underwater Bridge Inspection Report, which is prepared every 5 years.

The selected Contractor will be required to maintain and repair the trench pump stations in accordance with the standards set forth in **Appendix I**.

The selected Contractor will be required to file and maintain all inspection records and reports as required by law, and provide them to ACTA for review upon request. The selected Contractor will act as ACTA's agent for all FRA and CPUC matters, and ACTA will submit the selected Contractor's name to the regulatory agencies as the responsible party for inspection, maintenance and recordkeeping. Refer to **Appendix J** for a partial list of the number and frequency of inspections/tests, reporting requirements, and sample reports.

Ultrasonic testing of rails, as required by the FRA, will be included within the Agreement's scope of Services. **Appendix T** contains the latest Ultrasonic Rail Testing Defect Reports. The selected Contractor will be required to inspect all structures using experienced qualified staff. The Contractor will be required to coordinate all inspections that require fouling of tracks with the San Bernardino Dispatch Center and PHL's Badger Bridge Control House a minimum of one week in advance of the scheduled services when possible. Exceptions may be granted by ACTA for emergencies on a case-by-case basis.

The selected Contractor will be required to maintain to operating standards two emergency generators located at Foote Street and CP Alameda. The Contractor will be required to make inspection records available for ACTA's periodic review.

Railroad Involvement and Coordination

The proposed services involve activities on an operating railroad and the selected Contractor will be required to coordinate its activities with the Railroads and PHL, ensuring that any service disruption and track outages remain limited. The selected Contractor will be required to request and coordinate all "track and time" requests with the San Bernardino Dispatch Center and/or PHL's Badger Bridge Control Houses. The Railroads reserve the right to perform or share certain tasks including but not limited to derailment clearing and repairs.

Both Railroads will provide local personnel for technical support to the selected Contractor. In addition to regular inspections by the FRA and CPUC, each Railroad will periodically inspect the track structure and the signal and communication systems to assess the Contractor's performance.

At a minimum of twice per year, the Railroads will provide, at no additional cost to the Contractor, specialized equipment to inspect the geometry and condition of the tracks, and the Contractor will be required to assist with these inspections upon request. The inspection results will be provided to the Contractor for information or corrective action and used to evaluate the Contractor's performance. Any corrective actions necessary shall be the responsibility of the Contractor per FRA and Railroad requirements. **Appendix U** contains the latest Geometry Car Inspection Report.

Permits and Approvals

The selected Contractor will be responsible for obtaining appropriate permits and approvals from ACTA, the Railroads, and other regulatory agencies as may be required to perform services under the Agreement. Examples of other required approvals and permits include those that may be necessary for the ACTA Annual Emergency Drill, and pump station maintenance services requiring traffic lane closures.

Safety & Security

The selected Contractor is expected to make safety its first priority. The selected Contractor shall submit a Safety Plan for approval by ACTA prior to commencement of Services and update it annually prior to each calendar year. The Contractor will be required to report all injuries in accordance with **Appendix K** and appropriate regulations. All safety and injury records shall be subject to audit by ACTA. All workers shall be trained in accordance with the requirements outlined in **Appendix K**, and records of training shall be kept on file and made available on request.

The selected Contractor shall ensure that its employees and its Subcontractors' employees have a valid current picture ID card issued by the Contractor or Subcontractor. Every employee must have a valid ID card to enter upon the Rail Corridor or Ports' properties. The contractor and its Subcontractors must assure that proper background checks have been performed and completed before any of its employees work under the ACTA Maintenance of Way Agreement.

Pursuant to requirements of the Transportation Security Administration's (TSA), all Contractor and Subcontractor employees must have a valid Transportation Worker Identification Credential (TWIC) before entering upon the Rail Corridor or Ports' properties.

Security services for the Rail Corridor are provided by Railroads' and local police forces. The Contractor is required to provide a Subcontractor for security guard services at the Maintenance Yard, the cost of which will be included in the Annual Maintenance Budget.

Emergencies

In case of an emergency (natural disaster, vandalism, or accident) the Contractor shall be available to provide immediate support and assistance. The Contractor shall coordinate its activities with the appropriate municipalities, agencies, Railroads, and Rail Corridor security forces. The Contractor shall adhere to the ACTA Crisis Communications Plan as it relates to communication and notification of incidents. In the case of structural damage, the Contractor shall consult with ACTA's designated engineer and the Railroads prior to placing tracks back into service.

The Mid-Corridor trench has pre-cast concrete struts at the top of the wall every 10 to 25 feet depending on the location. If an emergency exists where more access from the top of the trench is needed than available, the removal of one or more struts might be possible as a last resort with approval of ACTA's engineer. No strut shall be removed without the written consent of ACTA.
If this extreme measure must be taken, extensive repairs to the wall structure might be necessary prior to resuming operations and will require approval and oversight by ACTA's designated engineer and the Railroads.

The Contractor shall provide direct support in case of an emergency on a 24 hour / 7 days a week basis. This includes support in the event of train derailment, trespassing, injury, a leaking container or rail car, hazardous material spills, fire, flood, earthquakes, signal and switch failures, broken or buckled rail, pump failures or other service disruptions. In the event of an emergency, the Contractor shall make specialized Subcontractors available as needed to provide assessment, repair and removal.

Utilities and Municipalities

Numerous utilities are located along and across the Rail Corridor. Refer to **Appendix L** for a list of the utility types and locations. The Contractor shall periodically inspect the utility casings crossing the trench for leaks or damage. The Contractor shall coordinate services impacting utilities with the appropriate utility owner.

ACTA has agreements with various municipalities regarding the division of maintenance for various structures throughout the Rail Corridor. An inventory of these structures is attached in **Appendix G**.

Records

The Contractor shall make available to ACTA and its representatives any documents related to inspection, maintenance, and costs for the Agreement. This includes all FRA and CPUC required reports, inspections, and testing, asset records and inventory as well as all other reports generated through the Safety Plan or emergency response. A plan to retain timecards, certified payroll, and other employee or cost support data shall be agreed upon with ACTA prior to start of the Agreement.

Flagging Services

In addition to providing flagging to perform the Services, the Contractor shall provide additional flagging services for projects undertaken by ACTA, other agencies, private companies or utilities that require work within fifty feet of the Rail Corridor. These additional flagging services are provided on an as-needed basis and are not included in the Annual Maintenance Budget.

Stairs and Ladders

The trench has a total of 53 emergency access stairs and ladders, with 46 drop-type emergency ladders, one fixed ladder and six emergency stairwells within the trench. The stairs and ladders are used by train crews to exit, and first responders to enter, the trench in an emergency. The drop ladders are manually raised and lowered by a winch system from either the top or bottom of the trench. When the ladders are lowered, a sensor on the ladder sends a signal to the San Bernardino Dispatch Center so the track is taken out of service due to restricted clearance. In addition, there are four stairwells that access two trench control points and two pump stations and two caged ladders that access signal niches used by maintenance personnel. The maintenance of these stairs and ladders is a crucial element of the Rail Corridor's safety system and the selected Contractor will be solely responsible for keeping all ladders and stairs in operating condition. See **Appendix M** for the Ladder Inspection and Maintenance Plan.

Dispatching

The Alameda Belt Line, a joint venture between the two Railroads, operates the Rail Corridor's train control system from the Joint Dispatch Center in San Bernardino, California. In addition, PHL provides dispatching for the port area from the Badger Bridge Control House. The Badger Bridge is a lift bridge over Cerritos Channel, manned 24 hours a day, 7 days a week by PHL.

There is a clear division of dispatching and maintenance responsibility in the Ports between PHL and the Contractor. The Railroads maintain the dispatching equipment in San Bernardino, California. PHL, with support from the Railroads, maintains the dispatching equipment in the Badger Bridge Control House. The Contractor will be responsible for servicing and maintaining the ACTA alarm system at both the Joint Dispatch Center and PHL's Badger Bridge Control House. The ACTA Track Charts in **Appendix B** shows the dispatching responsibility and maintenance responsibility jurisdictions.

Automatic Equipment Identification (AEI) Readers

There is a network of AEI Readers located in the Rail Corridor as described and shown in **Appendix O.** The AEI Reader system is an integral element of ACTA's Revenue Collection System and must be operational at all times. The Contractor, using qualified personnel, is responsible for maintaining all of the AEI equipment located along the Rail Corridor. ACTA personnel maintains the AEI computer equipment at an off-site location.

Pump Stations

There are two storm drain pump stations in the trench at the Greenleaf Station in Compton and the Nadeau Station in the Los Angeles County unincorporated area of Walnut Park. These pump stations must be operational at all times. The trench is designed to accept storm water from a 100-year storm, collect the water in below-track holding basins, and pump the storm water out of the holding basins into municipal systems. In addition, the drainage channels throughout the trench must be kept free of sediment. The drainage channels are covered by removable steel gratings and have portable steel plate dams spaced along the channels to be dropped in place in the event of a hazardous spill. The selected Contractor must propose qualified pump personnel to provide regular maintenance for the pump stations and coordinate maintenance of the pump stations with ACTA's environmental staff. There are also under track drains in the at-grade sections of the Rail Corridor that must be maintained and cleaned out periodically. These facilities are also inspected by regulatory agencies for conformance to discharge requirements.

Special Trench Features – Alarms, Cameras, Cables

There is a fiber optic line along the trench barrier walls that provides communications between the San Bernardino Dispatch Center and the various control points along the trench. Motion detectors are in place at the fixed stairwells and trench portals. There are also security cameras located throughout the trench and at the Opp Street private crossing. At each ladder location, there are emergency telephones at street and track level, and a sensor switch to notify the Dispatch Center that the ladder is lowered. The Contractor will be required to test this equipment on a quarterly basis to maintain it and keep in operational at all times. Fire department dry standpipes are located every 500 feet along one side of the trench and the selected Contractor will be responsible for testing the dry standpipes on an approved schedule. The selected Contractor will be required to support ACTA in holding an annual emergency drill every March which includes participation by local fire departments, other emergency response providers, and the Railroads.

Spare Parts

ACTA maintains spare parts for the AEI Reader equipment, signals, switches and communication equipment, and has rail and ties (both concrete and timber) and other specialty track parts in inventory, which will be available to and replaced by the Contractor. An inventory of these items will be provided to the selected Contractor for written acceptance. The Contractor shall maintain the inventory and record materials used and received during the term of the Agreement. The Contractor will order replacement parts when necessary, with the cost of replacement items included in the annual budget and billed monthly when received. The Contractor will be required to obtain ACTA's approval prior to ordering special parts or equipment authorized in the annual budget.

Graffiti/Trash/Vegetation Control

The selected Contractor will be required to regularly remove graffiti and trash from the Rail Corridor and related facilities, as well as provide vegetation control and removal services throughout the Rail Corridor.

Capital Replacement and Enhancements

Throughout the term of the Agreement, the selected Contractor will be required to perform capital repairs and replacement of track and other items as approved under each annual budget.

If and when additional tracks, extensions, switches, or other items are required and placed into service during the term of the Agreement, these enhancements will become the maintenance responsibility of the selected Contractor.

Overhead Clearance

ACTA's standard for minimum vertical clearance along the Rail Corridor is 24 feet 8 inches above top of rail. The selected Contractor will be required to maintain no less than this minimum 24 feet 8 inches where the existing clearance is greater than or equal to this height. In several locations along the Rail Corridor where this minimum clearance can not be achieved, the Contractor shall maintain the existing vertical clearance between 23 feet 6 inches and 24 feet 8 inches.

Additional Information furnished by ACTA

The following additional information shall be made available as necessary to the selected Contractor:

- Memorandums of Understanding between municipalities and ACTA
- Agreements with utility owners
- Railroad agreements
- As-built drawings of ACTA facilities
- Complete track and signal design drawings
- ACTA crisis communications plan
- Other relevant documents and information maintained by ACTA and requested by the Consultant

ACTA

Alameda Corridor Transportation Authority

Maintenance of Way Services

Appendix A

Draft Maintenance Agreement

ALAMEDA CORRIDOR

MAINTENANCE AGREEMENT
(RAIL CORRIDOR AND NON-RAIL COMPONENTS)

by and between

ALAMEDA CORRIDOR TRANSPORTATION AUTHORITY,
a California joint powers authority

and

Contractor Name

dated as of

[_________], 2025

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EXHIBITS

ALAMEDA CORRIDOR MAINTENANCE AGREEMENT
RAIL CORRIDOR AND NON-RAIL COMPONENTS

THIS ALAMEDA CORRIDOR MAINTENANCE AGREEMENT (this **"Agreement"**) is made and entered into by and between **ALAMEDA CORRIDOR TRANSPORTATION AUTHORITY**, a joint powers authority created under the laws of the State of California (**"ACTA"),** and [________________]**,** a [____________] (**"Contractor"**) with reference to the following Recitals:

R E C I T A L S:

A. Pursuant to that certain Amended and Restated Alameda Corridor Use and Operating Agreement dated as of December 15, 2016 (as such agreement has been or may be amended, modified or supplemented from time to time, **"Operating Agreement"),** by and among ACTA, the City of Long Beach, a municipal corporation acting through its Board of Harbor Commissioners (**"POLB"),** the City of Los Angeles, a municipal corporation acting through its Board of Harbor Commissioners (**"POLA"),** BNSF Railway Company, a Delaware corporation (formerly known as The Burlington Northern and Santa Fe Railway Company) (**"BNSF"),** and Union Pacific Railroad Company, a Delaware corporation (**"UP"),** ACTA constructed the rail infrastructure project known as the Alameda Corridor in Los Angeles County, California.

B. Pursuant to the Operating Agreement, the Contractor has been selected to provide the maintenance services for the Rail Corridor and the Non-Rail Components and perform related duties, as described in this Agreement. In accordance with the Operating Agreement, ACTA seeks to engage Contractor to provide the maintenance services and Contractor desires to perform such maintenance services and fulfill its other duties, all as more particularly described in this Agreement.

NOW, THEREFORE, Contractor and ACTA hereby agree as follows:

ARTICLE 1
DEFINITIONS

1.1 Specific Definitions. The following capitalized terms are used in this Agreement with the following meanings:

"AEI Readers" means the "Automatic Equipment Identification" reader system equipment located on the Rail Corridor.

"**ACTA AEI Reader Maintenance**" means maintenance of the AEI Readers through subscription and usage of a remote site monitor service from an equipment manufacturer or similar provider to monitor the health of the readers, hands on hardware replacement and/or diagnostics, and weekly and monthly management reports. The weekly and monthly management report shall be attached to the monthly fixed fee invoice as support.

"**Affiliate**" has the meaning given to such term in Section 150 of the California Corporations Code, as amended from time to time.

"**Allowed Markup**" means a percentage amount added to the costs and expenses actually incurred by Contractor in purchasing or providing equipment, materials, supplies and/or other Direct Costs, including the costs of subcontracting and vendor services, in connection with Contractor's performance of the Services under this Agreement. This percentage shall equal 5 percent (5%) for labor, 5 percent (5%) for Subcontractors' entire costs (including Subcontractors' materials, equipment, and supplies), and 10 percent (10%) for materials (any items built into construction). The Allowed Markup shall not apply to Contractor's Fully Burdened Labor Rates, Contractor-owned or leased vehicles and equipment, Services performed under this Agreement by an Affiliate of the Contractor, and Services transferred to a Subcontractor that were to be performed by the Contractor under the Approved Maintenance Plan unless otherwise approved by ACTA.

"**Annual Maintenance Budget**" has the meaning given such term in Section 5.1.

"**Approved Maintenance Plan**" has the meaning given such term in Section 5.2.

"**Bridge Management Plan**" means the plan to maintain and inspect ACTA rail bridges developed by the Contractor in compliance with FRA 49CFR Part §237 et seq. requirements.

"**Capital Expenses**" means the costs and expenses incurred in making any Capital Improvements.

"**Capital Expense Guidelines**" means the guidelines adopted pursuant to the Operating Agreement from time to time, the current version of which is attached hereto as Exhibit 4.

"**Capital Improvements Charges**" means any capital additions, betterments and upgrades, or capital replacements to the Maintained Facilities as determined to be Capital Expenses in accordance with the Capital Expense Guidelines.

"**CFR**" means the Code of Federal Regulations.

"**Commencement Date**" has the meaning given such term in Section 4.1.

"**Consequential Damages**" has the meaning given such term in Section 15.2.2.

"**Contract Year**" means each twelve month period commencing on January 1 and ending on December 31 during the term hereof, except that the first Contract Year of the term hereof shall commence on the Commencement Date and end on December 31, 2025, and the last Contract Year of the term hereof shall commence on January 1, 2030 and end at 11:59 p.m. Los Angeles time on April 14, 2030.

"**Corridor Dispatcher**" means the entity selected from time to time pursuant to the Operating Agreement to provide dispatching service with respect to the Rail Corridor. As of the date hereof, the Corridor Dispatcher is, collectively, BNSF and UP.

"**CTO**" means a Contract Task Order for work authorized under Section 5.9.

"**Deficiency Notice**" has the meaning given such term in Section 5.3.

"**Direct Costs**" has the meaning given such term in Section 5.6.5.

"**Drill Track**" means a single track rail line, support structures relating thereto and the real property on and along which such rail line is located, generally running adjacent to and parallel with the Rail Corridor, as shown on the Map, which Drill Track is for the use and operation of UP in connection with serving local industry and access to UP's Dolores Yard.

"**Environmental Laws**" means any and all federal, state and local laws, statutes, ordinances, orders, regulations, plans, policies and decrees and the like now or hereafter in effect and applicable to the Rail Corridor which relate to (a) Hazardous Substances; (b) the generation, use, storage, transportation or disposal of Hazardous Substances or solid waste; or (c) occupational safety and health, industrial hygiene, land use or the protection of human, plant or animal health, safety or welfare, and the rules, regulations and ordinances of applicable federal, state and local agencies and bureaus, as amended from time to time.

"**Environmental Losses**" means all charges, losses, liabilities, damages, fees, demands, claims, proceedings, investigations, actions, judgments, causes of action, disbursements, monetary settlements, assessments, fines, penalties, costs and expenses incurred in connection with any investigation, characterization, defense of claims, clean-up, remediation, disposal or repairs arising out of or relating to the release of Hazardous Substances on, in, under or around the Maintained Facilities or other areas from and after the date hereof.

"**Federal Acquisition Regulation**" means the Federal Acquisition Regulation contained in 48 CFR 2.101, as amended from time to time.

"**Force Majeure Event**" means an event due to any cause(s) beyond Contractor's control, including, but not limited to, acts of God, fire, earthquake, flood, mud slide, washout, storm, blockage, explosion, casualty, strike, labor dispute (excluding labor disputes involving the Contractor or its Subcontractors), riot, insurrection, civil disturbance, act of civil or military authority, embargo, act of public enemy, war, delays in transportation due to a force majeure event, court order or injunction, delays caused by acts or orders of a governmental body, including changes in law or regulations. Force Majeure Events shall not include derailments unless the derailment resulted directly from one of the Force Majeure Events described in the preceding sentence.

"**FRA**" means the Federal Railroad Administration.

"**FRWS**" means the FRA Railroad Workplace Safety standards contained in 49 CFR 214.

"<u>FTSS</u>" means the FRA Track Safety Standards contained in 49 CFR 213 Subparts A to F.

"<u>Fully Burdened Labor Rate</u>" means the annually negotiated hourly rates at which Contractor will bill ACTA for labor costs incurred in connection with Rail Corridor Services and/or Non-Rail Component Services performed under an Approved Maintenance Plan. Each Approved Maintenance Plan shall set forth the agreed to Fully Burdened Labor Rate for each Contractor job classification. For the first Contract Year, such rates and classifications will be those contained in the Approved Maintenance Plan effective on the Commencement Date (Exhibit 3). The Fully Burdened Labor Rate shall include the applicable hourly rate or salary (expressed as an hourly rate) subject to minimum prevailing wage requirements which the Contractor pays an employee in such job classification during the course of their daily work performed in a single role or multiple roles per day as necessary all of Contractor's markups for overhead (including fringe benefits and bonuses), profit on labor, Local Administrative and Office Support Costs, and Safety Equipment Costs. The Fully Burdened Labor Rate shall be an all-inclusive rate and Contractor shall not be permitted to charge any other amount for the labor of its employees.

"<u>Hazardous Substances</u>" means (a) any chemical, compound, material, mixture or substance that is now or hereafter defined or listed in, or otherwise classified pursuant to the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended, 42 U.S.C. Section 9601, *et seq.,* the Hazardous Materials Transportation Act, 40 U.S.C. Section 1801 *et seq.,* the Resource Conservation and Recovery Act of 1976, as amended, 42 U.S.C. Section 6901 *et seq.,* the California Health and Safety Code, Sections 25115-25117, 25249.5, 25249.8, 25281 and 25316, and any other applicable Environmental Laws, as a "hazardous substance", "hazardous material", "hazardous waste", "extremely hazardous waste", "acutely hazardous waste", "radioactive waste", "infectious waste", "biohazardous waste", "toxic substance", "pollutant" "toxic pollutant", "contaminant" and any other term or terms not mentioned herein intended to define, list, or classify substances by reason of properties such as ignitability, corrosivity, reactivity, carcinogenicity, toxicity, reproductive toxicity, "EP toxicity" or "TCLP toxicity"; (b) petroleum, natural gas, natural gas liquids, liquefied natural gas, synthetic gas usable for fuel (or mixtures of natural gas and such synthetic gas) and ash produced by a resource recovery facility utilizing a municipal solid waste stream, and drilling fluids, produced waters and other wastes associated with the exploration, development or production of crude oil, natural gas, or geothermal resources; (c) "hazardous materials" as defined in Section 2782.6(d) of the California Civil Code; (d) "waste" as defined in Section 13050(d) of the California Water Code; (e) asbestos in any form; (f) urea formaldehyde foam insulation; (g) transformers or other equipment which contain dielectric fluid containing levels of polychlorinated biphenyls (PCBs) above levels permitted by applicable law; and (h) any other chemical, material, or substance that, because of its quantity, concentration, or physical or chemical characteristics, exposure to which is limited or regulated for health and safety reasons by any governmental authority.

"<u>Indemnitee</u>" has the meaning given such term in <u>Section 16.4.1</u>.

"<u>Indemnified Entities</u>" has the meaning given such term in <u>Section 16.1</u>.

"<u>Indemnified Matter</u>" has the meaning given such term in <u>Section 16.4.1</u>.

"**<u>Indemnitor</u>**" has the meaning given such term in <u>Section 16.4.1</u>.

"**<u>Local Administrative and Office Support Costs</u>**" means costs of items such as office supplies, cleaning supplies, office equipment, computers and accessories, office furniture, photography equipment and accessories, cell phone service and phone accessories, telephone and internet services, postal & courier service and supplies, ice/water for the office, soda & coffee (and related supplies), food (including catering) for meetings/training sessions/holidays, marketing materials, auto cleaning supplies, gifts for safety awards, tools (including but not limited to hand tools, motorized, electrical, test devices, cordless, or any other tools which would be necessary to perform the "Services" as described in Article 6 of this agreement), and personal work boots. These costs shall be included in the Fully Burdened Labor Rates.

"**<u>Losses</u>**" means liabilities, losses, actions, causes of action, penalties, demands, detriments, claims, damages, costs and judgments and all expenses incurred in connection therewith, including claims made under the Federal Employer's Liability Act, costs of investigation, attorneys' fees and costs, expenses or arbitration, trial or appeal, and judgments. "Losses" shall include any claim, action, judgment or similar liability incurred or made by a third party, including those relating to personal injury, death or property damage.

"**<u>M&O Charges</u>**" means the annual cost of maintaining and repairing the Maintained Facilities, including the cost of maintaining and repairing communications facilities, signals and interlockers, debris removal, repair and maintenance of rails, ties, ballast, undercutting, drainage and surfacing, but the term "M&O Charges" does not include the "Non- Rail Maintenance and Capital Improvement Charges" as defined below.

"**<u>Maintained Facilities</u>**" means all portions of the Rail Corridor, to the limits shown on the Map, including (a) the real property comprising the Rail Corridor (to the limits of Owner's ownership of such real property) and all Trackage now or hereafter located thereon, (b) the storm water system for the Rail Corridor, including under-track drains at various locations, and including the storm water system located in the trench portion of the Rail Corridor (which portion of the storm water system is part of the Non-Rail Components), (c) the Maintenance Yard, and (d) the Non-Rail Components. The Maintained Facilities shall include the Roadway Bridge Structures. Notwithstanding anything to the contrary in this Agreement, the Maintained Facilities do not include (i) the cantilevered platform over the trench portion of the Rail Corridor on which the Drill Track is located (all of which, as of the date hereof, are maintained by UP), (ii) public streets, roadways or highways along the Rail Corridor, including curbs, gutters, sidewalks, landscaping, street lights and traffic signals, drainage and utility lines and facilities located on such public streets, roadways or highways, (iii) the surface pavement of streets on the Roadway Bridge Structures, or the curbs, gutters, sidewalks, landscaping, lighting and traffic signals, drainage, barrier walls, fence structures and fencing, and utility lines and facilities located on the Roadway Bridge Structures, (iv) any Trackage (including Drill Track) which on or after the date hereof is maintained by PHL or its successors or assigns (as indicated on the Map), (v) any Trackage beyond the limits of the Rail Corridor shown on the Map, or (vi) the track, ballast and signaling devices comprising the Drill Track; provided that, the Maintained Facilities shall include landscaping to the extent landscaping encroaches on or interferes with the use or operation of the Rail Corridor.

"**Maintenance Invoices**" has the meaning given such term in Section 5.6.1.

"**Maintenance Standards**" has the meaning given such term in Section 6.2.

"**Maintenance Yard**" has the meaning given such term in Section 11.7.

"**Map**" means the map (consisting of 25 pages) attached hereto as Exhibit 1.

"**Non-Rail Components**" means (i) the walls, retaining walls, embankments, barrier walls, fence structures and fencing, support structures, drainage facilities (including the two storm water pump stations shown on the Map) and emergency drop ladders (and related telephone and alarm equipment) of and for the trench portion of the Rail Corridor, (ii) the structural portions of the Washington Avenue Grade Separation bridge and the Henry Ford Avenue Grade Separation bridge, and (iii) the AEI Readers. Notwithstanding anything to the contrary in this Agreement, the Non-Rail Components do not include (i) any Trackage (including the Drill Track), (ii) the cantilevered platform over the trench portion of the Rail Corridor on which the Drill Track is located, (iii) public streets, roadways or highways along the Rail Corridor, including curbs, gutters, sidewalks, landscaping, street lights and traffic signals, drainage and utility lines and facilities located on such public streets, roadways or highways, or (iv) the surface pavement of streets on the Roadway Bridge Structures, or the curbs, gutters, sidewalks, landscaping, lighting and traffic signals, drainage, barrier walls, fence structures and fencing, and utility lines and facilities located on the Roadway Bridge Structures.

"**Non-Rail Maintenance Charges**" means the cost of maintaining and repairing the Non-Rail Components.

"**Operating Agreement**" has the meaning given such term in the Recitals.

"**Owner**" means, collectively, POLA and POLB.

"**Request for Proposals**" has the meaning given such term in Section 3.3.

"**PHL**" means Pacific Harbor Line, Inc., a Delaware corporation.

"**Port Rail Agreements**" means, collectively, (i) that certain San Pedro Bay Harbor Rail Operating Agreement dated as of December 1, 1997, by and between POLA and PHL, and (ii) that certain Long Beach Rail Operating Agreement dated as of June 1, 1998, by and between POLB and PHL, as each of such agreements has been or in the future may be extended or amended from time to time.

"**Quarterly Reconciliation Invoice**" means, an invoice provided by the Contractor to ACTA for (i) previously disputed items that have been subsequently accepted by ACTA or corrected by the Contractor, or (ii) adjustments for labor or other direct costs that were paid within the previous quarter but were later found to be incorrect, or (iii) invoices from vendors and suppliers or Subcontractor costs that were not previously submitted in the appropriate monthly invoice. The purpose of the Quarterly Reconciliation Invoice is to allow ACTA and the Contractor to financially record monthly costs in a timely manner but to also allow for necessary adjustments before closing those months from the previous quarter. The Quarterly Reconciliation Invoice should be submitted to ACTA no later than 45 days after the end of each calendar quarter and those costs are to be included in the quarterly unaudited statement required in Article 13.2 of this Agreement.

"Rail Corridor" means the multiple main track, high density, mainline railroad system (including the Trackage), together with the real property on which such railroad system is located, as shown on the Map, located along and parallel to Alameda Street beginning, in the north, for each Railroad, at the point that such Railroad leaves the mainline tracks or trackage rights owned or held by such Railroad (other than the Rail Corridor itself), which point, for each Railroad, is shown on the Map, and ending, in the south, at the points shown on the Map.

"Railroad" means, individually, BNSF or UP, as the context may require, and **"Railroads"** means, individually or collectively, BNSF and/or UP, as the context may require, and the assignees of the foregoing permitted pursuant to the Operating Agreement, together with any other Class I or financially responsible and experienced regional railroad that in the future may be granted rights to use the Rail Corridor consistent with the terms of the Operating Agreement.

"Remedial Action" means Contractor's response to conditions detected during inspections, including measures to protect the safety of Trains and the public, temporary adjustments or repairs, and permanent adjustments, corrections and/or repairs and measures specified as Remedial Action by the FTSS.

"Roadway Bridge Structures" means the structural portions of the bridges and overpasses over the trench portion of the Rail Corridor.

"Safety Equipment Costs" means the costs of safety supplies and equipment including but not limited to hard hats, reflective vests, safety glasses, and safety shoes. These costs shall be included in the Fully Burdened Labor Rates.

"Services" has the meaning given such term in Section 6.1.

"Subcontractor" means any third party hired by Contractor which is qualified to perform the work for which it is engaged, to assist or perform Contractor's Services under this Agreement; provided, however, that no such engagement shall relieve Contractor of any of its obligations or liabilities under this Agreement.

"Trackage" means all present and future railroad related improvements, systems or equipment, and all tracks (including main line tracks, spur tracks, lead tracks, passing tracks, yard tracks and industry tracks) and other rail facilities, including rails and fastenings, switches, frogs, bumpers, ties, ballast, signaling devices and systems, interlocking devices and plants, crossing warning devices, crossing surfaces, pole lines and communication facilities and equipment (including the fiber optic communications line installed in and along the Rail Corridor for purposes relating to the Rail Corridor, but excluding the AEI Readers), and all track support structures and related facilities (including roadbed, embankments, bridges, dikes, pavement, culverts, tunnels, drainage systems, and maintenance, access and service roads).

"<u>Train</u>" means one or more freight trains, locomotives, cabooses, railroad cars, track and maintenance equipment, track inspection equipment, and all other rail-related machines and equipment.

"<u>Vacant Position</u>" has the meaning given such term in <u>Section 5.8</u>.

1.2 <u>References.</u> All references made (i) in the neuter, masculine or feminine gender shall be deemed to have been made in all such genders, and (ii) in the singular or plural shall be deemed to have been made, respectively, in the plural or singular as well. All references to Sections and subsections are to Sections and subsections of this Agreement unless indicated otherwise. The words "herein", "hereof", "hereunder" and other similar compounds of the word "here" when used in this Agreement shall refer to this entire Agreement and not to any particular provision or section unless specifically indicated otherwise. The terms "include" or "including" do not limit the preceding words or terms.

ARTICLE 2
ENGAGEMENT OF CONTRACTOR; USE OF RAIL CORRIDOR

2.1 <u>Engagement of Contractor; Changes in Scope of Services</u>. On and subject to the terms and conditions of this Agreement, ACTA hereby engages Contractor to perform the Services specified in this Agreement with respect to the Maintained Facilities. Contractor accepts such engagement, acknowledges that it has inspected and reviewed the Services to be provided under this Agreement, and shall exercise the care and skill expected of an experienced practitioner in its profession in the prompt performance of all its obligations under this Agreement. The foregoing engagement is non-exclusive and, as between ACTA and Contractor, ACTA may in its sole discretion augment or supplement the Services to be provided under this Agreement with forces of another contractor. Further, notwithstanding anything to the contrary in this Agreement (including <u>Section 5.7</u> and <u>Article 7</u>) and, from time to time during the term of this Agreement, ACTA may elect, in its sole discretion, by providing thirty (30) days' prior written notice to Contractor (except that in an emergency, ACTA shall be required to give only such notice as may be feasible under the circumstances) to cause certain Services to be provided by the forces of another contractor (e.g., if ACTA determines that the Contractor's proposed cost of certain Services, as set forth in a proposed annual maintenance plan and budget, or otherwise, is more expensive than the cost for such Services that would be charged by another entity, ACTA may elect to have such Services provided by an entity other than Contractor). In any case where work in or on the Maintained Facilities is to be conducted by another entity, Contractor shall cooperate fully with such other entity.

2.1.1 In the event that ACTA elects to have such Services performed by another entity as described above, other than on a temporary basis (i.e., Services performed over a period of one hundred eighty (180) days or less), ACTA shall notify the Contractor in writing pursuant to <u>Article 21</u> and Contractor shall submit to ACTA (no later than ten (10) days' following notice to Contractor), a proposed termination statement which shall include (1) all amounts owed to Contractor or any Subcontractor for those Services performed through the proposed termination date; (2) termination payments, if any, contractually owed by Contractor to Subcontractors and/or vendors as a direct result of the termination of such Services; provided, however, that (i) ACTA previously authorized and directed Contractor to perform such Services, and (ii) such termination payments, if any, are a reasonable approximation of the damages incurred by Subcontractors and/or vendors as a direct result of the termination of such Services; and (3) reasonable costs incurred by Contractor to comply with ACTA's written directions in connection with the transfer of Services, including reasonable demobilization costs, if any. Contractor shall provide ACTA with supporting documentation as requested by ACTA, including but not limited to copies of contracts, invoices, receipts and other documents. Notwithstanding the foregoing, in no event shall ACTA be obligated to pay for lost profits or other consequential damages resulting from any such termination.

2.1.2 In the event that ACTA elects to proceed to have such Services performed by another entity, then (a) ACTA and Contractor may agree to equitably adjust, as necessary, pursuant to a CTO as provided in Section 5.9, the Approved Maintenance Plan to account for any anticipated decrease in Contractor's time and costs of performance, and (b) ACTA shall pay the termination statement described in Section 2.1.1 in accordance with and subject to the provisions of Section 5.6. Notwithstanding the foregoing, Contractor shall have a duty to mitigate Contractor's losses that arise from ACTA's termination of such Services.

2.2 Use of Rail Corridor. Contractor and its Subcontractor are hereby authorized to use the Rail Corridor for the term of this Agreement to the extent necessary to perform the Services hereunder, and for no other purpose. Contractor hereby is granted a license to enter the Rail Corridor to perform the Services described in this Agreement on the terms and conditions contained herein; such engagement, however, does not, and shall not be construed to, give or grant Contractor any right, title or interest of any kind or character in or to the Rail Corridor or any portion thereof or interest therein, or in or to any other property of POLA, POLB, ACTA, BNSF and/or UP, and Contractor specifically acknowledges that it has no leasehold, easement or other interest in any of such real or personal property. Contractor shall have no right to grant, convey, enter into, modify, extend or renew leases, licenses, easements or conveyances of all or any portion of the Rail Corridor, or any right or interest therein.

2.3 Use by POLA, POLB, ACTA, BNSF and/or UP. POLA, POLB, ACTA, BNSF and/or UP may use or grant additional rights to third parties in and to all or any portion of the Rail Corridor in such manner as each such entity deems appropriate, consistent with and subject to the terms and conditions of the Operating Agreement, so long as such rights and the actual use of the Rail Corridor by such entities or by others duly authorized by such entities do not materially interfere with Contractor's ability to perform the Services hereunder.

2.4 Additions to, Modifications of and Removal of Facilities by POLA, POLB, ACTA, BNSF and/or UP.

2.4.1 Additions. Subject to Section 8.4, any of ACTA, POLA, POLB, BNSF and/or UP, each acting in its sole discretion and consistent with and subject to the terms and conditions of the Operating Agreement, at any time may construct new track and other rail facilities in and on the Rail Corridor and designate such new track and other rail facilities as Maintained Facilities. Where reasonably practicable, ACTA shall consult with Contractor prior to the commencement of construction of any such addition or modification to the Rail Corridor or Non-Rail Components if such construction foreseeably would interfere with Contactor's ability to perform the Services hereunder or risk safety of any of Contractor's employees or Subcontractors. When such addition or modification is completed and any necessary regulatory approvals or exemptions have been obtained, such addition or modification may be designated by ACTA as part of the Maintained Facilities. Unless ACTA designates a different maintenance standard, the maintenance standard for new facilities or additions or modifications made to the Maintained Facilities under this Agreement shall be the Maintenance Standards, as set forth in Section 6.2.

2.4.2 **Removals**. As between ACTA and Contractor, and subject to ACTA, POLA, POLB, BNSF and/or UP obtaining any necessary regulatory approvals or exemptions, ACTA may remove (or cause to be removed) any portion of the Maintained Facilities from service, either temporarily or permanently, upon thirty (30) days' prior written notice to the Contractor (except that in an emergency, ACTA shall be required to give only such notice as may be feasible under the circumstances). In the event that the removal of any Maintained Facilities adversely affects Contractor's overall rights or obligations hereunder, then Contractor may submit to ACTA (no later than ten (10) days' following notice to Contractor) a proposed termination statement pertaining only to that portion of the Maintained Facilities at issue, which shall include (1) all amounts owed to Contractor or any Subcontractor for those Services performed with respect to the removed Maintained Facilities through the proposed removal date; (2) termination payments, if any, contractually owed by Contractor to Subcontractors and/or vendors as a direct result of the removal of such Maintained Facilities; provided, however, that (i) ACTA previously authorized and directed Contractor to perform Services with respect to the removed Maintained Facilities, and (ii) such termination payments, if any, are a reasonable approximation of the damages incurred by Subcontractors and/or vendors as a direct result of the removal of such Maintained Facilities; and (3) reasonable costs incurred by Contractor to comply with ACTA's written directions in connection with the removal of such Maintained Facilities from Service, including demobilization costs, if any. Contractor shall provide ACTA with supporting documentation as requested by ACTA, including but not limited to copies of contracts, invoices, receipts and other documents. Notwithstanding the foregoing, in no event shall ACTA be obligated to pay for lost profits or other consequential damages resulting from any such termination. In the event that ACTA elects to proceed with the removal of such Maintained Facilities, then ACTA shall pay such termination statement in accordance with and subject to the provisions of Section 5.6. Notwithstanding the foregoing, Contractor shall have a duty to mitigate Contractor's losses that arise from ACTA's removal of any portion of the Maintained Facilities.

2.4.3 **Adjustment to Approved Maintenance Plan**. In the event of any additions to, modifications of, and/or removal of Maintained Facilities as described in Section 2.4, the Approved Maintenance Plan may be equitably adjusted, as necessary, pursuant to a CTO as provided in Section 5.9, to reflect any such additions to, modifications of, and/or removal of Maintained Facilities and any corresponding anticipated increase (or decrease, as the case may be) in Contractor's time and costs of performance. For purposes of Section 2.4, any removal or deletion from service of a portion of the Maintained Facilities for less than 90 days shall not be considered a "removal" requiring an adjustment to the Approved Maintenance Plan.

2.5 **No Changes to Maintained Facilities by Contractor**. Contractor shall not take out of service, embargo, make change to or remove any of the Maintained Facilities (other than temporarily in the course of its maintenance and repair activities, in an emergency or as a result of a hazardous condition) without the prior written approval of ACTA, which approval may be given or withheld in the sole discretion of ACTA.

ARTICLE 3
AS-IS; WARRANTY DISCLAIMER; CONSTRUCTION WARRANTIES

3.1 Acknowledgement Regarding Investigations. Contractor acknowledges that prior to its execution of this Agreement, Contractor had the opportunity to investigate and determine (a) the physical aspects and condition of all portions of the Maintained Facilities, (b) past and present rail operations on the Maintained Facilities, and (c) such other matters as Contractor deemed relevant to analyze the proposed transaction, to discover any risks and to determine whether the transaction is economically viable for Contractor. Without limiting the generality of the foregoing, if ACTA and/or the Railroads notify Contractor that any geometry car or other rail or facility inspections of the Rail Corridor will be conducted after the date hereof and prior to the Commencement Date, Contractor shall cause Contractor's personnel (appropriately trained for such inspections) to accompany ACTA's and/or the Railroads' personnel on such inspections, and Contractor shall promptly notify ACTA in writing if such inspections disclose any condition that Contractor believes will negatively affect Contractor's ability to perform the Services under this Agreement. Contractor's investigations have included, among other things, meetings with Owner, ACTA and the Railroads. Contractor further acknowledges that (i) Contractor has received and reviewed a copy of the Operating Agreement and the Port Rail Agreements, (ii) Contractor's entry into this Agreement is based solely on the results of its own investigations and examinations, or its election not to investigate some or all of such matters as may be relevant, and not on any representation, warranty, promise or statement by Owner, ACTA, either Railroad or any representative, employee or agent thereof (other than those expressly provided in this Agreement), and (iii) none of ACTA, Owner or either Railroad, or the employees, representatives or agents of any of them, has made any representation, warranty, promise or statement, express or implied, to Contractor, or to anyone acting for or on behalf of Contractor, concerning or regarding such matters.

3.2 Acceptance of Rail Corridor and Maintained Facilities As-Is. Subject to Section 16.3, Contractor hereby enters into this Agreement and accepts the Maintained Facilities in THEIR AS-IS CONDITION AND IN THEIR AS-IS STATE OF REPAIR ON THE DATE OF THIS AGREEMENT. Contractor hereby waives, and ACTA hereby disclaims, all warranties of any type or kind whatsoever with respect to the Maintained Facilities, or any component thereof, including those of fitness for a particular purpose or use.

3.2.1 Notwithstanding the foregoing, it is agreed that if Contractor encounters unforeseen latent defects of an unknown and concealed nature that (i) could not or should not have been discovered or anticipated by Contractor after the exercise of due diligence in inspecting the Maintained Facilities (**"Latent Defects"),** and (ii) such Latent Defects increase Contractor's cost of performance of Services beyond any budgeted contingencies for the relevant period, as its sole remedy Contractor may submit a request for a CTO to equitably increase the Approved Maintenance Plan to the extent made necessary by the Latent Defect(s) encountered. For purposes of this Agreement, Latent Defects shall not include, among other things, conditions arising in the ordinary course as a result of ordinary wear and tear of the Maintained Facilities.

3.3 **No Representations or Warranties Regarding Materials or Documents**. Contractor acknowledges that the delivery of materials and documents (including the Request for Proposals for Alameda Corridor Maintenance Services dated September 30, 2024 and the related appendices and addenda thereto (the "**Request for Proposals**") to Contractor by or on behalf of ACTA has been made solely to facilitate Contractor's investigations relating to this transaction, and none of ACTA, POLA, POLB, BNSF or UP make any representations or warranties of any kind regarding the completeness, accuracy or thoroughness of the information contained in such materials and documents.

ARTICLE 4
COMMENCEMENT DATE; TERM

4.1 **Commencement Date and Term**. The term of this Agreement, and Contractor's duties hereunder, shall commence on [_________], 2025 (the **"Commencement Date"**). Unless it is terminated earlier in accordance with any provision entitling a party to terminate this Agreement, this Agreement shall terminate at 11:59 p.m. Los Angeles time on April 14, 2030. However, if a replacement maintenance contractor for the Maintained Facilities has not been selected on or before April 14, 2030, or if the replacement maintenance contractor has been selected but is not prepared to commence maintenance services as of April 15, 2030, then Contractor shall continue to perform the Services on the terms set forth in this Agreement until the earlier of (i) April 14, 2030, or (ii) the termination date set forth in a written notice from ACTA to Contractor once a replacement maintenance contractor has been selected in accordance with the provisions of the Operating Agreement and Contractor has completed all remaining Services directed by ACTA. Notwithstanding anything to the contrary contained herein, ACTA, in accordance with the provisions of the Operating Agreement, shall have the right to extend the term of this Agreement with Contractor for an additional term of five (5) years terminating at 11:59 p.m. Los Angeles time on April 14, 2035, by providing Contractor with written notice of such election at least ninety (90) days prior to the expiration of the initial term.

ARTICLE 5
APPROVED MAINTENANCE PLAN; MAINTENANCE INVOICES

5.1 **Annual Maintenance Budget**. No later than September 1 of each Contract Year, Contractor shall provide to ACTA, POLA, POLB, BNSF and UP proposed maintenance plans and budgets for the Maintained Facilities for the next succeeding Contract Year. However, since the last Contract Year ends April 14, 2030, the plans and budgets that are submitted in the preceding year should be prepared for the entire calendar year through December 31, 2030. The plans and budgets shall be substantially in the form contained in Exhibit 3 hereto and shall include all items necessary for Contractor to comply with the maintenance requirements and standards established under this Agreement for the Maintained Facilities (the "**Annual Maintenance Budget**"). The Annual Maintenance Budget shall be developed in good faith between Contractor and ACTA and shall include the following items:

(a) A written Work Plan and monthly schedule containing all the routine and special work items to be performed, including assumptions used in developing such Annual Maintenance Budget;

(b) Separate subplans and subbudgets for each of the categories of charges and expense: (i) M&O Charges, (ii) Capital Improvements Charges, (iii) Non-Rail Maintenance Charges, and (iv) ACTA AEI Reader maintenance charges;

(c) Estimates of all amounts to be paid by ACTA for direct labor and staffing (including the supporting information for the Fully Burdened Labor Rate associated with each job classification appearing in the plan);

(d) Estimates of all amounts to be paid by ACTA for Direct Costs (based on agreed-upon standard rates and unit prices for materials, equipment, rentals and other anticipated Direct Costs);

(e) Estimates of all Services to be subcontracted, including a list of all Subcontractors that Contractor intends to engage during the applicable Contract Year;

(f) Estimates of all amounts to be paid by ACTA relating to safety plans, security, employee training and associated costs; and

(g) All assumptions used in developing such Annual Maintenance Budget.

5.2 Review and Approval of Proposed Maintenance Plans. Within 30 days after receipt of Contractor's proposed Annual Maintenance Budget for the Maintained Facilities under Section 5.1, POLA, POLB, BNSF and UP shall approve or disapprove such plan and budget through Mutual Agreement in accordance with the provisions of Section 8.3 of the Operating Agreement. Upon approval of the proposed Annual Maintenance Budget, the proposed Annual Maintenance Budget shall become the Approved Maintenance Plan for the applicable Contract Year. If the proposed Annual Maintenance Budget is not approved, then the parties disapproving the proposed Annual Maintenance Budget shall provide to the Contractor detailed reasons for such disapproval, whereupon Contractor within 15 days after its receipt of notice of such disapproval, shall deliver to ACTA, POLA, POLB, BNSF and UP a revised Annual Maintenance Budget which shall reflect the comments (if any) made to the original proposed Annual Maintenance Budget. The process described in the preceding two sentences shall continue until a revised Annual Maintenance Budget is approved. If a proposed Annual Maintenance Budget for a Contract Year has not been approved by January 1 of such year, then to reduce any disruption to maintenance and operations on the Maintained Facilities, the prior Contract Year's Approved Maintenance Plan shall apply to the maximum extent practicable or necessary and Contractor shall provide the Services in accordance therewith and ACTA shall pay Maintenance Invoices in accordance herewith, until an Annual Maintenance Budget is approved.

5.2.1 The Annual Maintenance Plan may be amended from time to time during the Contract Year through Mutual Agreement of the Owners and Railroads in which case Contactor shall receive a notice from ACTA pursuant to Article 21. Such amendments will occur when:

(a) ACTA requests the Contractor to add items or modify existing items contained in the Approved Maintenance Plan using authorized contingency funds approved by the Owner and Railroads for each calendar year; or

(b) ACTA requests the Contractor to add items or modify existing items contained in the Approved Maintenance Plan pursuant to Mutual Agreement of the Owner and Railroads during the calendar year.

5.2.2 The Annual Maintenance Plan for the first Contract Year shall be that contained in Exhibit 3, which includes the negotiated Fully Burdened Rates for the first Contract Year.

5.3 **Plan Dispute**. If ACTA changes Contractor's proposed budget for the Maintained Facilities for the upcoming Contract Year in the Approved Maintenance Plan without a commensurate change in Contractor's applicable responsibilities, then Contractor, within 15 days after being notified by ACTA of such changes may for reasonable cause notify ACTA in writing (a "**Deficiency Notice**") that in Contractor's reasonable judgment the approved plan will not enable Contractor to meet the standards required of Contractor under this Agreement, specifying in detail the reasons why Contractor believes deficiencies exist, and all areas where Contractor believes deficiencies exist. Contractor and ACTA promptly shall meet after delivery of the Deficiency Notice to attempt to resolve any differences. If the parties are unable to resolve their differences within 20 days after delivery of the Deficiency Notice, then either Contractor or ACTA may invoke the dispute resolution procedures specified in Article 20. Should such dispute not be resolved prior to the beginning of the applicable Contract Year, then to reduce any disruption to maintenance and operations on the Maintained Facilities, the Approved Maintenance Plan shall apply and Contractor shall provide the Services in accordance therewith and ACTA shall pay Maintenance Invoices in accordance therewith until the dispute is resolved; provided, that if the arbitrator determines that the Approved Maintenance Plan was not sufficient to meet the standards required of Contractor hereunder, Contractor shall not be deemed in default under this Agreement for failing to meet such standards if such failure resulted from deficiencies in the Approved Maintenance Plan.

5.4 **Modifications to Maintenance Standards**. As between Contractor and ACTA, ACTA shall have the right, in its sole discretion, consistent with and subject to the terms and conditions of the Operating Agreement, to modify the Maintenance Standards, or scope thereof, to be observed by Contractor with respect to the Services; provided, that ACTA gives thirty (30) days' prior written notice of such modifications to Contractor (except that in an emergency, ACTA shall be required to give only such notice as may be feasible under the circumstances). In such event, ACTA and Contractor may agree to equitably adjust, as necessary, pursuant to a CTO as provided in Section 5.9, the Approved Maintenance Plan to account for any anticipated increase in Contractor's time and cost of performance as a direct result of such modifications.

5.5 **Not-to-Exceed Amount**. In no event shall the maximum aggregate amount of Maintenance Invoices in any calendar year exceed (i) the estimated amount contained in the Approved Maintenance Plan, and (ii) additional funds, if any, paid directly by the Railroads to ACTA pursuant to the terms of the Operating Agreement and/or a separate agreement among

ACTA, the Railroad(s) and the Owner, without the prior written approval of ACTA, the Owner and the Railroads.

5.6 Payments to Contractor.

5.6.1 Maintenance Invoices. As further described below, no later than the last day of each calendar month after the Commencement Date, Contractor shall submit an invoice to ACTA for the Services performed by Contractor during the prior calendar month (the **"Maintenance Invoice"**). Each Maintenance Invoice shall be payable in accordance with this Section 5.6 and shall include:

(a) A description of the Services performed for the prior calendar month, including (i) the job classification of each employee that performed during such period, (ii) the Fully Burdened Labor Rate assigned to each such job classification, and (iii) the number of hours worked by each employee in their assigned job classification during such period (or the number of hours which employee was available and present to work at the Maintained Facilities but was unable to do so for reasons beyond Contractor's control in accordance with Section 5.6.4(b); provided, however, in no event shall the total number of hours worked by any salaried employee exceed the limit described in Section 5.10);

(b) A description of the Direct Costs incurred for the prior calendar month, which Direct Costs shall either be based on the agreed-upon standard rates and unit prices contained in the Approved Maintenance Plan, or, for Direct Costs not included in the then current Approved Maintenance Plan and approved by ACTA, at the Contractor's cost plus the Allowed Markup;

(c) A description of the Services and Direct Costs for signals and communications work performed in the prior calendar month as provided in Section 5.6.3;

(d) The following four categories of Services and Direct Costs contained in the Approved Maintenance Budget, as may be amended pursuant to Section 5.2.1; (i) M&O Charges (funded from Railroad sources), (ii) Capital Improvements Charges (funded from the Reserve Account), (iii) Non-Rail Maintenance Charges (funded from the Reserve Account), and (iv) ACTA AEI Reader Maintenance (funded from Railroad sources and ACTA Administration sources); and

(e) Each such invoice shall provide reasonable details, including such supporting documentation as reasonably required by ACTA, subject to ACTA's audit rights as set forth in Section 13.3. Contractor shall attach to each such invoice signed timecards detailing the time each of Contractor's employees spent performing Services under this Agreement and payroll registers for that time period. Timesheets and payroll registers shall be audited and must reflect the correct rates paid for each employee during a normal workday in which that individual performs different duties in another job classification that is a higher rate than their designated job. In the event that Contractor uses subcontracting services during such period, Contractor shall also provide the information and documents required under Section 5.7 (including the invoice for subcontracting Services performed for the prior calendar month, which invoice shall be in the same form and contain the same information, as may be applicable, as required under this Section 5.6.1).

5.6.2 **CTO Invoices.** Contractor shall submit separate individual invoices for additional work where a CTO has been issued pursuant to Section 5.9(f).

5.6.3 **Quarterly Reconciliation Invoices.** Contractor shall submit a Quarterly Reconciliation Invoice as defined in Article 1.

5.6.4 **Payment of Invoices**. Subject to Contractor's compliance with the requirements contained in this Section 5.6, payment of the amount shown on each such Maintenance Invoice shall be made within 30 days after ACTA's receipt of a complete and undisputed invoice (i.e. an invoice free of error and containing sufficient validation of charges). If the invoice includes disputed charges, ACTA shall notify the contractor of any invoice irregularities (including but not limited to unsupported costs, rate errors, mathematical errors, and discrepancies between signed timesheets and payroll registers) as soon as possible. If by mutual consent the invoice cannot be resolved before an agreed upon payment date, the charges for disputed items will be deducted from the invoice amount before payment is made. ACTA and the Contractor shall work to resolve the disputed issues and will later agree for corrected or subsequently accepted charges to be included in the Quarterly Reconciliation Invoice. If there remain any unresolved items for the quarter, the disputed portion shall move through the dispute resolution procedures set forth in Article 20. The monthly Maintenance Invoices and the Quarterly Reconciliation Invoices are subject to audit per Section 13.3 of this agreement.

5.6.5 **Signals and Communications and AEI Reader Maintenance Costs.** The signal, communications and AEI Reader maintenance costs shall be set forth in the Approved Maintenance Plan and shall constitute the basis for paying Contractor for signal, communications and AEI Reader maintenance work performed during each Contract Year. Contractor shall include in each monthly Maintenance Invoice the Services and Direct Costs for signal, communications as set forth in the Approved Maintenance Plan.

(a) Contractor shall invoice ACTA for AEI Reader Maintenance on a monthly basis in the amount of 1/12 of the budget, and include the invoice with the Weekly and Monthly Management reports. Hardware inventory replenishment shall be a separate line item on invoices with appropriate asset tag number included when the asset can be tagged.

5.6.6 **ACTA's Payment Obligation**. (a) Except as provided in Section 5.6.3 and Section 5.6.4(b), Contractor shall invoice ACTA for, and ACTA shall be obligated to pay Contractor for, only those Services actually performed by Contractor or Subcontractor. ACTA and Contractor each acknowledge and agree that this Agreement is not a "fixed price contract" and ACTA is obligated to pay only for those Services actually performed by Contractor or Subcontractor. In addition, unless otherwise approved in writing by ACTA (pursuant to a CTO or otherwise), ACTA shall have no obligation to pay Contractor or any Subcontractor for any Services or Direct Costs that exceed the estimated amount contained in the Approved Maintenance Plan or for which Contractor fails to provide the supporting documentation required under Section 5.6.1. ACTA shall not be obligated to pay Contractor for any Services or Direct Costs performed or incurred by a Subcontractor for which Contractor has not satisfied the requirements contained in Section 5.7.

(b) Notwithstanding the foregoing, but only in the limited circumstances described below, Contractor may invoice ACTA for, and ACTA shall be obligated to pay Contractor for, Contractor's employee(s) and/or Subcontractor(s) that were available and present to work at the Maintained Facilities but were unable to do so for reasons solely attributable to the acts or omissions of ACTA, POLA, POLB and/or the Railroads (excluding Force Majeure Events), and such an event could not have been anticipated by Contractor or such Subcontractors. In no event, however, shall ACTA be obligated to pay more than 200 total hours of such down time in any calendar month. ACTA's obligation to pay such amounts shall be subject to Contractor's compliance with the requirements contained in Section 5.6. Notwithstanding the foregoing, if such a situation occurs, Contractor will promptly take steps to minimize the costs resulting from such situation, including, without limitation, performing work at another location, where possible.

5.6.5 **Direct Costs.** All materials, supplies, equipment, vendor services, subcontracting services and such other direct costs as defined in the Federal Acquisition Regulation (collectively, **"Direct Costs"**) purchased or provided by Contractor to perform the Services under this Agreement, with the exception of costs included in Local Administrative and Office Support Costs and Safety Equipment Costs, shall be charged to ACTA at either the agreed-upon rates and unit prices contained in the Approved Maintenance Plan, or, for Direct Costs not included in the then current Approved Maintenance Plan and approved by ACTA, at the Contractor's cost plus the Allowed Markup; provided, however, that the Allowed Markup shall not apply to Services performed under this Agreement by an Affiliate of Contractor.

5.7 **Subcontractors**. Contractor shall be permitted to hire one or more Subcontractors with respect to the performance of the Services to be provided by Contractor hereunder, provided that the requirements contained in this Section 5.7 and elsewhere in this Agreement are satisfied.

5.7.1 **Payments to Subcontractors**. Each Subcontractor shall be paid by Contractor according to the rate established in the contract between Contractor and Subcontractor, provided that the following requirements are satisfied:

(a) Contractor shall deliver to ACTA (as part of the monthly Maintenance Invoice pursuant to Section 5.6.1), (1) an itemized list of all Services actually performed by Subcontractor in the prior calendar month with required support documents as required by the prime within this agreement and others document as needed; (2) a copy of the invoice prepared by Subcontractor with respect to such Services; (3) a copy of the certification or affidavit prepared by Subcontractor stating that the work has been performed and completed by Subcontractor and no lien, attachment or claim with respect to the Maintained Facilities has been filed that has not been released or will not be released simultaneously with the payment to Subcontractor; and (4) such additional supporting documentation as reasonably required by ACTA. With respect to Subcontractors that are paid based on hourly rates, the itemized list required under clause (1) above shall also include the job classification of each worker, the rate assigned to each such job classification, and the number of hours worked by each worker.

(b) In the event that Services are transferred to a Subcontractor that were to be performed by the Contractor under the Approved Maintenance Plan, then no Allowed Markup shall apply unless otherwise approved by ACTA.

(c) Except as provided in Section 5.6.4(b), in no event shall ACTA be obligated to pay for Services not actually performed by Subcontractor. In addition, unless otherwise approved in writing by ACTA (pursuant to a CTO or otherwise), ACTA shall have no obligation to pay Contractor for any Services performed or Direct Costs incurred by a Subcontractor that exceed the estimated amount contained in the Approved Maintenance Plan or for which Contractor fails to provide the supporting documentation required under Section 5.6.1.

5.7.2 **Records Regarding Subcontractors.** Contractor's records and books detailing work performed by a Subcontractor shall be in reasonable detail, shall include such supporting documentation as ACTA reasonably may request, and shall be subject to ACTA's audit rights as set forth in Section 13.3.

5.7.3 **Contracts with Subcontractors.** Contractor shall submit a Subcontractor Approval Form to obtain the written approval of ACTA prior to entering into any contract (or at any time during the term of the contract) in which the aggregate annual amount payable exceeds Twenty Five Thousand Dollars ($25,000). Contractor shall provide ACTA with a copy of each such contract (and any amendments thereto). Contractor shall include in each contract with a Subcontractor a provision which entitles ACTA to audit Subcontractor's records and books, and shall require that Subcontractor's records and books (i) describe in reasonable detail the Services performed by Subcontractor, including any Direct Costs incurred, (ii) include such supporting documentation as ACTA reasonably may require, and (iii) be subject to ACTA's audit rights as set forth in Section 13.3. Contractor shall require Subcontractor to retain such books and records for a period of not less than three (3) calendar years after the termination of this Agreement. In addition, to the extent permitted by law, Contractor shall include in each subcontract the stipulation that Contractor, not ACTA, Owner or Railroads, is solely responsible for payment to the Subcontractor for the amounts owing and that the Subcontractor shall have no claim, and shall take no action against ACTA or any of the other Indemnified Entities for nonpayment by Contractor.

5.7.4 **Prohibition Against Sub/Sub Subcontracting.** Contractor shall include in each contract with a Subcontractor a provision which prohibits any Subcontractor of a Subcontractor from subcontracting any Services under this Agreement (i.e., any sub-sub-Subcontracting is prohibited) unless otherwise agreed to in writing by ACTA.

5.8 **Vacant Positions**. A position listed in the Annual Maintenance Budget that is no longer occupied by an employee of Contractor or by a Subcontractor for all or some of a monthly invoice period is a vacant position (**"Vacant Position"**). Any Vacant Position shall be listed by Contractor as a line item on Contractor's next Maintenance Invoice delivered to ACTA, along with a notation regarding the time period within the monthly invoice period for which the position is vacant. Contractor shall not invoice, nor shall ACTA be obligated to pay, for any Vacant Position.

5.9 **CTOs**. Contractor shall submit to ACTA or ACTA shall submit to the Contractor a proposed CTO in accordance with the procedures contained in this Section 5.9, in the event that one or more of the following should occur:

(a) An addition to, modification of and/or removal of Maintained Facilities as described in Section 2.4;

(b) Contractor encounters Latent Defects at the Maintained Facilities of the type described in Section 3.2;

(c) ACTA determines to modify the Maintenance Standards as described in Section 5.4;

(d) A delay or failure by ACTA, Owner, BNSF and/or UP results in material delay or failure by Contractor to perform Services hereunder, or otherwise materially adversely affects Contractor's rights or obligations hereunder;

(e) ACTA requests the Contractor to perform emergency work; or

(f) ACTA requests the Contractor to perform other additional services to support ACTA's capital program or third-party work such as by utility owners on or adjacent to the Rail Corridor (e.g., flagging and inspection services).

The CTO request shall include (i) the scope of the increased (or decreased, if applicable) Services (ii) the schedule for performing and completing the Services, if applicable, (iii) an estimate of the increased (or decreased, if applicable) labor and Direct Costs required to perform the Services (including necessary headcount and the Fully Burdened Labor Rate attributable to each job classification), (iv) the Contractor's Allowed Markup, if applicable, and (v) a maximum guaranteed amount agreed upon by Contractor and ACTA to be paid for such Services, if applicable. The CTO shall utilize the Fully Burdened Labor Rate and other standard unit costs and prices used in the then-effective Approved Maintenance Plan and any new job classifications and associated new or modified Fully Burden Rate. ACTA shall review, revise if necessary in its reasonable judgment, and approve in writing the CTO (or the revised CTO, if applicable); provided that prior to any such approval, ACTA where applicable shall first obtain the prior written approval of Owner and the Ports pursuant to Section 8.3 of the Operating Agreement. If ACTA approves in writing such CTO (or a revised CTO), then both Contractor and ACTA must sign the approved CTO before Contractor may, or is required to, begin any such Service. Until the completion of any such Service, Contractor shall submit a status report along with the monthly invoice described in Section 5.6.1 indicating the percentage of the total work that has been performed during such monthly invoice period. Upon completion of this process, the Approved Maintenance Plan shall be considered amended to reflect the increased (or decreased, if applicable) Services and estimated increase (or decrease, if applicable) costs set forth in the approved CTO.

If Contractor believes additional compensation is due for Services or Direct Costs not covered in the Approved Maintenance Plan, Contractor shall not be obligated to proceed until a CTO has been executed by both parties. In no event shall ACTA be prohibited from employing contractors other than Contractor to perform any such Service.

5.10 Fully Burdened Labor Rate. The Fully Burdened Labor Rate attributable to each of Contractor's employee job classifications which will be allocated, in whole or in part, to perform

Rail Corridor Services and/or Non-Rail Component Services must be specified in the Approved Maintenance Plan.

5.10.1 The Approved Maintenance Plan, in the course of identifying all job classifications allocated to provide Services under said plan and the applicable Fully Burdened Labor Rate, will also identify whether each job classification is compensated on an exempt salaried or non-exempt hourly basis. For exempt salaried job classifications, the Approved Maintenance Plan will further indicate whether one hundred percent (100%) of the individual's time is expected to be spent providing Services under said plan, and if not, the best estimate of the percentage of his or her time the individual will spend providing Services pursuant to the Approved Maintenance Plan. This estimate of time to be worked compared to actual time worked and other relevant conditions will be subject to audit by ACTA. Unless otherwise agreed to in writing by ACTA, in no event shall Contractor invoice ACTA for, nor shall ACTA be obligated to pay, more than forty (40) hours per week for any exempt salaried job classification.

5.10.2 In addition, except in the case of emergencies, planned overtime for non-exempt job classifications shall be approved in advance by ACTA. In the case of non-exempt employees performing work for another client on the same day or the same week, approval from ACTA must be obtained in writing to charge ACTA for overtime that is caused by this dual use.

5.10.3 It is Contractor's obligation to provide adequate employee coverage to staff the job classifications listed in the Approved Maintenance Plan, and, except as provided in Section 5.6.4(b), Contractor may only invoice ACTA (i) for the Fully Burdened Labor Rate attributable to job classifications as identified in the Approved Maintenance Plan and (ii) to the extent work was actually performed.

ARTICLE 6
MAINTENANCE OF THE MAINTAINED FACILITIES

6.1 Contractor's Obligation to Provide the Services. During the Term, Contractor shall provide all of the maintenance, inspection, repair, replacement, graffiti removal and other services with respect to the Maintained Facilities described in this Agreement, including, without limitation, the services more specifically described in Section 3.0 (Scope of Services) of Exhibit 7 attached hereto, performed to assure continued reliable and safe operation of the Maintained Facilities (collectively, the **"Services"**).

6.1.1 Without limiting the generality of the foregoing, the Services shall include the following:

(a) Preventative maintenance of the Maintained Facilities in a manner that preserves the economic life of the property and guards against excessive wear, tear, erosion or damage.

(b) The prompt removal or painting over of any graffiti on the Maintained Facilities, repairing of any damage to the Maintained Facilities caused by vandals, and removal from the Maintained Facilities and proper disposal of all trash and debris. The Approved Maintenance Plan shall set forth a schedule for inspection, repair and removal activities relating to graffiti, vandalism and debris. In addition to promptly removing or painting over graffiti in the normal course of providing the Services, Contractor shall remove or paint over any graffiti on the Maintained Facilities promptly after receiving a request from ACTA.

(c) The planning, purchasing, storage, distribution and control of all materials required to perform the Services under this Agreement. All materials and equipment purchased by Contractor pursuant to this Agreement for the provision of the Services shall be used solely for the purpose of providing the Services (for purposes of this subparagraph, material and equipment do not include items owned by Contractor the use of which is billed to ACTA at the agreed rates in the Approved Maintenance Plan). The Approved Maintenance Plan shall set forth agreed-upon procedures for purchasing materials for the applicable Contract Year and the amounts budgeted therefor, as well as procedures for storing, tracking and managing such materials (which procedures shall be subject to audit by ACTA, Owner and Railroads, or an agent of each such party, and shall remain available for audit by ACTA, Owner and Railroads during the term of this Agreement and for a period of not less than three (3) calendar years after the termination of this Agreement. Without limiting the generality of the foregoing, Contractor acknowledges that ACTA previously has purchased, and has delivered to Contractor the materials and equipment described in Schedule 1 attached hereto (which Schedule, if not finalized prior to the execution of this Agreement, shall be delivered by ACTA to Contractor as soon thereafter as possible, and upon delivery by ACTA such Schedule shall be deemed incorporated into this Agreement without the necessity of executing any further instruments). All of such material and equipment, and all material and equipment purchased by Contractor during the term of this Agreement at ACTA's expense, shall be stored and controlled by Contractor in a manner that ensures the security and safety thereof, and Contractor shall be solely responsible, at its cost, for any theft, loss or damage of any kind to such material while it is in the possession or under the control of Contractor. Upon the expiration or earlier termination of this Agreement, Contractor shall (i) provide a detailed written accounting of all such material and equipment previously received from ACTA or purchased at ACTA's expense, (ii) promptly turn over or deliver to ACTA (or as directed by ACTA) all such material not previously installed on or in the Maintained Facilities or otherwise disposed of in accordance with the provisions of this Agreement, and (iii) with respect to any such material and equipment unaccounted for under the preceding clause (ii), pay to ACTA an amount equal to the cost incurred to acquire such material and equipment.

(d) Contractor shall maintain an accurate inventory of all material, supplies and equipment purchased under this Agreement and provide to ACTA a copy thereof each year. Such annual inventory shall be subject to ACTA's audit rights set forth in Section 13.3. Contractor shall use bar codes, labels or other appropriate identification mechanism to identify and physically label ACTA's equipment. Furthermore, Contractor shall not commingle its equipment, supplies or materials with those belonging to ACTA.

(e) In the event of any emergency, (i) Contractor shall promptly notify ACTA and the Railroads of such emergency, and (ii) Contractor shall respond with all resources needed to restore safe operating conditions and restore regular railroad service, consistent with other maintenance and safety obligations and consistent with good industry practice. Contractor shall cooperate fully with any investigation regarding an emergency situation. In any emergency, Contractor's employees shall provide any assistance requested in a manner that is not in conflict with rail service on the Rail Corridor and Contractor's obligations under this Agreement. Without limiting the generality of the foregoing, if Contractor at any time has taken any Trackage or other Maintained Facilities out of service in order to conduct the Services, and an event then occurs which causes or results in other Trackage or Maintained Facilities becoming blocked or fouled or otherwise being taken out of service, then at ACTA's request, Contractor shall take such steps as necessary to return to service, as promptly as reasonably possible, the Trackage or other Maintained Facilities on which Contractor had been conducting such Services.

6.2 Maintenance Standards.

6.2.1 All Services with respect to the Maintained Facilities will be made in a good and workmanlike manner, consistent with industry practice, and, in the case of replacements, will be made using materials of a kind and quality comparable to the items being replaced, which materials must be in compliance with all applicable laws (including building codes). Each of ACTA, Owner, BNSF and UP shall have the right, without obligation, to inspect the Maintained Facilities at any time to ensure compliance with this Section 6.2 and for any other purpose incidental to the rights of ACTA under this Agreement. Contractor shall maintain the Maintained Facilities (a) in a manner that does not impair the ability of ACTA, Owner or the Railroads to have access to and over and to operate on the Maintained Facilities, and which is designed to protect the safety of the public and preserve the economic life of the Maintained Facilities, (b) in accordance with the UP Track and Signal Standards set forth in Exhibit 7-Appendix F attached hereto, the Bridge Management Plan developed by the Contractor, and all applicable FRA, federal, state and local laws, rules and regulations (including the FTSS and FRWS), (c) in FRA Class 4 condition (except as noted in Exhibit 7-Appendix F attached hereto or unless otherwise agreed by ACTA in writing), and (d) in accordance with the applicable Approved Maintenance Plan.

6.2.2 From time-to-time ACTA (consistent with and subject to the terms and conditions of the Operating Agreement) may notify Contractor of proposed modifications to the Maintenance Standards to be observed by Contractor on the Maintained Facilities and, may adopt such modifications. Contractor also may propose modifications to such Maintenance Standards for consideration by ACTA. In the event that any modifications are adopted by ACTA, then the provisions of Section 5.4 shall apply.

6.3 Excess or Salvage Material. Contractor shall have the right to propose to ACTA that it would like to reuse at other locations on the Maintained Facilities any excess or second-hand material removed by Contractor in connection with replacement or repairs on the Maintained Facilities. ACTA, in its sole discretion, shall approve in writing or disapprove any such proposal within twenty (20) days after its receipt thereof. If ACTA does not approve in writing Contractor's proposed reuse of such excess or second-hand materials within such twenty-day (20) period, or if for any reason such excess or second-hand material is not reused by Contractor, then, subject to ACTA's prior written approval of such sale, Contractor shall sell such material removed by

Contractor from the Rail Corridor. The gross proceeds from any such sale shall be remitted to ACTA for deposit in the M&O Fund. The costs incurred in removing the materials and the cost incurred in connection with the sale shall be included in Contractor's monthly Maintenance Invoice. All receipts and supporting evidence must be presented at the time of the written request to salvage material.

6.4 Inspections. None of ACTA, Owner or any Railroad shall have any responsibility for inspecting, maintaining, servicing or repairing the Maintained Facilities or any portion thereof or any other equipment or property on the Maintained Facilities.

6.4.1 Notwithstanding the foregoing, ACTA, Owner and/or the Railroads shall have the right to inspect any such property or equipment at any time for safety and/or security reasons and, in the case of a non-safety/security inspection, at any time provided that such inspection shall not materially interfere with Contractor's ability to perform the Services. Without limiting the generality of the preceding sentence, if ACTA, Owner and/or the Railroads notify Contractor that any geometry car or other rail or facility inspections of the Rail Corridor will be conducted after the Commencement Date, Contractor shall support and assist in such inspections through flag protection, on board observation by Contractor's personnel (appropriately trained for such inspections), review of test results and analysis of data. Further, if any such inspections disclose that the Services provided or conducted by Contractor do not meet the Maintenance Standards, then Contractor shall promptly perform Remedial Action to correct such defects or deficiencies at its sole cost and expense.

6.4.2 Contractor shall perform special inspections of the Maintained Facilities after storms, fires, derailments, earthquakes, motor vehicle accidents, vandalism or other disruptions to service, to determine if there has been any damage or alteration of conditions affecting the condition of the Maintained Facilities or the safety of Trains. If regulatory agencies perform inspections of the Maintained Facilities, Contractor shall support such inspections through transportation, flag protection, inspection, and documentation of inspection, record research, and Remedial Actions for any defects or deficiencies discovered in such inspections.

6.5 Repair of Damage Caused by Contractor. Contractor shall be responsible for promptly repairing any damage to the Maintained Facilities resulting from Contractor's or Subcontractor's acts or omissions regardless of whether such acts were unintentional. Contractor shall promptly inform ACTA and each Railroad in writing of the nature of such damage caused by Contractor or Subcontractor and the exact Remedial Action performed or to be performed by Contractor to repair such damage. Such repair work performed by Contractor shall be completed in a timely manner at Contractor's sole cost and expense; provided, however, such repair work performed by Contractor shall not unreasonably interfere with ACTA, Owner, and/or Railroads' use of the Maintained Facilities.

6.6 Coordination of Services with Other Entities. Contractor acknowledges that the Maintained Facilities comprise a segment of a larger rail and infrastructure system which, among other things, connects with Trackage owned or operated by one or both of the Ports, one of the Railroads or PHL at the southerly end of the Rail Corridor as well as with Trackage owned or operated by each of the Railroads at the northerly end of the Rail Corridor and at certain connection points along the Rail Corridor. Accordingly, as an integral component of the Services, Contractor at all times shall interface, coordinate and fully cooperate with any other entity providing repair, maintenance, improvement, dispatching, security services, railroad service and other services with respect to, or operating on, the Rail Corridor, and Trackage and rail facilities that connects to or are adjacent to the Rail Corridor, including (i) the Corridor Dispatcher with respect to the Rail Corridor, (ii) PHL (and its successors and assigns), Owner and the Railroads with respect to the Trackage at the southerly end of the Rail Corridor, (iii) the Railroads with respect to Trackage at the northerly end of the Rail Corridor and at various connection points along the Rail Corridor, and (iii) one or both of the Ports with respect to Trackage owned or operated by the Ports. Further, Contractor at all times shall interface, coordinate and fully cooperate with any other person or entity that from time to time may perform work on the Rail Corridor (including the entities providing train operations, dispatching services and security services with respect to the Rail Corridor, which services, as of the date of this Agreement, are provided jointly by BNSF and UP). In addition to the forgoing, Contractor at all times shall interface, coordinate and fully cooperate with other persons and entities which provide technical support and testing services with respect to the AEI Readers. Nothing in this Section 6.6 shall be construed as creating an obligation or duty by Contractor to permit other entities to utilize Contractor's equipment, materials or supplies.

6.7 Warranty of Services. Contractor warrants to ACTA, POLA, POLB, BNSF and UP on behalf of itself and on behalf of any Subcontractor it employs to perform the Services that (i) all Services performed by Contractor or Subcontractor shall be done in a workmanlike manner, in compliance with all applicable federal, state and local laws, regulations or other valid orders of a governmental agency, and other applicable professional standards and in compliance with the requirements of this Agreement, (ii) all parts, equipment and materials used by Contractor or Subcontractor in provision of the Services shall be equal or better than the specifications set forth in Exhibit 7-Appendix F, and (iii) Contractor shall employ and ensure that Subcontractor employs a sufficient number of skilled, qualified and trained employees to perform the Services.

6.7.1 Contractor shall be responsible for taking any corrective action required to satisfy the foregoing warranties. Within thirty (30) days after Contractor's discovery of, or within thirty (30) days after receiving written notice from any of ACTA, Owner, BNSF or UP of, a breach of the foregoing warranties, Contractor shall at its sole expense remove, repair and/or replace any non-conforming work (including parts and materials used in that work), or shall commence reasonable efforts to affect a cure, and shall bear the cost of repair or replacement of any other portions of the Maintained Facilities or work performed by any other contractor, that is damaged by Contractor's or Subcontractor's non-conforming work. Contractor shall repair any work which does not comply with applicable laws, regulations, orders or professional standards or which has not been done in a workmanlike manner, all at Contractor's sole cost.

6.7.2 Notwithstanding anything to the contrary in this Agreement, Contractor's warranty excludes remedy for manufacturer defects, damage or defect caused by abuse or modifications not executed by Contractor or its Subcontractors, improper or insufficient maintenance not performed by Contractor or its Subcontractors, or normal wear and tear under normal usage.

6.7.3 The only warranties made by Contractor in connection with the work are those set forth in this Section 6.7. Those warranties are exclusive and in lieu of all other warranties, whether statutory, express or implied, including warranties of merchantability, fitness for particular purpose and those arising from course of dealing and usage of trade. ACTA, POLA, POLB, BNSF and UP's sole and exclusive remedy for warranty nonconformities in the work shall be for Contractor to repair or replace the nonconforming work as provided in this Section 6.7.

6.7.4 If Contractor fails to commence reasonable efforts to affect a cure within a reasonable time of Contractor's discovery of, or receipt of written notice of, the alleged breach of the foregoing warranties, and thereafter complete such repair and/or replace any non-conforming work within a reasonable time, to the reasonable satisfaction of ACTA, Owner, BNSF and UP, any of ACTA, Owner, BNSF and/or UP shall have the right, but not the obligation, to correct and/or replace any work or materials that is/are defective or do not comply with the Maintenance Standards; provided, however, that the exercise of such right shall be without prejudice to any other right or remedy such party may have under this Agreement. Contractor shall fully reimburse ACTA, Owner, BNSF and/or UP (as applicable) for any expenses incurred hereunder, including the applicable party's overhead costs (provided, that if such work is done by BNSF and/or UP, overhead costs shall be billed in accordance with such Railroad's customary billing practices).

6.7.5 Notwithstanding any of the foregoing, if the work of Contractor or any of its Subcontractors is not in compliance with this Agreement or creates a hazard to the public health or safety or the safety of the employees or other contractors (and their employees) of ACTA, Owner or either Railroad or to the employees of Contractor or Subcontractor, ACTA may undertake at Contractor's sole expense and without prior notice all Services necessary to correct that hazardous situation.

6.7.6 Contractor shall require any Subcontractor to undertake and guaranty the same obligations to the Contractor and to ACTA, Owner and Railroads as are set forth in this Section 6.7.

6.7.7 Contractor's obligations under this Section 6.7 shall continue for three (3) years after either Contractor's completion of the non-conforming work or the termination of this Agreement, whichever is earlier.

ARTICLE 7
DERAILMENTS

7.1 Clearing of Derailments and Repair of Damage Caused by Derailments. Pursuant to the Operating Agreement, any Railroad whose Train derails shall be responsible for promptly clearing the derailment. If a Railroad's Train derails and the Railroad does not promptly clear the derailment, ACTA has the right to engage one or more contractors to cause the derailment to be cleared.

7.1.1 As between Contractor and the Railroads, to the extent that a derailment was not caused by the act or omission of Contractor, the costs of clearance of such derailment shall be borne solely by the Railroad(s) whose Train(s) derailed. Contractor shall promptly provide to the applicable Railroad(s) or ACTA, as the case may be, all assistance that may be requested to clear any derailment, regardless of the cause thereof. Further, Contractor promptly shall repair any damage to the Maintained Facilities resulting from any derailment. Except as provided in Section 7.1.2, Contractor shall be entitled to reimbursement of Contractor's costs for such work (at the agreed-upon standard rates and unit prices contained in the current Approved Maintenance Plan) incurred in connection with such assistance, and for repair of any damage to the Maintained Facilities resulting from any derailment, from the Railroad(s) whose Train(s) derailed. Contractor shall be responsible for collecting from the affected Railroad(s) such amounts; provided, however, that ACTA shall use commercially reasonable efforts (without any obligation to incur out-of-pocket costs thereby) to assist Contractor in Contractor's efforts to collect such amounts from the affected Railroad(s). In the event that the affected Railroad(s) does not make payment to Contractor within ninety (90) days of Contractor's submission of an invoice, then ACTA may (but is not obligated to) pay such invoice in accordance with the requirements set forth in Section 5.6, subject to reimbursement by the Railroad(s) pursuant to the terms of the Operating Agreement.

7.1.2 Contractor shall be responsible for the cost of any derailment to the extent that it was caused by the act or omission of Contractor or any Subcontractor. In any such case, Contractor shall promptly provide assistance in clearing the derailment and shall repair any resulting damage to the Maintained Facilities, at no cost to ACTA, Owner or the Railroads (but only to the extent of Contractor's responsibility). Any costs incurred by a Railroad in clearing any such derailment shall be calculated by that Railroad and provided to ACTA and Contractor, and Contractor promptly shall pay such amount to such Railroad, but only to the extent of Contractor's responsibility.

7.1.3 Where the extent of Contractor's responsibility for costs relating to a derailment is disputed, Contactor, ACTA and/or the Railroad(s) whose Train(s) derailed, may submit the issue to dispute resolution pursuant to Article 20.

ARTICLE 8
CAPITAL IMPROVEMENTS

8.1 **Capital Improvements**. Contractor shall make the Capital Improvements necessary to ensure that the Maintained Facilities are operated and maintained in compliance with all federal, state and local laws, and each Approved Maintenance Plan shall include a description of Capital Improvements that Contractor proposes to make during the applicable Contract Year. The costs of such Capital Improvements, if approved as part of the Approved Maintenance Plan in accordance with Article 5 hereof, will be paid as provided in Article 5. In addition, Contractor shall make such additional Capital Improvements requested by ACTA from time to time provided the following conditions are satisfied (i) ACTA (with the prior written approval of the Railroads and the Owners) determines that such additional Capital Improvements shall be included in the Scope of Services in accordance with Section 2.4 and Section 8.3 hereof, and (ii) the costs of such additional Capital Improvements shall be paid by either (x) funds allocated under the Approved Maintenance Plan or an amendment to the Approved Maintenance Plan, or (y) funds paid directly by the Railroads to ACTA pursuant to the terms of the Operating Agreement and/or a separate agreement among ACTA, the Railroad(s) and the Owner. Contractor invoices shall be in reasonable detail and shall include such supporting invoices and documentation as ACTA or the Railroad(s) may request. If the Railroad(s) or ACTA, as the case may be, in good faith dispute all or any portion of any such invoice, ACTA shall be obligated to pay only the undisputed portion of such invoice until the dispute has been resolved. Any dispute regarding such an invoice shall be settled by the dispute resolution procedures set forth in Article 20.

8.1.1 Contractor and ACTA acknowledge that the annual Approved Maintenance Plans are intended to provide for a normalized maintenance and replacement schedule over a period of time that will maintain the Maintained Facilities and all components thereof in the condition required by this Agreement. The maintenance program set forth in the Approved Maintenance Plans shall include the periodic replacement of ties, rail, switches and other components of the Maintained Facilities, to the extent required during the Contract Year, with materials of like quality. Contractor and ACTA further acknowledge that notwithstanding consistent performance of the normalized maintenance and replacement program described above, at some point in the future major portions or components of the Maintained Facilities will need to be replaced. During the term of this Agreement, Contractor shall provide to ACTA (with a copy to the Owner and Railroads) information regarding annual replacement of ties, rail, switches and other components of the Maintained Facilities as part of the Approved Maintenance Plan.

8.2 **Ownership of Improvements and Alterations**. All materials, replacements, substitute items and Capital Improvements installed or made by or on behalf of Contractor or any other person on the Maintained Facilities, or on any other property owned or controlled by Owner or ACTA, shall be the property of Owner or ACTA (as the case may be) unless ACTA notifies Contractor otherwise.

8.3 **Capital Improvements by ACTA, Owner or Railroads**. None of ACTA, Owner or Railroads shall have any obligation whatsoever to make any Capital Improvements or other modifications or additions on or to the Maintained Facilities (or otherwise). Subject to the restrictions set forth in Article 14, ACTA, Owner and Railroads each shall be entitled, but shall not be obligated, to make such Capital Improvements and modifications to the Maintained Facilities as ACTA, Owner and Railroads, each in its sole discretion, and consistent with and subject to the terms and conditions of the Operating Agreement, deems necessary or desirable, and ACTA shall be entitled to employ contractors other than Contractor to perform such Capital Improvements or other modifications to the Maintained Facilities.

8.4 **Construction Work by ACTA, Owner or Railroads**. Upon at least 30 days' prior written notice to Contractor, and subject to the terms and conditions hereof, either ACTA, Owner or Railroads may elect to construct modifications, additions or other improvements (including Capital Improvements) to the Maintained Facilities, to the extent consistent with (and subject to) the terms and conditions of the Operating Agreement. In connection with any construction activity, ACTA, Owner or Railroad(s), as the case may be, may schedule at least one construction period of at least eight continuous hours during each day to perform its construction activities on or adjacent to the Maintained Facilities so long as such work will not interfere significantly with train operations on the Rail Corridor. The specific construction periods shall be determined by ACTA, Owner and/or the Railroads (whoever has elected to construct) in consultation with Contractor, with the goal of not significantly interfering with rail operations on the Maintained Facilities. ACTA, Owner and/or Railroads also may conduct construction and related activities at times outside of the designated construction periods, provided, that such activities outside the designated period do not materially interfere with Contractor's ability to perform the Services.

8.5 **Repair of Damage Caused by Force Majeure**. Notwithstanding the other provisions of this Agreement, solely as between ACTA and Contractor, repair of any damage caused in the future by a Force Majeure Event shall be the sole responsibility of ACTA, subject to the provisions of Article 18.

ARTICLE 9
SAFETY AND SECURITY

9.1 **Safety Program**. Contractor shall establish, and Contractor and all Subcontractors shall observe, a safety program for all of its activities on the Maintained Facilities in accordance with prevailing industry standards including an FRA approved On-Track Safety Program, and shall use reasonable care in all of its activities in, on or about the Maintained Facilities. Contractor's safety program shall address, in reasonable detail, all safety and security measures undertaken or otherwise in the planning stages, in order to comply with various safety and security rules and regulations which may apply to the Services from time to time, including without limitation, the Transportation Workers Identification Credentialing program implemented by the Department of Homeland Security, and to the extent applicable to Contractor and/or its Subcontractors. Contractor will provide ACTA with a copy of all Contractor and subcontractor employees' Transportation Worker Identification Credential (TWIC) information. Contractor's safety plan shall be updated annually to reflect the Services to be provided by Contractor during the following Contract Year, with the annual updates to be delivered by Contractor to ACTA with the proposed Annual Maintenance Budget for the following Contract Year, and the original safety program and the annual updates shall be subject to prior review, comment and approval by ACTA, the Owner and the Railroads. Without limiting the generality of the foregoing, Contractor acknowledges and agrees that the emergency drop ladders located in the trench portion of the Rail Corridor shall not be used by Contractor or its employees or contractors for routine ingress or egress to or from the trench (but the foregoing shall not preclude Contractor and its employees and contractors from performing tests, inspections, repairs and maintenance services on and with respect to such emergency drop ladders in accordance with the provisions of this Agreement).

9.2 **Encroachers, Trespassers and Other Third Parties; Hazards**. Contractor shall notify ACTA in writing of any trespassers and other operations and activities on the Maintained Facilities which interfere with Contractor's performance of the Services. Contractor shall not allow or authorize any person or entity other than a Railroad, Contractor (including its contractors and Subcontractors), ACTA or Owner to operate equipment (including locomotives, hi-rail vehicles and track mobiles) on any of the Maintained Facilities. Contractor shall give ACTA prompt written notice of any encroachment onto the Maintained Facilities by adjoining property owners or tenants which interferes with operations on the Maintained Facilities.

9.3 **Security**. Contractor shall be solely responsible for providing any security services or measures it deems necessary or desirable for its property and equipment, but shall have no responsibility for providing any other security services or measures with respect to the Maintained Facilities. Contractor acknowledges that neither ACTA, Owner nor any Railroad shall have any responsibility to provide any security services or measures to protect from theft of or vandalism or damage to any property, equipment or improvements owned or used by Contractor. Any loss due to theft, damage or vandalism of Contractor's property, equipment or improvements shall be borne by Contractor at its sole cost and expense, but only to the extent that such theft, damage or vandalism was not attributable to or did not result from, the negligent acts of ACTA, the Owner, BNSF and/or UP.

ARTICLE 10
COMPLIANCE WITH LAWS, LICENSING, TAXES AND ASSESSMENTS

10.1 **Compliance with Laws**. Contractor shall ensure that Contractor and its Subcontractors comply, at its sole cost and expense, with all applicable federal, state and local laws, rules, ordinances, regulations, permits and orders in effect during the term of this Agreement that relate to or govern Contractor's performance of the Services (including, without limitation, all applicable requirements of the California Labor Code, the California Department of Industrial Relations, the FRA, the California Public Utilities Commission, the Department of Homeland Security and the requirements of the Occupational Safety and Health Act). If any failure on Contractor's part to so comply results in a fine, penalty, cost or charge being imposed or assessed on or against ACTA, POLA, POLB or any Railroad, Contractor and Subcontractor shall promptly reimburse, defend, indemnify and hold such parties harmless with respect to such fine, penalty, cost or charge and all expenses and attorneys' fees incurred in connection therewith, but only to the extent that such fine, penalty, cost or charge was not attributable to or did not result from, the negligent acts or omissions of ACTA, the Owner, BNSF and/or UP.

10.2 **Licenses and Permits**. Contractor shall obtain and maintain in full force and effect, at its sole cost and expense, all governmental licenses (including contractor's licenses required under California law), permits (including building permits), approvals, franchises and other entitlements that are necessary for it to perform the Services under this Agreement. Contractor acknowledges that any approval by or consent of ACTA which may be given pursuant to this Agreement with respect to the subject matter hereof shall not be deemed or construed as eliminating or reducing Contractor's obligation to obtain any licenses, permits, approvals, franchises or entitlements which may be necessary or required from UP, BNSF, POLA and/or POLB, or from departments or agencies of either POLA or POLB.

10.3 **Compliance with Prevailing Wage Requirements**. Services provided under this Agreement are subject to the provisions governing payment of prevailing wages on public works projects found in Labor Code Section 1720 *et seq*. and the requirements of Title 8 of the California Code of Regulations Section 16000 *et seq*., and are subject to compliance and monitoring and enforcement by the State of California Department of Industrial Relations. Pursuant to Labor Code Section 1771, the Contractor and all Subcontractors of any tier must pay not less than the general prevailing rate of per diem wages, and the general prevailing rate of holiday and overtime work in the locality in which the public work is to be performed for each craft, classification or type of workers needed to execute this Agreement.

10.3.1 For the purpose of this Agreement, the wages required to be paid for all Contractor and Subcontractor job classifications shall be no less than the Prevailing Wage Rate for the County of Los Angeles established by the Director of the Department of Industrial Relations in effect on the first advertisement date of the Request for Proposal. Contractor shall post a schedule at the office building at the Maintenance Yard or other appropriate, visible location on the jobsite showing all prevailing wage rates for each craft, classification, or type of worker needed to perform the Services. Copies of prevailing rate of per diem wages are available on the Internet at: www.dir.ca.gov/dlsr/DPreWageDetermination.htm, and are on file at ACTA's office located at 3760 Kilroy Airport Way, Suite 200, Long Beach, California 90806 and shall be made available by ACTA upon request. Contractor and Subcontractors must comply with applicable statutes and regulations, including but not limited to the payroll record keeping requirements of Labor Code Section 1776, and the penalty provisions of Labor Code Sections 1775, 1776, 1777.7, and 1813. All hourly employees will be paid the appropriate rate for the work performed by classification on a daily basis when an employee is performing multiple duties in different job classifications that require a higher rate of pay per that job classification. Contractor must provide monthly employee payroll registers as part of the corresponding monthly invoice to show proof of the appropriate payment to the employee.

10.3.2 Pursuant to Labor Code Section 1774, Subcontractors of any tier must also comply with requirements for payment of prevailing wages. Contractor is responsible for ensuring that all Subcontractors comply with prevailing wage requirements and is responsible for Labor Code violations by Subcontractors of any tier. The agreement executed between Contractor and each Subcontractor must include a copy of the provisions of Labor Code Sections 1771, 1775, 1776, 1777.5, 1813 and 1815, at a minimum.

10.3.3 Pursuant to Labor Code Section 1771.4 and as directed by the Labor Commissioner, Contractor and Subcontractors performing prevailing wage work must furnish electronic Certified Payroll Records (eCPRs) directly to the Labor Commissioner (aka Division of Labor Standards Enforcement). ACTA reserves the right to require Contractor to submit to ACTA each month the Certified Payroll Records of Contractor and its Subcontractors of every tier. Pursuant to Labor Code Section 1776, Contractor must also make payroll records available for inspection by ACTA upon request at all reasonable hours at the principal office of the Contractor. The electronic Certified Payroll Records (eCPRs) are subject to ACTA's periodic audit.

10.3.4 No Contractor or Subcontractor may engage in the performance of Services under the Agreement unless currently registered and qualified to perform public work pursuant to Labor Code Sections 1725.5 and 1771.1.

10.4 <u>Compliance with Apprenticeship Requirements</u>. Contractor and its Subcontractors must comply with employment and training programs established by the Department of Industrial Relations - Division of Apprenticeship Standards, pursuant to Labor Code Sections 1773 and 1773.1. Pursuant to Labor Code Section 1777.5 and Title 8 of California Code of Regulations Section 230, Contractor and Subcontractors of any tier who are not already approved to train by an apprenticeship program sponsor shall, within ten (10) calendar days of signing the Agreement or Subcontract, as applicable, but in any event prior to the first day in which the Contractor or Subcontractor has workers employed at the Maintained Facilities, submit the

Public Works Contract Award Information form (DAS Form 140) to the appropriate local apprenticeship committees whose geographic area of operation include the area where the Services are being provided and who can supply apprentices. Contractors and Subcontractors must also submit a copy of the forms to ACTA upon request.

ARTICLE 11
PERSONNEL AND EQUIPMENT

11.1 **Personnel**. Contractor shall hire, train and supervise, at its sole cost and expense (except as provided in any Approved Maintenance Plan), all persons necessary to perform the Services except to the extent Contractor engages contractors or Subcontractors under Contractor's supervision and for whom Contractor shall be responsible, to perform such duties and obligations. Contractor shall ensure that all persons performing the Services, including all contractors and Subcontractors hired by Contractor, are competent, trained, qualified and, to the extent required by law or by sound business practices in the industry, licensed or certified for the task that they are performing. Contractor's training programs and hiring qualifications shall be subject to prior review, comment and approval by ACTA (which approval shall not be unreasonably withheld or delayed). Any Subcontractor hired by Contractor shall be required to accept joint and several liability with Contractor for any Losses to ACTA, POLA, POLB, BNSF and/or UP to the extent such Losses result from any act or omission of such Subcontractor. Any subcontract shall be subject to the prior review and approval of ACTA.

11.1.1 Without limiting the generality of the foregoing, Contractor shall designate a full-time qualified maintenance contract manager who shall be ACTA's point of contact for the management, operational administration, financial administration and supervision of this Agreement, which manager shall be subject to ACTA's prior approval. If ACTA is dissatisfied with the performance of such manager, and following consultation between Contractor's appropriate corporate officer and ACTA the dissatisfaction is not resolved, Contactor shall remove such manager immediately and name an interim manager, acceptable to ACTA, within a reasonable period. Contractor shall not otherwise transfer or reassign such manager until a replacement approved in writing by ACTA has accepted the position and is available to begin work in that position. Such manager shall attend service meetings with ACTA staff and otherwise, as requested. Further, Contractor shall develop and include in the Approved Maintenance Plan an organizational structure for its workforce. This structure will define the reporting relationships, assignments and job classifications, and shall include a telephone and radio contact list for each person listed. Included will be provisions for after hours and emergency response to problems (which shall include contacts for Contractor's personnel that can be reached 24-hours per day for emergency purposes). ACTA shall have the right to require Contractor to remove and replace any of the workforce personnel assigned by Contractor or any Subcontractor following prior consultation with Contractor's manager and/or other appropriate corporate officers. Contractor shall maintain an updated list of all FRA Part 213.7(a) qualified personnel working under this Agreement.

11.2 **Relationship of ACTA and Contractor**. Notwithstanding anything to the contrary contained herein, this Agreement shall not be deemed or construed to make ACTA, Railroads, POLB or POLA, on one hand, and Contractor, on the other, partners or joint venturers, or to render one liable for any of the debts or obligations of the other unless expressly so provided in this Agreement.

11.3 Relationship of ACTA and Subcontractors. Notwithstanding anything to the contrary contained herein, this Agreement shall not be deemed or construed to make ACTA, Railroads, POLB or POLA, on one hand, and any Subcontractor, on the other, partners or joint venturers, or to render one liable for any of the debts or obligations of the other unless expressly so provided in this Agreement.

11.4 No Employment Relationship Created. Contractor's and Subcontractors' relationship to ACTA, Railroads, POLB or POLA in the performance of the Services is that of an independent contractor, and all of the terms and conditions of this Agreement shall be interpreted in light of that relationship. Contractor and Subcontractors agree and understand that their employees are not the employees of ACTA, Railroads, POLB or POLA, and that this Agreement is not intended to, nor does it, create a joint employment relationship or an employer-employee relationship.

11.4.1 Except as may be otherwise stated in this Agreement, Contractor shall select and shall have full and complete control of and responsibility for all the agents, employees, and Subcontractors (if any) which are employed or used by the Contractor to provide Rail Corridor Services and/or Non-Rail Component Services pursuant to an Approved Maintenance Plan. None of said agents, employees, or Subcontractors shall be, or shall be deemed to be, the agent, employee or subcontractor of ACTA, Railroads, POLB or POLA, for any purpose whatsoever, and ACTA, Railroads, POLB or POLA, shall have no duty, liability or responsibility, of any kind, to or for the acts or omissions of Contractor or its agents, employees or Subcontractors, or any of them.

11.4.2 Contractor agrees that it is exclusively liable for the payment of taxes or contributions for unemployment insurance or old age pensions or annuities or social security payments which are measured by the wages, salaries or other remuneration paid by Contractor to its employees and/or Subcontractors.

11.4.3 Any contract or agreement that Contractor enters into with a Subcontractor must contain language similar to that of this Section 11.4 (and its subsections) designed to ensure that the employees, agents, and independent contractors of Subcontractors are not treated as or found to be employees of ACTA, Owner or the Railroads.

11.5 Contractor Supplied Equipment. Contractor agrees to furnish Services as provided herein using the Contractor's own means and methods. Accordingly, Contractor and each Subcontractor shall provide its own equipment to perform the Services at the agreed-upon standard rates and unit prices contained in the Approved Maintenance Plan. All of Contractor's and each Subcontractor's equipment operating on the Maintained Facilities shall be adequately powered and otherwise in such condition that the efficient use and operation of the Maintained Facilities will not be disrupted. Without limiting the generality of the foregoing, Contractor shall at all times after the Commencement Date obtain and maintain the equipment identified on Exhibit 2 attached hereto for use in connection with performance of the Services. Contractor acknowledges that the list of equipment attached hereto as Exhibit 2 is a minimum requirement based on Contractor's initial estimates. If additional or different equipment is necessary from time to time for Contractor to perform the Services, Contractor promptly shall obtain and place in service such equipment at its sole cost and expense (except to the extent set forth in an Approved Maintenance Plan).

11.6 <u>Labor Protective Conditions</u>. As between ACTA, Owner and the Railroads, on one hand, and Contractor, on the other, Contractor shall be responsible, at no cost to ACTA, Owner or the Railroads, for all labor protective conditions applicable to its employees and any Subcontractor performing the Services or in connection herewith. ACTA, POLA, POLB, UP and BNSF do not accept, succeed to or assume, and this Agreement shall not be construed to impose or allow ACTA's, POLA's, POLB's, UP's or BNSF's acceptance, succession to or assumption of, any obligations of Contractor or any Subcontractor under any of its collective bargaining agreements with its employees or their representatives. Contractor shall use all applicable agreements in place with its employees or their representatives to obtain any and all available cost and other efficiencies in the work force that can be derived from such practices. ACTA shall not be required to reimburse Contractor or any Subcontractor for any cost increases related to work rule changes (in the Contract Year the changes become effective) unless the changes are the result of a change in law and are mandated by said law changes to be paid by ACTA. Contractor's and each Subcontractor's agreements with any bargaining unit shall include a no-strike clause or, in the alternative, a clause that requires the employees covered by such agreement to complete all of the dispute resolution procedures in that agreement and required by applicable law before engaging in any self-help actions. If employees of Contractor or any Subcontractor picket or unlawfully honor a picket line of another union, and such picketing (or unlawful honoring of another picket line) disrupts operations on the Rail Corridor, Contractor shall reimburse ACTA for any and all costs and expenses incurred by ACTA, Owner and Railroad resulting from such service disruptions (including lost fees and other payments which otherwise would have been received by ACTA under the Operating Agreement had operations on the Rail Corridor not been disrupted). ACTA will have no liability or obligation for any additional costs incurred by Contractor or any Subcontractor in performing the Services as a result of picketing activities.

11.7 <u>Maintenance Yard</u>. ACTA may (but shall not be obligated to) provide to Contractor during the term of this Agreement one storage yard located in the southerly portion of the Rail Corridor in the location shown on Page 4 of the Map attached hereto as <u>Exhibit 1</u> (to the extent actually provided by ACTA, the **"Maintenance Yard");** such Maintenance Yard shall be used and operated by Contractor solely for purposes relating to this Agreement and the Rail Corridor, and Contractor shall not use the Maintenance Yard for the purpose of providing services or storage with respect to other customers or properties or for the other business interests of Contractor or its affiliates. With respect to the Maintenance Yard, the parties acknowledge that (a) the area shown on the Map consists of significantly more land than the area which will be made available to Contractor for such Maintenance Yard, and (b) such Maintenance Yard may consist of approximately four acres of land, the specific boundaries of which will be agreed upon by ACTA and Contractor, and an office building, parking lot, and indoor and outdoor storage areas. If ACTA elects to make the Maintenance Yard available to Contractor, ACTA will do so solely as an accommodation to Contractor in connection with this Agreement, and ACTA at all times reserves the right to modify, decrease or change the boundaries of such space or to move the location of the Maintenance Yard at its sole discretion. ACTA may decide not to make the Maintenance Yard available to Contractor for any reason. None of ACTA, POLA, POLB, BNSF or UP make any representation or warranty of any kind regarding the condition of the Maintenance

Yard or the adequacy of the Maintenance Yard (or any property hereinafter designated as a Maintenance Yard) for Contractor's purposes, and Contractor shall accept the Maintenance Yard in its **"AS-IS, WHERE IS"** condition, with all faults. Contractor shall be solely responsible for (i) providing any yards and facilities that Contractor may need in addition to the Maintenance Yard in connection with performing the Services, (ii) all maintenance, repair and replacement of the Maintenance Yard and all improvements and facilities thereon, (iii) payment of all utility costs and other costs and expenses relating to the use, operation, maintenance, repair and replacement of the Maintenance Yard and all improvements and facilities thereon; provided that, ACTA and Contractor shall each share on an equal basis the cost of providing security for the Maintenance Yard and the cost for janitorial services in connection with the cleaning of the office building located at the Maintenance Yard; provided further, that none of ACTA, POLA or POLB intend or are required to provide any such security services or janitorial services (all costs and expenses in this clause (iii) shall be included in the budgets for an Approved Maintenance Plan pursuant to the procedures set forth in Section 5.2 and reimbursed by ACTA in connection therewith, except to the extent such costs or expenses relate to or arise from damage, destruction, acts or omissions caused by Contractor or its employees, agents or Subcontractors), (iv) keeping the Maintenance Yard and all improvements and facilities thereon free of all contamination by Hazardous Substances as described in Section 16.2, (v) compliance with all applicable laws, rules, regulations and ordinances relating to the use, operation, maintenance and repair of the Maintenance Yard and all improvements and facilities thereon, and (vi) returning the Maintenance Yard to ACTA at the expiration or earlier termination of this Agreement in the same condition as existed on the date of this Agreement, reasonable wear and tear excepted, which obligation shall include turning over to ACTA any improvements or facilities constructed by Contractor during the term of this Agreement, or any improvements to any existing improvements or facilities, at no additional charge or cost to ACTA (the obligation in this clause (vi) shall survive the expiration or earlier termination of this Agreement).

11.7.1 If ACTA elects to make the Maintenance Yard available to Contractor, ACTA will have the right to subsequently terminate Contractor's use of the Maintenance Yard by giving at least 120 days prior written notice of such termination to Contractor, which termination shall not limit Contractor's duties and obligations under this Agreement; provided, that concurrently with such termination, ACTA, POLA and/or POLB may provide Contractor with one or more replacement yards in the vicinity of the Rail Corridor which are functionally equivalent to the Maintenance Yard being taken out of service, which replacement yard(s) will be provided at no charge to Contractor and thereafter will be deemed to be a "Maintenance Yard" under this Agreement, and Contractor will be responsible for moving any equipment or materials to the new Maintenance Yard; provided that ACTA shall reimburse Contractor for all of Contractor's reasonable costs, including labor costs, associated with moving any equipment or materials to the new Maintenance Yard.

ARTICLE 12
PROHIBITION AGAINST LIENS;
PAYMENT OF TAXES AND ASSESSMENTS

12.1 Liens. Contractor or Subcontractor shall not cause, allow or permit the filing of any mortgage, deed of trust, judgment lien or any mechanic's, materialman's or other lien, charge or encumbrance against any or all or any portion of any property owned or controlled by ACTA, POLA, POLB, UP and/or BNSF or any improvements thereon provided ACTA first pays Contractor all amounts due for the performance of the work that is the subject of the lien or security interest. However, if such filing does occur, Contractor shall cause the same to be discharged of record within 30 days after the date of filing of the same (or an earlier period if a suit for foreclosure of such lien has been filed or if a mortgagee requires the removal of such lien earlier and notice of such requirement is delivered to Contractor) provided, that Contractor shall be entitled to contest the same as provided by law so long as Contractor exercises such rights in a manner which prevents foreclosure of any such lien, charge or encumbrance.

12.2 Taxes. Contractor shall promptly pay all taxes of any kind or nature, and any governmental or special district assessments, all bonded indebtedness incurred by Contractor, all license fees and other charges, if any, properly levied or assessed against or as a result of this Agreement or Contractor's performances of Services under this Agreement, subject to Contractor's right to contest the same as provided by law, which right shall be exercised by Contractor in a manner which prevents the foreclosure of any lien for such taxes. Should Contractor elect to contest the taxes and assessments payable by Contractor under this Section 12.2, Contractor shall indemnify, defend and hold harmless ACTA, POLA, POLB, UP and BNSF and their respective officers, directors, employees, commissioners, agents, successors and assigns, from any and all matters arising therefrom, including any penalties or late charges relating to such taxes and assessments and all costs and expenses (including reasonable attorneys' fees) arising out of such contest.

ARTICLE 13
REPORTS AND NOTICES

13.1 Delivery of Notices. Contractor promptly shall deliver to ACTA copies of all notices, correspondence and information it receives from any governmental agency, tenant, licensee, shipper, customer, easement holder or Railroad (a) regarding the condition or maintenance of all or any portion of the Maintained Facilities and any other property owned or controlled by ACTA, POLA, POLB, BNSF and/or UP, or (b) alleging violation of any law with respect to the Rail Corridor by Contractor, any Railroad, ACTA, POLA ,or POLB, or (c) alleging violation of or default under any agreement to which ACTA, POLA and/or POLB is a party with respect to the Maintained Facilities. In addition, if Contractor becomes aware of any persistent and continuing unsafe condition on the Maintained Facilities, Contractor shall promptly notify ACTA, the Owner and the Railroads of such unsafe condition.

13.2 Statements. Within forty-five (45) days after the end of each calendar quarter, Contractor shall deliver to ACTA quarterly unaudited statements for the immediately preceding calendar quarter in a form acceptable to ACTA, showing all cost incurred with respect to both the

Rail Corridor and the Non-Rail Components, and separately allocated to each of the Rail Corridor and Non-Rail Components, and if requested by ACTA, showing the location of all such cost incurred, and such other information as ACTA may reasonably request. Within 90 days after the end of each Contract Year, Contractor shall deliver to ACTA an annual report of cost incurred with respect to both the Rail Corridor and the Non-Rail Components, in a form acceptable to ACTA. Such unaudited statements and annual reports shall characterize each itemized cost incurred as either a Rail Corridor cost incurred or a Non-Rail Component cost incurred or an allocated cost and shall detail the allocation methodology. ACTA shall have the right to audit such statements and reports in accordance with Section 13.3.

13.3 Audit Rights. At any time during the term of this Agreement and for a period of not less than three (3) calendar years after the termination of this Agreement, ACTA has the right to inspect and audit Contractor's statements, books and records with respect to Contractor's performance of Services under this Agreement. Contractor agrees to accept the results of ACTA's audit(s), including, but not limited to, when questioned or disputed costs are extrapolated or applied to the entire population or Contract Year, and to pay or reimburse ACTA for any amounts due under this Agreement pursuant to such audit results. ACTA shall have the right to audit rates billed to ACTA as compared to rates paid to the Contractor's employee and whether or not the correct rate was applied in such instance, and/or the correct number of hours were applied to such rate, and whether wages meet or exceed the minimum prevailing wage rate requirement. ACTA has the right to enter, or cause its agent to enter, Contractor's or Subcontractor's place of business (or such other facilities where such books or records are stored pursuant to Section 13.6) during normal business hours to perform such inspection and audit; provided, that ACTA shall give Contractor and Subcontractor reasonable prior notice of its desire to inspect such books and records at Contractor's or Subcontractor's place of business (or such other facilities where such books or records are stored). Contractor shall also cause similar audit provisions to be a part of any subcontract agreement into which Contractor shall enter into in connection with this Agreement.

13.4 Inspection Reports. Contractor shall perform and document all inspections of the Maintained Facilities required under applicable federal, state and local laws and shall submit to the appropriate governmental entities all reports required to be submitted under applicable federal, state and local laws and shall deliver copies of such reports to ACTA. In addition, Contractor shall prepare and submit to ACTA all other data and reports relating to the Services as needed to satisfy requirements for submission of information or reports to any federal, state or local governmental agencies.

13.5 Other Reports and Information. Contractor and Subcontractor shall make available to ACTA, the Owner and the Railroads any reports prepared by or on behalf of Contractor regarding the condition or status of the Maintained Facilities or any portion thereof, and shall prepare and deliver to ACTA any other reports and information relating to the Services as may be reasonably requested by ACTA such as a monthly Incident Report. Contractor and Subcontractor shall retain all such information during the term of this Agreement and for a period of not less than three (3) calendar years after the termination of this Agreement.

13.6 Records Retention; Review. Contractor and Subcontractor, as the case maybe, shall maintain at its office in Los Angeles County, California, full and complete records of all of its activities pursuant to this Agreement, including all permits, licenses, inspection reports, governmental or regulatory notices or approvals, maintenance logs, inspection reports and records and reports of any accidents or injuries on the Maintained Facilities. ACTA, the Owner or the Railroads may at any time during normal business hours and upon reasonable prior written notice review and/or copy (at the expense of the person reviewing and copying the records) any or all of such records and information, which review may be performed by the employees of ACTA, the Owner or the Railroads or by any agent thereof. Such records shall be maintained by Contractor and Subcontractor for a period of not less than three (3) calendar years after the termination of this Agreement.

13.7 Public Records Act. All records, documents, drawings, plans, specifications and other material relating to the Maintained Facilities and the conduct of ACTA's business, including materials submitted by Contractor in its proposal and during the course of performing the Services under this Agreement, shall become the exclusive property of ACTA, and may be deemed public records to the extent required under the California Public Records Act. Said materials may be subject to the provisions of the California Public Records Act. ACTA's use and disclosure of its records are governed by this Act. ACTA will not advise as to the nature or content of documents entitled to protection from disclosure under the California Public Records Act, including interpretations of the Act or the definitions of trade secret, confidential or proprietary. Should ACTA receive materials that are clearly and prominently labeled "trade secret," "work product," "attorney-client privilege," "confidential," "proprietary" or "privileged," ACTA will notify, in writing, Contractor of any request for the disclosure of such materials. Under no circumstances, however, will ACTA be liable or responsible for the disclosure of any labeled materials whether the disclosure is required by law or a court order or occurs through inadvertence, mistake or negligence on the part of ACTA or its officers, employees, agents and/or contractors. In the event of litigation concerning the disclosure of any material submitted by Contractor, ACTA's sole involvement will be as a stake holder, retaining the material until otherwise ordered by a court. Contractor, at its sole expense and risk, shall be responsible for prosecuting or defending any action concerning the materials, and shall defend, indemnify and hold ACTA harmless from all costs and expenses, including reasonable attorneys' fees, in connection with such action.

13.8 Confidentiality.

13.8.1 For and during the entire term of this Agreement, Contractor shall consider and keep any information, data, figures, records, findings and the like received or generated by Contractor in the performance of the Services as private and privileged records and shall not divulge such matters to any person, firm, corporation or other entity except as provided in this Agreement or otherwise on the direct written authorization of ACTA or as required by law or a court order. Further, upon expiration or termination of this Agreement for any reason, Contractor shall continue to treat as private and privileged any information, data, figures, records and the like, and will not release any such information to any person, firm, corporation or other entity, either by statement, deposition, or as a witness, except upon direct written authority of ACTA or as required by law or a court order.

13.8.2 Contractor shall ensure that all published information regarding this Agreement and the Services is factual and that it does not in any way imply that ACTA, POLA, POLB, BNSF, and/or UP endorses Contractor's firm, service, and/or product except to the extent that ACTA, POLA, POLB, BNSF and/or UP gives written permission for Contractor to publish such an endorsement.

13.8.3 Contractor shall refer all inquiries from the news media to ACTA, and shall comply with ACTA's directions regarding statements to the media relating to this Agreement or the Services. However, if any news inquiries address, directly or indirectly, any action or inaction of Contractor, Contractor may issue such statements as it deems necessary or appropriate.

13.9 **Ownership of Reports and Documents**. The originals of all letters, documents, reports and other products and data produced under or in connection with this Agreement shall be delivered to, and become the property of ACTA. Copies may be made for Contractor's records, but shall not be furnished to others without written authorization from ACTA.

ARTICLE 14
OPERATING AGREEMENT

14.1 **Role of Owner and Railroads**. Contractor and ACTA acknowledge that pursuant to the Operating Agreement, the Owner and Railroads are required to establish and modify Maintenance Standards with respect to the Rail Corridor and have the right to review and approve or disapprove proposed maintenance plans, budgets, and Capital Expenses with respect to the Rail Corridor, all on the terms and conditions specified in the Operating Agreement. As provided under the Operating Agreement, ACTA acts on behalf of, and at the direction of, the Owner and Railroads with respect to this Agreement and the subject matter hereof. Accordingly, Contractor shall be required to deal only with ACTA as the contracting party under this Agreement and with respect to the Services. Contractor shall be entitled to conclusively rely upon any notice, consent or approval given by ACTA to Contractor pursuant to this Agreement, notwithstanding any conflicting notice Contractor may receive from the Owner or the Railroads.

14.2 **No Modification of Operating Agreement**. Notwithstanding anything to the contrary in this Agreement, this Agreement is not intended to, and shall not be deemed or interpreted to, amend, modify, limit or supersede in any way the respective rights, duties, obligations and liabilities of ACTA, POLA, POLB, UP and/or BNSF under the Operating Agreement, and as between and among such parties, the Operating Agreement shall continue to govern and control the respective rights, duties, obligations and liabilities of such parties.

14.3 **Authorized ACTA Representatives**. For the purpose of any approval, consent, authorization or other action required by ACTA under this Agreement, unless ACTA provides written notice to the Contractor otherwise, ACTA's Chief Executive Officer or his or her designee shall be deemed to be an authorized representative of ACTA hereunder and shall be authorized to perform all such actions on behalf of ACTA under this Agreement.

ARTICLE 15
DEFAULT AND REMEDIES

15.1 Defaults.

15.1.1 Contractor Defaults. Any of the following events shall be deemed a default by Contractor hereunder:

(a) Failure by Contractor to pay any undisputed amounts or charges required to be paid by it under this Agreement within thirty (30) days after receipt of written notice by Contractor that the same was not paid when due;

(b) Failure to maintain insurance as required hereunder, which failure continues for five (5) business days after Contractor's receipt of written notice by ACTA;

(c) Failure to perform any other non-monetary obligation of Contractor or Subcontractor hereunder within thirty (30) days of receipt of written notice by ACTA; provided, that if Contractor or Subcontractor commences to cure such failure but such failure cannot be cured within such 30 day period despite diligent pursuit of such cure, Contractor shall be entitled an extension of the period of time necessary to cure such default if Contractor continues to diligently pursue such cure and shall not be deemed in default;

(d) Commencement of an insolvency, bankruptcy or other similar proceeding by or against Contractor which proceeding is not dismissed within 90 days after commencement thereof;

(e) The making of a general assignment for the benefit of creditors of Contractor; and

(f) Violation by Contractor or Subcontractor of any collective bargaining or other labor agreement to which Contractor or Subcontractor is a party, which violation gives rise to a legal work stoppage, strike or other form of labor slowdown that disrupts rail operations on the Rail Corridor.

15.2 Remedies. The remedies provided for herein shall be cumulative.

15.2.1 Damages. In the event of a default by the Contractor under this Agreement which is not cured within the applicable cure period, if any, provided for herein, ACTA shall have all remedies available at law or in equity against the Contractor except as provided in Section 15.2.2.

15.2.2 Waiver of Consequential Damages. Subject to the exclusions set forth below, neither ACTA nor Contractor shall make a claim, and each party hereby agrees to waive such claim, against the other for consequential damages arising out of or related to this Agreement, regardless of whether the basis for such claim is breach of contract or tort. The term consequential damages shall mean those special, indirect or incidental damages which flow from an action or failure to act, and includes loss of use, income, and profit (**"Consequential Damages"**). This waiver shall not apply to any claim made under any of the following circumstances:

(a) A claim for fraud, intentional misconduct or criminal acts;

(b) A claim for indemnification under Article 16, including any third-party claim subject to indemnity where Consequential Damages are claimed; and

(c) A claim for Consequential Damages to the extent it is covered by the insurance required under Article 17.

15.2.3 Right to Cure. In the event of a default by Contractor under this Agreement which is not cured within the applicable cure period provided for herein, ACTA shall have the right, but not the obligation, to cure the default hereunder. All sums expended by ACTA in exercising its rights under the preceding sentence, including reasonable attorneys' fees, shall be repaid by Contractor upon demand therefor.

15.2.4 Termination for Default. In the event of a default under this Agreement by Contractor which is not cured within the applicable cure period provided for herein, ACTA will have the right to terminate this Agreement by delivery of written notice to Contractor, Owner and the Railroads at least fifteen (15) days prior to declaring Contractor terminated.

15.3 Termination for Convenience. At any time during the term of this Agreement, ACTA shall have the right to terminate this Agreement for convenience and without any liability therefor, by providing written notice to Contractor at least ninety (90) days prior to the termination date set forth in such notice. In such event, as between ACTA and Contractor, ACTA shall be responsible for obtaining any governmental approvals or exemptions that may be necessary in connection with any such termination of Service. In the event that Contractor is terminated pursuant to this Section 15.3, Contractor shall submit a proposed termination statement to ACTA (no later than ten (10) days' following the termination date) which shall include (1) all amounts owed to Contractor or any Subcontractor for Services performed through the termination date; (2) termination payments, if any, contractually owed by Contractor to Subcontractors and/or vendors as a direct result of the termination of such Services; provided, however, that (i) ACTA previously authorized and directed Contractor to perform all such Services, and (ii) such termination payments, if any, are a reasonable approximation of the damages incurred by Subcontractors and/or vendors as a direct result of the termination of such Services; and (3) reasonable costs incurred by Contractor to comply with ACTA's written directions in connection with the termination, including demobilization costs, if any. In no event shall ACTA be obligated to pay for lost profits or other consequential damages resulting from any such termination. ACTA shall pay such termination statement in accordance with and subject to the provisions of Section 5.6.

15.4 Transfer of Rights Upon Termination. In the event that ACTA elects to terminate this Agreement pursuant to Section 15.2.4 or Section 15.3, ACTA, in its sole discretion, shall have the right to require the transfer of all of Contractor's rights hereunder (other than the right to receive payments on account of periods prior to the assignment), on terms and conditions acceptable to ACTA, to a replacement maintenance contractor (or contractors) designated by ACTA, and ACTA shall so notify the Contractor who such replacement maintenance contractors shall be. Upon such transfer Contractor shall (a) assign all of its right, title and interest in and to this Agreement to such replacement maintenance contractor(s) upon the request of ACTA; provided, however, that such assignment shall provide that Contractor be fully released from all obligations (except for obligations of indemnity pertaining to Services performed prior to the termination) under this Agreement that arise after the date of such assignment; (b) immediately cease all activities on the Maintained Facilities; (c) turn over to ACTA all material and inventory then held by Contractor with respect to the Rail Corridor and previously paid for by ACTA (with the understanding and agreement that, at a minimum, Contractor shall be obligated to turn over to ACTA all material and inventory delivered to Contractor at the commencement of the term of this Agreement, or to otherwise account for the use of such material and inventory in connection with Contractor's performance of the Services); and (d) remove, within 30 days after the termination of this Agreement, all equipment owned by Contractor from the Maintained Facilities.

ARTICLE 16
INDEMNIFICATION AND LIABILITY

16.1 General Indemnity. To the maximum extent permitted by applicable law, Contractor shall indemnify, defend (with counsel reasonably acceptable to the Indemnified Entities (as hereinafter defined)) and save harmless ACTA, POLA, POLB, and each of UP, BNSF and PHL, and each of them, and their respective officers, directors, employees, commissioners, agents, successors and assigns (individually "**Indemnified Entity"** and collectively, the **"Indemnified Entities"**, but excluding from such persons Contractor and the respective agents, contractors and Subcontractors of Contractor), from and against any Losses to the extent that they result from any act or omission of Contractor or its affiliates or subsidiaries, or their respective employees, agents, representatives, contractors, Subcontractors, invitees or licensees, during the term hereof, including Losses for (a) personal injury to or death of any person or damage to property, including the property of any other person or entity, which may result from the Services or equipment of Contractor or its affiliates or subsidiaries, or their respective employees, agents, representatives, contractors, Subcontractors or invitees, (b) a breach of the terms of this Agreement or of any law, ordinance or regulation, or a failure by Contractor to obtain or maintain in effect any license, permit, approval, franchise or other governmental approval required by law, or (c) the activities during the term hereof of Contractor or its affiliates or subsidiaries, or their respective employees, agents, representatives, contractors, Subcontractors, invitees or equipment, on or around the Maintained Facilities or elsewhere. Notwithstanding anything in this Agreement to the contrary, Contractor shall have no obligation to defend and indemnify the Indemnified Entities for their sole negligence. The indemnification provided under this Section 16.1 shall not be limited by the waiver of Consequential Damages set forth in Section 15.2.2. Nothing in this Article 16 shall relieve ACTA or Contractor of any liability for breach of this Agreement. Further, nothing in this Article 16 shall be construed to relieve any insurer of its obligation to pay claims consistent with the provisions of a valid insurance policy.

16.2 Environmental Provisions and Indemnity.

16.2.1 Contractor shall not release, nor shall its affiliates or subsidiaries, or its or their respective agents, employees, representatives, contractors or Subcontractors, invitees or licensees release, any Hazardous Substances in, on or under the Maintained Facilities or on any other property and shall comply, at no cost to ACTA, Owner or the Railroads, with all Environmental Laws in connection with performance of its duties and obligations hereunder and its operations on the Maintained Facilities, and shall cause its affiliates and subsidiaries, and its and their respective agents, employees, representatives, contractors or Subcontractors, invitees or licensees, to comply with all Environmental Laws. Contractor shall not, however, be in breach of this provision if the release is of a de minimis quantity of the Hazardous Substance in question, provided, that Contractor removes within a reasonable time the Hazardous Substances and repairs any damage caused by the release or its removal that was released. To the maximum extent permitted by law, Contractor shall indemnify, defend (with counsel reasonably acceptable to the Indemnified Entities) and hold harmless the Indemnified Entities from and against any Environmental Losses arising out of a breach of any obligation under this Section 16.2.1 except to the extent such Environmental Losses result directly from the sole negligence of the Indemnified Entities.

16.2.2 Contractor shall promptly send copies to ACTA of any material notice, information or request for information it receives from any governmental authority or third party with respect to Hazardous Substances on, in or under the Maintained Facilities. For purposes of this Section 16.2.2, a notice shall be deemed material if it concerns an actual or alleged violation of any Environmental Law.

16.3 ACTA's Indemnity for Certain Environmental Contamination. Solely as between ACTA and Contractor, ACTA shall indemnify, defend and hold harmless Contractor and its officers, directors, shareholders, employees, agents, successors and assigns, from and against any and all Environmental Losses resulting from either (a) the presence of Hazardous Substances in, on or under the Maintained Facilities prior to the Commencement Date, or (b) the migration of Hazardous Substances onto or under the Maintained Facilities after the Commencement Date and before termination hereof (excluding matters covered by Contractor's indemnification in Section 16.2.1), except to the extent any such Environmental Losses result from the negligence or willful misconduct of Contractor or Contractor's affiliates or subsidiaries, or their respective agents, employees, contractors or Subcontractors, representatives or invitees. Nothing in this Section 16.3 shall be deemed to supersede, limit, alter or modify in any way any existing agreements between or among ACTA, POLA, POLB, UP and/or BNSF with respect to the matters described in this Section 16.3.

16.4 Demand Process; Notifications.

16.4.1 Demand. If any claim, action, proceeding, investigation or demand is brought or threatened against any Indemnified Entity entitled to indemnification hereunder (an **"Indemnitee"**), by reason of any matter requiring indemnification (an **"Indemnified Matter"**), Indemnitee shall give written notice thereof to the person required to make such indemnification (an **"Indemnitor"**) which notice shall contain a reasonably detailed description of the event, occurrence or condition giving rise to the claim for indemnity and shall enclose a true copy of any and all documents served upon or received by Indemnitee.

16.4.2 Payment. If Indemnitee suffers or incurs any Losses arising from or in connection with any Indemnified Matter, Indemnitor shall pay Indemnitee the total of such Losses suffered and incurred by Indemnitee within 90 days following demand therefor and delivery of an account of Losses suffered by Indemnitee and thereafter as such Losses are incurred and reported to Indemnitor by Indemnitee.

16.4.3 **Defense**. Indemnitor shall at its own cost, expense, and risk: (a) defend the Indemnified Entities in all suits, actions, or other legal or administrative proceedings that may be brought or instituted against an Indemnitee on account of any Indemnified Matter with counsel selected by Indemnitor and reasonably acceptable to each Indemnitee; (b) pay and/or satisfy any judgment or decree that may be recorded against an Indemnitee in any such suit, action, or other legal or administrative proceedings; and (c) reimburse each Indemnitee for all Losses incurred by each Indemnitee relating to or in connection with any such suit, action, or other legal or administrative proceedings.

16.4.4 **Settlement**. Notwithstanding anything in this Agreement to the contrary, Indemnitor shall not, without the prior written consent of every Indemnitee (which consent shall not be unreasonably withheld, conditioned or delayed), settle or compromise any action, suit, proceeding, or claim relating, directly or indirectly, to any Indemnified Matter where such settlement or compromise includes a payment in excess of Fifty Thousand Dollars ($50,000) on behalf of an Indemnified Entity, or consent to the entry of any judgment therein against an Indemnified Entity in excess of Fifty Thousand Dollars ($50,000). Nothing in this Section 1.9.4.5 prohibits or limits an Indemnitor's right to settle or compromise, or consent to entry of judgment in, any action, suit, proceeding or claim against said Indemnitor.

16.4.5 **Joinder**. Without limiting the rights of any Indemnitee pursuant to this Section 16.4, any Indemnified Entity shall have the right to join and participate in, as a party if it so elects, any suits, actions, or other legal or administrative proceedings that may be brought or instituted against an Indemnified Entity on account of any Indemnified Matter. In any such case, an Indemnified Party may, at its own cost and expense, employ its own legal counsel and consultants to prosecute, negotiate, or defend any claim, action, or cause of action, provided, that such an Indemnified Party shall not, without the prior written consent of the Indemnitor (which consent shall not be unreasonably withheld, conditioned or delayed), settle or compromise any action, suit, proceeding, or claim relating, directly or indirectly, to any Indemnified Matter or consent to the entry of any judgment therein in excess of Fifty Thousand Dollars ($50,000).

16.5 **Releases**.

16.5.1 To the maximum extent permitted by applicable law, Contractor hereby expressly releases, remises and discharges forever each of the Indemnified Entities from any and all liabilities, losses, actions, penalties, demands, detriments, claims, damages, costs or judgments which may have been or in the future may be incurred or suffered by Contractor or its property caused or otherwise resulting from the condition or state of repair of, or any defects in, the Maintained Facilities, except (i) as provided in Section 16.3 (with respect to indemnity for Environmental Losses), and (ii) to the extent that such liabilities, losses, actions, penalties, demands, detriments, claims, damages, costs or judgments result directly from the sole negligence or willful misconduct of an employee, agent, contractor, representative or invitee of an Indemnified Entity after the date hereof.

16.5.2 Contractor, after having read and been advised by legal counsel regarding the provisions of California Civil Code Section 1542 and in any and all similar statutes, rules and regulations and any other statute of the United States, hereby agrees, represents and warrants that the matters released in this Section 16.5 are not limited to the matters which are known or disclosed. California Civil Code Section 1542 reads as follows:

> **A GENERAL RELEASE DOES NOT EXTEND TO CLAIMS WHICH THE CREDITOR DOES NOT KNOW OR SUSPECT TO EXIST IN HIS OR HER FAVOR AT THE TIME OF EXECUTING A RELEASE WHICH, IF KNOWN BY HIM OR HER MUST HAVE MATERIALLY AFFECTED HIS OR HER SETTLEMENT WITH THE DEBTOR**.

16.5.3 Contractor hereby agrees, represents and warrants that it realizes and acknowledges that factual matters now unknown to it may have given or may hereafter give rise to causes of action, claims, demands, controversies, damages, costs, losses and expenses which are presently unknown, unanticipated and unsuspected, and further agrees, represents and warrants that the releases contained in this Section 16.5 have been negotiated and agreed upon in light of that realization and that it nevertheless hereby intends to release and discharge ACTA and the other Indemnified Entities from any such causes of action, claims, demands, controversies, damages, costs, losses and expenses.

Contractor: _____

16.6 Interpretation.

16.6.1 Each of the parties hereto hereby agrees that this Agreement is not intended to be, and none shall construe it as, a contract or agreement covered by the provisions of California Civil Code Section 2784.5 (which Section concerns certain hauling, trucking or cartage contracts or agreements).

16.6.2 Contractor hereby agrees that neither Contractor nor any Subcontractor is, and is not intended to be, the agent, servant or independent contractor (as such terms are used in California Civil Code Section 2782) of ACTA, POLA, POLB, BNSF and/or UP. In addition, Contractor agrees that neither it nor any of its agents or representatives shall claim or assert that the negligence or willful misconduct of Contractor, any Subcontractor, any Railroad or PHL is or should be imputed to ACTA, POLA and/or POLB under any agency or other legal theory, or that the negligence or willful misconduct of Contractor, Subcontractor, ACTA, POLA or POLB is or should be imputed to BNSF, UP and/or PHL under any agency or other legal theory.

16.6.3 Each of the parties hereby waives, to the extent permitted by applicable law, the provisions of California Civil Code Section 2782 (which Section places limitations on indemnifications in certain construction contracts).

ACTA: _____ **Contractor: _____**

16.7 References to POLA, POLB and ACTA. For purposes of the indemnification and liability provisions of Sections 16.1, 16.2, 16.4, 16.5, 16.6, and 16.8, "POLA" shall include the

City of Los Angeles, the Port of Los Angeles and its Board of Harbor Commissioners, "POLB" shall include the City of Long Beach, the Port of Long Beach and its Board of Harbor Commissioners, "ACTA" shall include the ACTA Board of Directors, and the indemnification in favor of each party to this Agreement shall include its respective officers, directors and employees.

16.8 **Survival**. The provisions of this Article 16 shall survive the expiration or earlier termination of this Agreement.

ARTICLE 17
INSURANCE

17.1 **Required Insurance**. Prior to commencement of any work under this Agreement, Contractor shall, at its sole cost and expense, purchase and maintain not less than the minimum insurance coverage and limits with the endorsements and deductibles indicated in this Agreement. Such insurance coverage shall be maintained with insurers having a current A.M. Best rating of not less than A-:VII and as described in this Agreement.

17.1.1 Commercial general liability insurance using, or providing coverage at least as broad as, Insurance Services Office (ISO) endorsement form CG 00 01. Limits are subject to review, but in no event less than One Hundred Million Dollars ($100,000,000) per occurrence and general aggregate. Exact structure and layering of the coverage shall be left to the discretion of Contractor, however, any excess or umbrella policies used to meet limits shall be at least as broad as the underlying coverages and shall otherwise "follow form." The following provisions shall apply:

(a) Coverage shall provide defense costs payable in addition to policy limits.

(b) Coverage shall contain no contractors' limitation endorsement limiting the scope of coverage for liability arising from pollution, explosion, collapse or underground property damage nor shall the policy or any applicable endorsements contain any exclusions or limitations of liability under the Federal Employers Liability Act.

(c) Coverage shall include contractually assumed liability for indemnification of a railroad using ISO endorsement form CG 24 17, "Contractual Liability - Railroads" or the equivalent.

17.1.2 Contractor's Pollution Legal Liability Insurance policy (or equivalent) with coverage limits not less than Five Million Dollars ($5,000,000) each claim in connection with the Services performed under this Agreement. All activities contemplated in this Agreement shall be specifically scheduled on the policy as "covered operations." Such policy shall cover, at a minimum, liability for bodily injury, damage to and loss of use of property, and clean-up costs arising from sudden, accidental and gradual pollution and remediation in connection with the Services under this Agreement. The following provisions shall apply:

(a) The policy shall provide coverage for the hauling of waste from the project site to the final disposal location, including non-owned disposal sites.

(b) Coverage shall be included on behalf of the insured for covered claims arising out of the actions of independent contractors.

(c) If the insured is using Subcontractors, the policy must include work performed "by or on behalf" of the insured.

(d) The policy shall contain no language that would invalidate or remove the insurer's duty to defend or indemnify for claims or suits expressly excluded from coverage. The policy shall specifically provide for a duty to defend on the part of the insurer.

(e) Coverage shall include pollution losses as a result of derailment arising or occurring as a result of Contractor's and/or its Subcontractors' failure to adequately maintain the Maintained Facilities or any other acts or omissions of Contractor or its Subcontractor(s).

17.1.3 Business automobile liability insurance providing a minimum limit of not less than Five Million Dollars ($5,000,000) each accident, using, or providing coverage at least as broad as, ISO endorsement form CA 00 01. Liability coverage shall apply to all owned, non-owned and hired autos. In the event that the work being performed involves transporting Hazardous Substances, Contractor and/or its Subcontractors shall provide coverage with a limit of Five Million Dollars ($5,000,000) per accident covering transportation of such materials by the addition to the Business Auto Coverage policy of ISO endorsement form CA 99 48, which amends the pollution exclusion to cover pollutants that are in or upon, being transported or towed by, being loaded onto, or being unloaded from a covered auto. The policy also shall include endorsement form MCS-90. Coverage shall also include contractually assumed liability for indemnification of a railroad using ISO endorsement form CA 20 70, "Contractual Liability - Railroads" or the equivalent.

17.1.4 Workers' compensation insurance as required by statute and employer's liability with limits of at least One Million Dollars ($1,000,000) policy limit Bodily Injury by disease, One Million Dollars ($1,000,000) each accident/Bodily Injury and One Million Dollars ($1,000,000) each employee Bodily Injury by disease. The policy shall include an "alternate employer" endorsement. The indemnification and hold harmless obligations of Contractor under this Agreement shall not be limited in any way by any limitation on the amount or type of damage, compensation or benefit payable by or for Contractor or any Subcontractor under Worker's Compensation Acts, Disability Benefits Acts or other employee benefits acts. If and to the extent Contractor or Subcontractor is subject to the Federal Employers Liability Act, Contractor shall provide coverage through a stand-alone policy or by an endorsement to Contractor's workers compensation policy using National Council on Compensation Insurance endorsement number WC 00 01 04 or the equivalent. Limits shall be no less than Five Million Dollars ($5,000,000) per accident or disease or coverage may be scheduled under any umbrella or excess liability policy used to satisfy the limits requirements in Section 17.1.1 above.

17.2 Additional Insureds. ACTA, POLA, POLB, BNSF and UP, and their commissions or boards, officers, employees and agents, shall be added to Contractor's commercial general liability and pollution liability policies as additional insureds in respect to liability arising out of Contractor's or Subcontractor's work under this Agreement. For the commercial general liability insurance policy, the required form is Insurance Services Office (ISO) endorsement form

CG 20 10 and form CG 20 37 or their respective equivalent with an edition date prior to 2004 or form otherwise acceptable to ACTA.

17.3 Insurance to be Primary. Each insurance policy provided by Contractor in compliance with these requirements shall contain wording or be endorsed to contain wording making it primary insurance as respects to, and not requiring contribution from, any other insurance the Indemnified Entities or additional insureds may possess, including any self-insurance or self-insured retention they may have. Any other insurance the Indemnified Entities or additional insureds may possess shall be considered excess insurance only and shall not be called upon to contribute with Contractor's insurance.

17.4 Separation of Insureds. Coverage under all liability policies shall apply separately to each insured against whom claim is made or suit is brought except with respect to the limits of liability. There shall be no cross liability exclusion precluding coverage for claims or suits by one insured against another. Any failure by Contractor to comply with reporting or other provisions of the policies of insurance required hereunder, including breaches of warranties, shall not affect coverage to the Indemnified Entities or additional insureds.

17.5 Cancellation or Termination of Insurance. Policies shall be endorsed to reflect that no cancellation or material modification of the coverage provided shall be effective until written notice has been given to ACTA at least thirty (30) days prior to the effective date of such modification or cancellation. In the event of non-renewal, written notice shall be given at least thirty (30) days prior to the effective date of non-renewal.

17.6 Verification and Maintenance of Coverage. Proof of compliance consisting of ISO endorsement form CG 20 10 and form CG 20 37 and any other endorsements as may be required by this Agreement and ACORD form 25 certificate of insurance (or equivalent) evidencing all required coverage shall be delivered to ACTA at or prior to execution of this Agreement. Upon ACTA's request, Contractor shall submit to ACTA copies of the actual insurance policies or renewals or replacements.

17.7 Failure to Maintain Insurance. A failure by Contractor to maintain the insurance required by this Article 17 shall be a default under this Agreement except as provided in Section 15.1.1, but shall not relieve Contractor of any of its liabilities or obligations under this Agreement. Furthermore, should Contractor fail to maintain the insurance required by this Article 17, in addition to any of ACTA's other remedies under this Agreement, at law or in equity, ACTA, at its sole option, may purchase any or all of the insurance required by this Article 17 and Contractor, immediately upon demand therefor, shall reimburse ACTA for the full cost of such insurance.

17.8 Changes to Coverage Requirements. ACTA reserves the right at any time during the term of this Agreement to change the amounts and types of insurance required by giving the Contractor sixty (60) days advance written notice of such change. If such change results in additional cost to the Contractor, ACTA will negotiate additional compensation proportional to the increased benefit to ACTA. Any type of insurance or any increase of limits of liability not described in this Agreement which Contractor requires for its own protection or on account of statute shall be its own responsibility and at its own expense.

17.9 Requirements not Limiting. Requirements of specific insurance coverage features described in this Article 17 shall not be construed to be a limitation of the liability on the part of Contractor or any of its Subcontractors, nor to relieve any of them of any liability or responsibility under this Agreement, as a matter of law or otherwise. Such requirements are not intended by any party to be limited to providing coverage for the vicarious liability of ACTA or of the Owner or the Railroads or to their supervisory role, if any. All insurance coverage provided pursuant to this Agreement in any way relating to ACTA, the Owners or the Railroads is intended to apply to the full extent of the policies involved.

17.10 Waiver of Right of Recovery. No liability insurance coverage provided pursuant to this Agreement shall prohibit Contractor, or Contractor's employees or agents, from waiving the right of recovery prior to a loss. Contractor hereby waives any right of recovery against the Indemnitees and agrees to require any Subcontractor to do so as well, and Contractor also shall obtain from its insurers a waiver of any right of recovery against the Indemnitees.

17.11 Agreement Deemed To Commence. For purposes of applying insurance coverage only, this Agreement will be deemed to commence when it is executed by both parties and any activity commences in furtherance of performance under this Agreement.

17.12 No Waiver by ACTA. Contractor acknowledges and agrees that any actual or alleged failure on the part of ACTA, the Owner or the Railroads to inform Contractor of non-compliance with any insurance requirement in no way imposes any additional obligations on ACTA, the Owner or the Railroads nor does it waive any rights hereunder in this or any other regard.

17.13 Priority of Interpretation. The insurance requirements in this Article 17 supersede all other articles and provisions of this Agreement to the extent that any other section or provision conflicts with or impairs the provisions of this Article 17. The insurance requirements set forth in this Article 17 are intended to be separate and distinct from any other provision in this Agreement and are intended to be interpreted as such.

17.14 Undisclosed Coverage Restrictions. None of the coverages required herein will be in compliance with these requirements if they include any coverage-limiting endorsement of any kind that has not been first submitted to and approved in writing by ACTA.

17.15 Self-Insurance Requires Approval; Retentions. Self-insurance will not be considered to comply with these requirements. Any self-insurance retention greater than Fifty Thousand Dollars ($50,000) (or, with respect to the Pollution Legal Liability Insurance Policy described in Section 17.1.2, One Hundred Thousand Dollars ($100,000)) shall be declared to and approved in writing by ACTA in accordance with the terms of the Operating Agreement.

17.16 Notice of Claim. Contractor agrees to provide immediate written notice to ACTA of any claim or loss against Contractor arising out of the work performed under this Agreement. ACTA assumes no obligation or liability by such notice, but has the right (but not the duty) to monitor the handling of any such claim or claims if they are likely to involve ACTA, the Owner or the Railroads or any of the Indemnified Entitles.

17.17 Insurance for Subcontractors. Contractor agrees to require all Subcontractors or other parties hired under this Agreement to provide the same types of insurance as required of Contractor unless otherwise agreed to by ACTA, except that the coverage limits with respect to the liability insurance policies described in Section 17.1 shall be Five Million Dollars ($5,000,000). The Subcontractor's general liability insurance shall add as additional insureds all parties identified in Section 17.2 using ISO endorsement form CG 20 10 and form CG 20 37. Additional insured status shall include coverage for completed operations. Contractor agrees to obtain certificates evidencing such coverage and make reasonable efforts to ensure that such coverage is provided as required hereby.

17.18 Supply Copies of Insurance Policies. Contractor shall provide to ACTA a copy of the insurance policies issued pursuant to this Article 17. Contractor shall provide to ACTA a copy of the insurance policies issued pursuant to Section 17.17 in connection with the Services performed by all Subcontractors or other parties hired under this Agreement. Contractor agrees to require all Subcontractors or other parties hired under this Agreement to comply with the requirements of this Section 17.18.

17.19 Payment and Performance Bonds. Prior to commencing any work under the Agreement, Contractor shall apply for and furnish ACTA separate payment and performance bonds for the estimated value of one year of services under the Agreement. The performance bond shall be in the amount of 6 million dollars ($6,000,000) and the payment bond shall be in the amount of 1.5 million dollars ($1,500,000) covering 100% faithful performance of (at the time services are provided and one year after completion, and during any warranty or guarantee period) and payment of all obligations arising under this Agreement and/or guaranteeing the payment in full of all claims for labor performed and material supplied for the work. All bonds shall be provided by a California admitted surety insurer with an AM Best's Guide rating of at least A-:VIII and shall be executed on ACTA issued forms. Samples of the bonds are set forth in Exhibits 6.

ARTICLE 18
CASUALTY

18.1 No Requirement to Repair. None of ACTA, Owner or Railroads shall have any obligation to repair or replace damage to the Maintained Facilities caused by a Force Majeure Event unless insurance proceeds are available to make such repairs or replacement. In furtherance of the foregoing, ACTA shall be entitled immediately and unilaterally to remove from service any portion of the Maintained Facilities, without liability to Contractor (other than for amounts due for Services performed prior to the Force Majeure Event), which are damaged or destroyed as a result of a Force Majeure Event. In such event, solely as between ACTA and Contractor, ACTA shall be responsible for (and shall pay all costs associated with) obtaining any governmental approvals or exemptions that may be necessary in connection with any such removal from service. Nothing in this Section 18.1 shall limit ACTA's right to remove from service any Maintained Facilities damaged by a Force Majeure Event under Section 18.2, regardless of the availability of insurance proceeds to make necessary repairs or replacements. In no event shall ACTA, Owner, the Railroads or Contractor have any liability to each other for injury to persons or damage to any property resulting from a Force Majeure Event.

18.2 Termination for Force Majeure. If ACTA determines, in its sole discretion, that damage caused by a Force Majeure Event to all or any material portion of the Maintained Facilities renders continuation of Contractor's Services under this Agreement impracticable, and if ACTA determines not to repair or restore the affected portion of the Maintained Facilities, ACTA shall be entitled, unilaterally, to terminate this Agreement with respect to all of the Maintained Facilities by written notice to Contractor, provided, that such notice must be given within one-hundred and twenty (120) days after the occurrence of the Force Majeure Event. Contractor shall not be held in breach of its obligations under this Agreement to the extent such a breach arises solely as a direct result of ACTA's termination as a result of a Force Majeure Event. In such event, as between ACTA and Contractor, ACTA shall be responsible for obtaining any governmental approvals or exemptions that may be necessary in connection with any such removal from service. This Agreement shall be deemed terminated on the later of (a) the date on which such notice is delivered or (b) the date on which the regulatory approvals or exemptions necessary to terminate this Agreement have been obtained, provided, that Contractor shall have ninety (90) days after the effective date of termination to wind up its affairs and to remove its property from the Maintained Facilities. In the event that Contractor is terminated pursuant to this Section 18.2, Contractor shall submit a proposed termination statement to ACTA (no later than ten (10) days following notice to Contractor) which shall include (1) all amounts owed to Contractor or any Subcontractor for Services performed through the termination date; (2) termination payments, if any, contractually owed by Contractor to Subcontractors and/or vendors as a direct result of the termination of such Services; provided, however, that (i) ACTA previously authorized and directed Contractor to perform such Services, and (ii) such termination payments, if any, are a reasonable approximation of the damages incurred by Subcontractors and/or vendors as a direct result of the termination of such Services; and (3) reasonable costs incurred by Contractor to comply with ACTA's written directions in connection with the termination, including demobilization costs, if any. In no event shall ACTA be obligated to pay for lost profits or other consequential damages resulting from any such termination. ACTA shall pay such termination statement in accordance with and subject to the provisions of Section 5.6.

ARTICLE 19
REPRESENTATIONS AND WARRANTIES

19.1 Representations and Warranties of ACTA. ACTA represents and warrants to Contractor that it is fully authorized to enter into this Agreement and that this Agreement is binding and enforceable against it and its respective successors and assigns, in accordance with the terms of this Agreement.

19.2 Representations and Warranties of Contractor. Contractor represents and warrants to ACTA that it is fully authorized to enter into this Agreement and that this Agreement is binding and enforceable against it and its respective successors and assigns, in accordance with the terms of this Agreement.

ARTICLE 20
DISPUTE RESOLUTION

20.1 **Written Notice and Good Faith Efforts**. In the event of a claim or dispute arising out of this Agreement, the disputing parties, which may include POLA, POLB, BNSF and UP, as well as ACTA and Contractor, shall notify in writing the other party(ies) of the dispute and thereafter the parties shall make good faith efforts to resolve the dispute through negotiation. If the relevant parties so agree, they may involve a disinterested person or persons experienced in railroad operations or financial matters (such as an accountant), if appropriate, to render his or her objective advice and opinion, which advice and opinion shall be advisory only and not binding unless the relevant parties agree in writing to be bound by his or her judgment in a particular instance.

20.2 **Superior Court Filing**. If for any reason the dispute is not resolved within thirty (30) days after notice of the dispute as provided above, a party may file an action and pursue available legal remedies in the Superior Court for the State of California, County of Los Angeles.

20.3 **Public Contract Code**. Notwithstanding the foregoing, if any claim or dispute involves a Claim as defined in Public Contract Code Section 9204, then such Claim shall be resolved in accordance with the provisions of Public Contract Code Section 9204, as may be amended from time to time.

ARTICLE 21
NOTICES

21.1 **Written Notification**. All notices and other communications under this Agreement shall be in writing and shall be given and received upon on of the following

(a) upon receipt by the sending party of a written confirmation of receipt by the receiving party when the notice is sent by e-mail

(b) on receipt, if mailed to the party to whom notice is to be given by overnight courier or first class mail, registered or certified, return receipt requested, postage prepaid and properly addressed as follows:

Contractor: [__________________]

ACTA: Alameda Corridor Transportation Authority
3760 Kilroy Airport Way, Suite 200
Long Beach, CA 90806
Attention: Chief Executive Officer
Email: mleue@acta.org

21.2 Address or Addressee Changes. Any party hereto may change its address or addressee to which notices are to be given by providing written notice of the change to the other parties.

ARTICLE 22
MISCELLANEOUS

22.1 Severability. Each provision of this Agreement shall be interpreted so as to be effective and valid under applicable law to the fullest extent possible. However, if any provision contained herein shall for any reason be held invalid, illegal or unenforceable in any respect, then, in order to effect the purposes of this Agreement it shall be construed as if such provision had never been contained herein.

22.2 Assignment; Agreement Binding on Successors and Assigns.

22.2.1 Assignment.

(a) Consistent with and subject to the terms and conditions of the Operating Agreement, (i) ACTA may assign all or a portion of this Agreement, and its rights and obligations hereunder, to Owner or to another entity which acquires all of the Rail Corridor or which is designated by Owner to operate the Rail Corridor, and (ii) Owner and each of the Railroads may sell, transfer or encumber all or any portion of the Rail Corridor or their rights or interest (if any) therein.

(b) Contractor may not assign or delegate its duties and obligations under this Agreement without the prior written consent of and notice to ACTA, which consent may be given or withheld by ACTA. Notwithstanding the preceding sentence, Contractor may employ Subcontractors, subject to the prior approval of ACTA, to perform specific duties of Contractor hereunder under a subcontract entered into in the normal course solely for performance of some, but not all, of Contractor's duties hereunder. Any such contract shall also include a provision that Subcontractor agrees to perform its work in accordance with the standards and obligations established by this Agreement. With respect to any Services provided by a Subcontractor, Contractor remains primarily liable to ACTA for fulfillment of all obligations stated in this Agreement (including the obligations stated in Article 16).

22.2.2 Binding Agreement. Subject to the restrictions on assignment set forth in this Agreement, this Agreement shall be binding upon and shall inure to the benefit of Contractor and ACTA, their respective successors and assigns.

22.3 Amendments. No modifications, amendments or changes herein or hereof shall be binding upon any party unless set forth in a document, duly executed and delivered by all parties. No provision of this Agreement shall be waived except by an instrument in writing signed by the party to be charged with such waiver.

22.4 Recordation and Termination. Without the prior written consent of all parties hereto, no party may record this Agreement. Upon termination of the rights granted to Contractor hereunder, Contractor shall execute, acknowledge and deliver to ACTA a copy of any appropriate instrument or instruments evidencing the termination.

22.5 Counterparts. This Agreement may be executed in any number of counterparts, each of which shall be deemed to be an original, and all of which together shall constitute one and the same instrument. The signature page of any counterpart may be detached therefrom without impairing the legal effect of the signature(s) thereon provided such signature page is attached to any other counterpart identical thereto except having additional signature pages executed by other parties to this Agreement attached thereto.

22.6 Third Party Beneficiaries. It is the intent of each party to this Agreement that each provision of this Agreement inure to the benefit of the parties hereto as well as to the benefit of POLA, POLB, BNSF and UP and the permitted successors and assignees of each of them, and shall not inure to the benefit of any other person or entity (including any governmental or quasi-governmental agency or authority). Contractor acknowledges that POLA, POLB, BNSF and UP are express third party beneficiaries of this Agreement and that POLA, POLB, BNSF and UP, together or individually, may sue Contractor directly or demand dispute resolution for any breach of this Agreement.

22.7 Effect of Agreement. All negotiations relative to the matters contemplated by this Agreement (including negotiations of matters described in the Request for Proposals issued by ACTA) are merged herein and there are no other understandings or agreements relating to the matters and things herein set forth other than those incorporated in this Agreement or agreements expressly referenced in this Agreement or the documents executed in connection herewith.

22.8 Waiver. The failure of any party at any time or times to require performance of any provision hereof shall in no manner affect the right at a later time to enforce the same. No waiver by any party of any condition, or of any breach of any term, covenant, representation, or warranty contained herein, in any one or more instances, shall be deemed to be or construed as a further or continuing waiver of any such condition or breach or waiver of any other condition or of any breach of any other term, covenant, representation or warranty.

22.9 Time of Essence. With respect to the performance by Contractor under this Agreement, time is of the essence.

22.10 Governing Law; Forum.

22.10.1 THIS AGREEMENT SHALL BE GOVERNED BY AND CONSTRUED IN ACCORDANCE WITH THE LAWS OF THE STATE OF CALIFORNIA, WITHOUT REFERENCE TO THE CONFLICTS-OF-LAW RULES AND PRINCIPLES OF SUCH STATE.

22.10.2 THE PARTIES HERETO AGREE THAT ALL ACTIONS, SUITS, PROCEEDINGS, CLAIMS RELATED TO THIS AGREEMENT AND THE TRANSACTIONS CONTEMPLATED HEREBY (INCLUDING ANY APPEALS OF OR CHALLENGES TO ANY

DISPUTE RESOLUTION PROCEEDING UNDER ARTICLE 20) MUST BE BROUGHT, FILED, PROSECUTED AND DEFENDED IN THE SUPERIOR COURT FOR THE STATE OF CALIFORNIA, COUNTY OF LOS ANGELES.

22.11 Incorporation of Exhibits. The exhibits attached hereto are incorporated herein by reference. In the event of any inconsistency between the exhibits and the body of this Agreement, the body of this Agreement shall govern.

22.12 Incorporation of Request for Proposals. Section 2.0 (Rail Corridor Description) and Section 3.0 (Scope of Services) and each Appendix to the Request for Proposals (except Appendices A, O and Q) are incorporated herein by reference. The Request for Proposals is attached hereto as Exhibit 7. Contractor acknowledges and agrees to perform the Services as described therein, provided that in the event of any inconsistency between any provision in the Request for Proposals and this Agreement, the provision most favorable to ACTA shall control.

22.13 Construction. The language in all parts of this Agreement shall be in all cases construed simply according to its fair meaning and not strictly for or against any of the parties hereto. Section headings of this Agreement are solely for convenience of reference and shall not govern the interpretation of any of the provisions of this Agreement. References to "Sections" or "Articles" are to Sections or Articles of this Agreement and references to "Exhibits" are to Exhibits attached hereto, unless otherwise specifically provided.

22.14 No Relocation Assistance. Contractor understands and agrees that nothing contained in this Agreement shall create any right in Contractor for relocation assistance or payment upon expiration or termination of this Agreement except as otherwise stated in this Agreement. Contractor acknowledges and agrees that it shall not be entitled to relocation assistance or payment pursuant to the provisions of Title 1, Division 7, Chapter 16, of the Government Code of the State of California (Sections 7260 *et seq.*) or any similar statute with respect to any relocation of its business or activities upon the expiration or termination of this Agreement except as otherwise stated in this Agreement. In consideration of the rights given Contractor under this Agreement, Contractor expressly waives any relocation assistance which such statutes or any future statutes may allow.

22.15 Non-discrimination. Contractor shall not discriminate in its employment practices against any employee or applicant for employment because of the employee's or applicant's race, color, religion, national origin, ancestry, sex, age, disability, sexual orientation, AIDS, HIV status, physical handicap or veteran status. All assignments and transfers of interest permitted pursuant to this Agreement, and all contracts or subcontracts entered into by Contractor with respect to the Maintained Facilities, shall contain this provision.

22.16 Public Works Contract. For the purpose of this Agreement, the Rail Corridor and the Non-Rail Components shall be deemed "public works" pursuant to California Labor Code Section 1720 *et seq*. and, as such, the parties shall comply with all applicable provisions of the California Labor Code and Title 8 of the California Code of Regulations Section 16000 *et seq*.

22.17 Small Business Enterprise (SBE) Participation. For the purpose of this Agreement, Contractor shall meet the level of participation for certified SBE subcontractors and vendors/suppliers contained in Exhibit 6, and comply with the other requirements therein, such as utilization, substitution, amendments to the scope of Services, compliance submissions, and monitoring.

22.18 Conflict of Interest. It is hereby understood and agreed that the parties to this Agreement have read and are aware of the provisions of Section 1090 *et seq*. and Section 87100 *et seq*. of the California Government Code relating to conflict of interest of public officers and employees. All parties hereto agree that they are unaware of any financial or economic interest of any public officer of employee of the City of Los Angeles or the City of Long Beach relating to this Agreement. Notwithstanding any other provision of this Agreement, it is further understood and agreed that if such a financial or economic interest does exist at the inception of this Agreement, ACTA may immediately terminate this Agreement without payment of any termination fee as provided herein or any other liability therefor by giving written notice thereof. Any termination fee which would otherwise be payable hereunder shall be paid by the party who failed to disclose the financial or economic interest.

22.19 Further Assurances. Each party shall execute all such instruments and documents and shall take in good faith all such actions as are reasonably necessary to carry out the provisions of this Agreement.

22.20 Transfer to Contractor of Certain Regulatory Obligations. To the maximum extent legally possible, ACTA intends to transfer to Contractor any maintenance, inspection and repair obligations that ACTA may have under applicable federal or state regulations with respect to the Maintained Facilities, including the requirements contained in 49 CFR § 213.5. Contractor accepts such transfer and shall fully cooperate with ACTA in the preparation and filing of any necessary applications with respect thereto. Upon any termination of this Agreement, Contractor shall execute such documents and instruments as may be necessary to transfer such responsibilities to another party designated by ACTA.

22.21 Taxpayer Identification Number. Contractor declares that it has an authorized taxpayer identification number which shall be provided to ACTA prior to payment under this Agreement. No payments will be made to Contractor under this Agreement without a valid taxpayer identification number.

[SIGNATURES ON NEXT PAGE]

IN **WITNESS WHEREOF**, the parties to this Agreement have duly executed it as of the day and year first above written.

"CONTRACTOR"

[___________________________]

By: ____________________________
Name: __________________________
Its: ____________________________

"ACTA"

ALAMEDA CORRIDOR TRANSPORTATION AUTHORITY, a Joint Powers Authority	**Approved as to form this _____ day of __________, 2025:**
By: ______________________________ Name: Michael Leue Its: Chief Executive Officer	By: ______________________________ **Name:** ________________________ **Its: Co-General Counsel**

EXHIBIT 1

MAP OF RAIL CORRIDOR
AND
MAINTAINED FACILITIES

(Exhibit to be added later)

EXHIBIT 2

SCHEDULE OF EQUIPMENT TO BE OBTAINED
AND
MAINTAINED BY CONTRACTOR

(Exhibit to be added later)

<u>EXHIBIT 3</u>

APPROVED MAINTENANCE PLAN FOR FIRST CONTRACT YEAR (COMMENCEMENT DATE THROUGH DECEMBER 31, 2025)

(Exhibit to be added later)

EXHIBIT 4

AMENDED AND RESTATED
ALAMEDA CORRIDOR
CAPITAL EXPENSE GUIDELINES
Effective January 1, 2018

Exhibit 4

AMENDED AND RESTATED
ALAMEDA CORRIDOR
CAPITAL EXPENSE GUIDELINES
Effective January 1, 2018

WHEREAS, Pursuant to Section 2.5 (b) of the AMENDED AND RESTATED ALAMEDA CORRIDOR USE AND OPERATING AGREEMENT, dated as of December 15, 2016 (the "Use and Operating Agreement"), by and among (i) BNSF RAILWAY COMPANY (formerly known as The Burlington Northern and Santa Fe Railway Company), a Delaware corporation (successor by merger to The Atchison, Topeka and Santa Fe Railway Company) ("BNSF"), (ii) UNION PACIFIC RAILROAD COMPANY, a Delaware corporation (which also is successor by merger to Southern Pacific Transportation Company) ("UP") (BNSF and UPRR are sometimes collectively referenced as "Railroads"), (iii) THE CITY OF LOS ANGELES, a municipal corporation, acting by and through its BOARD OF HARBOR COMMISSIONERS ("POLA"), (iv) THE CITY OF LONG BEACH, a municipal corporation, acting by and through its BOARD OF HARBOR COMMISSIONERS ("POLB") (POLA and POLB are sometimes collectively referenced as "Owner"), and (v) ALAMEDA CORRIDOR TRANSPORTATION AUTHORITY, a joint powers authority created under the laws of the State of California ("ACTA"), rules and regulations previously established pursuant to the original Use and Operating Agreement dated as of October 12, 1998 "may be updated or modified from time to time through Mutual Agreement of the Owner and Railroads". Such previously established rules include guidelines for determining whether the replacement of components of the Rail Corridor will be treated as a capital item, and paid as a Capital Expense, or a maintenance item, and paid as an M&O Charge.

WHEREAS, the Owner and Railroads previously adopted Revised Amended and Restated Capital Expense Guidelines dated June 30 2012 (the "Prior Guidelines") pursuant to which criteria were established for determining whether the replacement of components are to be treated as Capital Expenses. The Prior Guidelines expire on December 31, 2017.

WHEREAS, pursuant to Section 7 of the Prior Guidelines such Guidelines shall be reviewed, and if appropriate, modified, to take into account (i) any departure from the anticipated performance and operations of the Rail Corridor and/or (ii) changes in accounting standards and policies related to the capitalization of component replacements.

WHEREAS, accordingly, the Owner and Railroads have reviewed the Prior Guidelines and desire to amend the Prior Guidelines as set forth in these Amended and Restated Alameda Corridor Capital Expenses Guidelines. Terms not defined herein shall have the meanings assigned to such terms in the Use and Operating Agreement.

1. **Authorization for Amended and Restated Guidelines.** Article 1 of the Use and Operating Agreement defines "Capital Expenses" as the costs and expenses incurred in making any capital improvements or betterments, or replacements to the extent that costs and expenses of replacements are determined to be Capital Expenses to the Rail Corridor (other than the Non-Rail Components).

2. **Capital Expenses Defined.** Capital Expenses shall include the costs and expenses incurred in making any capital improvements or betterments, or the replacement of the components of the Rail Corridor listed on Exhibit A hereto. Capital Expenses shall not include the following components:

   A. Replacement of any component that is the result of warranty work paid for or reimbursed by parties other than ACTA, POLA, POLB, UP and/or BNSF;

   B. Except where required in connection with the installation of a capital improvement or betterment or the replacement of a component listed on Exhibit A hereto, replacement of any components or conducting any of the activities listed on Exhibit B hereto;

   C. Replacement of any Non-Rail Component (the treatment and funding of maintenance and capital improvements and replacements of Non-Rail Components shall be determined in accordance with the relevant provisions of the Use and Operating Agreement, including but not limited to Section 7.4);

   D. Replacement of any component that is the result of a casualty event (including any washout) for which ACTA, POLA, POLB, UP and/or BNSF (or their respective agents) is responsible; or

   E. Replacement of any component covered under property and/or casualty insurance as described in Section 11.2 of the Use and Operating Agreement.

3. **Treatment of Related Costs**. For purposes of determining the total cost or expense of the replacement of a component under these Revised Amended and Restated Guidelines, related costs will include all material and labor charges, handling charges, shipping costs, taxes, customary overhead and other charges necessary to place such component in service. Business interruption costs, lost opportunity costs and similar costs or charges shall not be included.

4. **Treatment of Salvage Credits**. For purposes of determining the total cost or expense of the replacement of a component under these Revised Amended and Restated Guidelines, any income and/or credits generated by, or otherwise related to, the salvage of such component shall be deducted from the cost or expense of such component.

5. **Components Not Addressed Under the Amended and Restated Guidelines.** In the event a component of the Rail Corridor is not otherwise addressed under these Amended and Restated Guidelines, Mutual Agreement of the Owner and Railroads may be sought by

ACTA to establish additional guidelines or procedures for the treatment of such component (either on a case-by-case basis or by amendment to these Guidelines).

6. **Annual Adjustment of Amounts.** All dollar amounts listed on Exhibit A hereto shall be adjusted annually on January 1 of each year, commencing with January 1, 2025, by gross changes in the Index Rate as compared to that Index Rate in effect on January 1, 2024 (rounded to the nearest $500). As used herein, the Index Rate shall mean the Producer Price Index – Industrial Commodities Less Fuels Series ID WPV03T15M03 (Base Data 198200), published by the United States Department of Labor, Bureau of Labor Statistics, or such successor index.

7. **Review of Standard.** It is recognized by ACTA, Owner and the Railroads that these Amended and Restated Guidelines are adopted taking into account (i) certain assumptions with respect to the anticipated performance and operations of the Rail Corridor and (ii) current accounting standards and policies related to the capitalization of replacements. Accordingly, Owner and the Railroads shall review these Amended and Restated Guidelines, and if appropriate, be modified by Mutual Agreement of the Owner and Railroads, from time to time to take into account (i) any departure from the anticipated performance and operations of the Rail Corridor and/or (ii) changes in accounting standards and policies related to the capitalization of replacements.

8. **Expiration of Amended and Restated Guidelines.** On or about June 30, 2022, a review of these Amended and Restated Guidelines shall be conducted by Owner and Railroads to determine whether there is a need for any changes or modifications to be made by Mutual Agreement of the Owner and Railroads. If Mutual Agreement by the Owner and Railroads to extend or modify these Amended and Restated Guidelines is not met then these Amended and Restated Guidelines, including any additions, modifications or amendments hereto pursuant to Paragraphs 4 and 6 above, shall automatically expire on December 31, 2022.

9. **Annual Maintenance and Capital Improvement Plan and Budget.** These Amended and Restated Guidelines shall not, and are not intended to, modify, change or otherwise alter the annual obligation under Section 8.3 of the Use and Operating Agreement to prepare or cause to be prepared a plan and budget for the inspection, maintenance, repairs and capital improvements and replacements to the Rail Corridor. These Amended and Restated Guidelines are intended to assist in such planning and budgeting process, but in no way shall these Amended and Restated Guidelines control or otherwise restrict approval or disapproval of any such plan and budget.

10. **Inconsistency with Use and Operating Agreement.** In the event of an inconsistency between any provision of these Amended and Restated Guidelines and the provisions of the Use and Operating Agreement, the provisions of the Use and Operating Agreement shall apply.

EXHIBIT A
REPLACEMENT OF TRACK AND TRACK SUPPORT STRUCTURE COMPONENTS TO BE TREATED AS CAPITAL EXPENSES*

GRADING

- Programmed replacements (*i.e.*, work in which grading installed exceeds 300 cubic yards per mile)
- Embankment or roadbed stabilization costing more than $7,000

The costs and expenses incurred in making these replacements shall be considered a Capital Expense if the component meets the above criteria.

OTHER RIGHT-OF-WAY EXPENDITURES

- Installation of paving totaling 40,000 square feet or more
- Protecting dike
- Rip rap (complete installation)
- Retaining and crash walls
- Road crossing surface material (complete replacement)
- Road crossing track and surface material (complete replacement)
- Encasement (complete installation at each location)
- Grade Separations
- Landscaping (complete installation at each location)
- Outside lighting (complete)

The costs and expenses incurred in making these replacements shall be considered a Capital Expense if (i) the component meets the above criteria and (ii) the cost of the component exceeds $7,000.

BRIDGES, TRESTLES AND CULVERTS

- Bridge superstructure
- Bridge sub-structure
- Replacement of more than 50% of a bridge trestle or approach
- The complete machinery for operating a movable span
- Protecting crib

* As provided in Section 5 of these Amended and Restated Guidelines, the list of components and activities set forth herein is not intended to be exhaustive or all inclusive and any component or activity not otherwise covered herein shall be addressed by Owner and Railroads through Mutual Agreement by the Owner and Railroads in accordance with Section 5.

- Complete culvert, including head/wingwalls, dispersion and trap systems and liners
- Bridge deck
- Bridge walkways

The costs and expenses incurred in making these replacements shall be considered a Capital Expense if (i) the component meets the above criteria and (ii) the cost of the component exceeds $7,000.

FENCES AND SIGNS

- One continuous mile of right-of-way fence
- One continuous mile of pipeline-with or without pumps
- Signage set/program if the cost exceeds $7,000

The costs and expenses incurred in making these replacements shall be considered a Capital Expense if the component meets the above criteria.

TIES

- Programmed replacements (*i.e.*, replacement of more than 300 wooden cross ties per mile or 250 concrete cross ties per mile)
- Complete replacement of a turnout or crossover
- Complete replacement of a switch section (i.e. from point of switch to toe of frog) if the cost exceeds $7,000
- Replacement of all ties on a bridge deck

The costs and expenses incurred in making these replacements shall be considered a Capital Expense if the component meets the above criteria.

RAIL AND OTHER TRACK MATERIAL

- 1,320 continuous track feet of rail, including rail welds, first pass rail grinding and other track material
- Turnout or crossover (complete), including rail and other track material
- Complete switch section or rail crossing frog
- Rail and other track material on individual curves regardless of length, including short tangents between connecting curves
- Special items of other track material if the cost of the item exceeds $7,000
- Track panels, if permanent and rail length exceeds 1,320 continuous track feet
- Rail lubrication applicator (complete) if the cost of the item exceeds $7,000

- First pass rail grinding, and 50% of the cost of all other annual programmed (tangent and curve) grinding
- Rail line relocation, if the relocation is made for the purpose of reducing curves or grades or eliminating bridges or tunnels or other physical features and if the portion of line being relocated exceeds 1,320 continuous track feet (including related ties, grading and ballast)

The costs and expenses incurred in making these replacements shall be considered a Capital Expense if the component meets the above criteria.

BALLAST

- Ballast replacements other than "skim lift" (i.e. out of face tamping of the track required to achieve a continuous raise of up to 1 inch to restore track surface and line) and other than "spot tamping" (i.e. lifting and tamping short sections of track of up to 215 feet, or a Number 20 turnout, per location, regardless of ballast depth, to restore track surface and line)

The costs and expenses incurred in making these replacements shall be considered a Capital Expense if the component meets the above criteria.

DRAINAGE AND WATER IMPROVEMENTS

- Complete water supply piping system
- A holding tank
- Pump house
- Pumping Machinery – each complete pump installation
- Water tank – each complete installation
- Water treating plant
- Well (including pump)
- Machinery & equipment
- Any individual component over $7,000
- Drainage improvements one mile or greater in length and costing in excess of $7,000
- Fire hydrant systems-complete

The costs and expenses incurred in making these replacements shall be considered a Capital Expense if the component meets the above criteria.

MISCELLANEOUS STRUCTURES AND FACILITIES

- A newly completed building
- Each outside installation, water, air, etc. line installation
- Each sewer installation, storm or sanitary

- Complete heating and/or air conditioning system (without ductwork)
- Machinery & equipment
- Each outside lighting installation complete
- Vehicular road
- Pollution abatement equipment-complete
- Catenary systems-complete
- Security and cargo scanning systems-complete
- Scales

The costs and expenses incurred in making these replacements shall be considered a Capital Expense if the component meets the above criteria.

COMMUNICATION SYSTEMS

- Complete mile section (or complete installation if less than a mile) of communication line
- Each mile or complete installation of cable with associated parts
- Each mile or complete installation of conduit and associated parts.
- Complete tower
- Complete installation at each location constituting a separate means of communication, such as radio, radar, carrier telephone, teletype, or other communication system
- Dispatching system
- Testing equipment (if purchased)
- Outside lighting (each complete installation)
- Communications equipment
- Computer software (acquisition or upgrades only)

The costs and expenses incurred in making these replacements shall be considered a Capital Expense if (i) the component meets the above criteria and (ii) the cost of the component exceeds $7,000.

SIGNALS & INTERLOCKERS

- Interlocking plant
- Interlocking machine
- Signal bridge
- Each side of a highway crossing protection installation
- Traffic control or C.T.C. system installation

- Defect detectors/AEI readers (a complete separate system for the detection of hot-box journals, dragging equipment, high water on tracks, or hot & cold wheels on railroad cars and/or for recording car movements)
- Control board
- Computer equipment
- Stepper
- Code unit
- Signal
- Switch machine

The costs and expenses incurred in making such a replacement shall be a Capital Expense if (i) the component meets the above criteria and (ii) the cost of the component exceeds $7,000.

EXHIBIT B
COMPONENTS AND ACTIVITIES NOT TO BE TREATED AS CAPITAL EXPENSES*

(Except as provided in Section 2.B. of the Guidelines)

- Track inspections, including visual, ultrasonic, track geometry car and hyrail.
- Signal and/or control system inspections and testing.
- Communication system inspections and testing.
- Bridge, trestle, culvert and other facility inspections.
- Pot holing and/or soil sampling.
- Vegetation control, including tree trimming/removal.
- Clearing of wrecks and rerailing.
- Right-of-way litter control/removal.
- Shifting and/or relocating of existing track.
- Rail transposition.
- Restoring chipped and/or battered rail ends.
- Track gauging.
- Replacing and/or tightening bolts and/or adjusting/replacing other rail fasteners.
- Replacing and/or resetting spikes and/or rail anchors in existing track.
- Maintaining/refilling rail lubricators.
- Adjusting switches.
- Pumping of excess water or other fluids from the right-of-way.
- Clean up/disposal of hazardous material spills and/or biohazard material.
- Cleaning switches.
- Replacement of broken or defective rails.
- Replacement of partial units or less-than-minimum quantities (as set forth in Exhibit A).
- Repairing insulated joints.
- Ballast regulating.
- Field welding and/or grinding.
- Lubricating joints.
- Repairing engine burns.
- Track shimming.
- Building and other facility maintenance, cleaning, repair, painting and/or landscape maintenance.
- Replacing signal wiring and/or relays.

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* As provided in Section 5 of these Amended and Rested Guidelines, the list of components and activities set forth herein is not intended to be exhaustive or all inclusive and any component or activity not otherwise covered herein shall be addressed by Owner and Railroads through Mutual Agreement of the Owner and Railroads in accordance with Section 5.

- Small tools and supplies.
- Automotive and roadway work equipment repairs, maintenance and operation.
- Replacement of signal/communications system batteries.
- Purchase, maintenance and repair of radios, cell phones, Nextel devices, etc.
- Relocation of fiber optic cables and/or conduits.
- Updating/maintaining of signal drawings, track charts and other Facility records.
- Facility utility expense.
- Maintenance and repair of roadways, walkways, handrails and other bridge appurtenances.
- Gauge restraint testing.
- Derailment investigations.
- Work train expenses.
- Fence and gate repairs, maintenance and painting.
- Repair/replacement of crossing gates.
- Maintenance and repair of high/wide load, hot box and dragging equipment detectors and AEI readers.
- Repair of rail sun kinks and/or pull-aparts.
- M&O vehicle and equipment leases, repairs, maintenance and servicing.

EXHIBIT 5

SMALL BUSINESS ENTERPRISE (SBE) REQUIREMENTS

Exhibit 5
Small Business Enterprise (SBE) Requirements

The following SBE requirements shall apply to the Agreement:

1. During the term of the Agreement, the Contractor shall be required to satisfy the SBE participation percentages using the SBE firms listed on its Commitment Plan Form (CPF), unless otherwise modified by written amendment to the Agreement.

2. Any SBE substitutions or changes in the participation percentages require a written amendment to the Agreement.

3. Unless otherwise approved by ACTA, the SBE participation percentages shall apply to each approved annual budget.

4. The Contractor shall submit for review an SBE Monthly Report showing the recent and cumulative dollar value of payments to small businesses.

5. If a firm's SBE status changes during the term of the Agreement, the Contractor shall notify ACTA for a determination as to whether a substitution or an addition shall be required.

6. Nothing herein shall be construed to supersede or limit the requirements for Contractor substitutions provided in Section 4100 et seq. of the California Public Contract Code.

7. ACTA may conduct site visits and interview SBE firms to verify compliance with the Agreement's SBE participation requirements. The Contractor shall ensure cooperation with such monitoring.

8. The Contractor may be considered in material breach of the Agreement for one or more of the following:

- Failure to submit SBE Monthly Reports;
- Failure to correct discrepancies found by ACTA in the SBE Monthly Reports;
- Falsifying or misrepresenting any SBE information provided to ACTA, including information provided to or on the online SBE databases;
- Substituting SBE firms without prior written ACTA approval; and/or
- Failure to meet SBE participation percentages as required by the Agreement.

9. In addition to any other remedy ACTA may have under the Agreement or by law or in equity, ACTA, in its sole discretion, may impose any or all of the following provisions against the Contractor if determined by ACTA to be in breach of the Agreement:

- Assess the cost of ACTA's audit of the books and records of the Contractor and the SBE firms claiming certification, where such audit is necessary because the Contractor has failed to timely submit a required SBE Monthly Report;

- Withhold payment up to 5 percent of each monthly invoice until the Contractor is deemed in compliance with the SBE requirements.

EXHIBIT 6

BOND SAMPLES

(Payment Bond and Performance Bond)

PAYMENT BOND SAMPLE

KNOW ALL PERSONS BY THESE PRESENTS:

That we,____
____
as principal ________________________, and ___________________________________
as surety(ies) are held and firmly bound unto THE ALAMEDA CORRIDOR TRANSPORTATION AUTHORITY, a California Joint Powers Authority ("ACTA"), in the penal sum of ____
_______________________________________ dollars ($ ___________) lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH: that whereas the principal entered into a certain contract, hereto attached, with ACTA, for the Alameda Corridor Maintenance Agreement (Rail Corridor and Non-Rail Components), Agreement No. ________ ("Contract").

NOW THEREFORE, if said principal(s) shall fail to faithfully perform and fulfill all the undertakings, covenants, terms, conditions and agreements of said Contract during the original term of said Contract and any extensions thereof that may be granted by ACTA, with or without notice to the surety(ies), and during the life of any guaranty required under the Contract, or shall fail to faithfully perform and fulfill all the undertakings, covenants, terms, conditions and agreements of any and all duly authorized modifications of said Contract that may hereafter be made, notice of which modifications to the surety(ies) being hereby waived, said surety(ies) shall fully and faithfully carry out and perform all of the terms, covenants and conditions of said Contract upon its part to be performed and if surety(ies) does so, then this obligation to be null and void, otherwise to remain in full force and effect, and in addition thereto, in case suit is brought upon this bond, the judgment rendered against the principal or surety(ies), or both, a reasonable attorney's fee, to be fixed by the court, taxed as costs and included in the judgment rendered therein, otherwise this obligation to be void.

IN WITNESS WHEREOF, the above bounded parties have executed this instrument under their several hands and seals this _____day of _________, 20__.

(Principal) ___________________________

____

ATTEST

(Surety) _____________________________

____

____

(Surety) _____________________________

____

(Corporate Seal)

PAYMENT BOND SAMPLE

KNOW ALL PERSONS BY THESE PRESENTS:

That we,____
____
as principal(s) and ____
_________________________________ as surety(ies) _______________
are held and firmly bound unto THE ALAMEDA CORRIDOR TRANSPORTATION AUTHORITY, a California Joint Powers Authority ("ACTA"), and any person or party named below in the penal sum equal to: ____
____
dollars ($__________) in lawful money of the United States, and the payment of which will and truly be made, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH,

THAT WHEREAS, the principal (s) entered into a certain contract attached hereto with ACTA for the Alameda Corridor Maintenance Agreement (Rail Corridor and Non-Rail Components), Agreement No. ________ ("Contract").

NOW, THEREFORE, if said principal (s) as Contractor(s) or subcontractor(s) fail(s) to pay for any services provided by mechanics, material suppliers, contractors, subcontractors, lessors of equipment, artisans, architects, registered engineers, licensed land surveyors, machinists, builders, teamsters or dray, or fail(s) to pay all persons and laborers of every class performing labor upon or bestowing skill or other necessary service on, or furnishing materials or leasing equipment to be used or consumed in or furnishing materials or leasing equipment to be used or consumed in or furnishing appliances, teams or power contributing to a work or improvement or fail(s) to pay for the value of such labor done or materials furnished and for the value and use of such appliances, equipment, teams or power, whether done or furnished at the instance of ACTA or of any person acting by its authority or under it as contractor or otherwise, or fail(s) to pay for amounts due under the Unemployment Insurance Code of the State of California with respect to work, or labor performed by any such claimant during the original term of said Contract and any extension thereof that may be granted by ACTA with or without notice to the surety(ies) or during the life of any guarantee required under the Contract, or fail(s) to pay for any amounts required to be deducted, withheld and paid over to the Franchise Tax Board from the wages of the Contractor and subcontractors pursuant to that portion of the Revenue and Taxation Code, imposing liability for failure to deduct, withhold, and pay employee taxes, with respect to such work and labor, then in such event said surety(ies) will pay the same in an amount not exceeding the sum of__________________________________
____
________________ dollars ($_________) and, in addition thereto, in case suit is brought upon this bond and judgment rendered against the principal (s) or surety(ies), or both, a reasonable attorney's fee to be fixed by the court, taxed as costs and included in the

judgment rendered therein; otherwise this obligation to be void.

It is understood and agreed by principal (s) and surety(ies) herein that by its terms, this payment bond shall insure to the benefit of any person named in Section 9100 of the Civil Code so as to give a right of action such persons or their assigns in any suit brought upon this payment bond.

IN WITNESS WHEREOF, the above-bounden parties have executed this instrument under their several hands and seals this ____ day of ________, 20__.

ATTEST

____

(Principal)__________________________

____

(Surety) ___________________________

____

(Surety) ___________________________

____

(Corporate Seal)

EXHIBIT 7

REQUEST FOR PROPOSALS (INCLUDING APPENDICES)
DATED AUGUST 15, 2024

(Exhibit to be added later)

SCHEDULE 1

SCHEDULE OF MATERIALS AND EQUIPMENT DELIVERED BY ACTA TO CONTRACTOR

(Schedule to be added later)

Maintenance of Way Services

Appendix B

Rail Corridor Track Charts

LEGEND:

- POWER SWITCH
- HAND THROW SWITCH
- SAFETRAN GCP 3000 BI-DIRECTIONAL
- SAFETRAN GCP 3000 UNI-DIRECTIONAL
- SIGNAL HOUSE
- 0.0 MILEPOST
- TRENCH WALLS
- SIGNAL STRUCTURE (2W, 10EA, 4W, 20E, 6W, 18EA)
- POWER DERAIL
- T.O. NUMBER
- HIGH/WIDE LOAD DETECTOR
- HOT BOX DETECTOR
- TRACK SEGMENT NUMBER
- DRAGGING EQUIPMENT DETECTOR
- HIGHWAY CROSSING GATE AND FLASHERS
- GRADE: DOWN
- AEI READER
- CROSSING DIAMOND
- GROUND SIGNAL
- CD CORRIDOR DISPATCHING JURISDICTION
- CM CORRIDOR MAINTENANCE CONTRACTOR
- PHL PHL MAINTENANCE
- ODM OTHER DISPATCH & MAINTENANCE
- PHLD PHL DISPATCHING JURISDICTION
- WAYSIDE LUBRICATOR (NO. OF UNITS)
- GRADE SEPARATION
- GRADE CROSSING
- BEGIN DEPRESSED CUT
- BUMPING POST
- HIGHWAY CROSSING FLASHER
- ACCESS LADDER
- EMERGENCY LADDER
- FIXED STAIRS
- EMERGENCY TELEPHONE
- DRY STANDPIPE
- DRAIN CUT OFF (STOP LOG)
- INSULATED JOINT

NOTES:

SIGNAL SPACING AND BLOCK LENGTHS ARE SHOWN FOR REFERENCE ONLY.

DIVISION OF MAINTENANCE AND DISPATCHING IS THE SIGNAL AND INSULATED JOINT CONTROLLING THE CONTROL POINT AS SHOWN.

AEI READERS, INCLUDING THOSE SHOWN OUTSIDE THE MAINTENANCE LIMITS OF THE CORRIDOR MAINTENANCE CONTRACTOR, ARE TO BE MAINTAINED BY CORRIDOR MAINTENANCE OPERATOR

SPEEDS SHOWN ARE DESIGN SPEEDS. OPERATING SPEEDS MAY BE DIFFERENT.

REFER TO TRACK CHART OF CONTROLLING RAILROAD FOR INFORMATION ON NON-ACTA TRACKS.

ALL ACTA MAINLINE RAIL IS 136 RE CWR ON CONCRETE TIES UNLESS OTHERWISE STATE WITHIN THE TRACK CHARTS.

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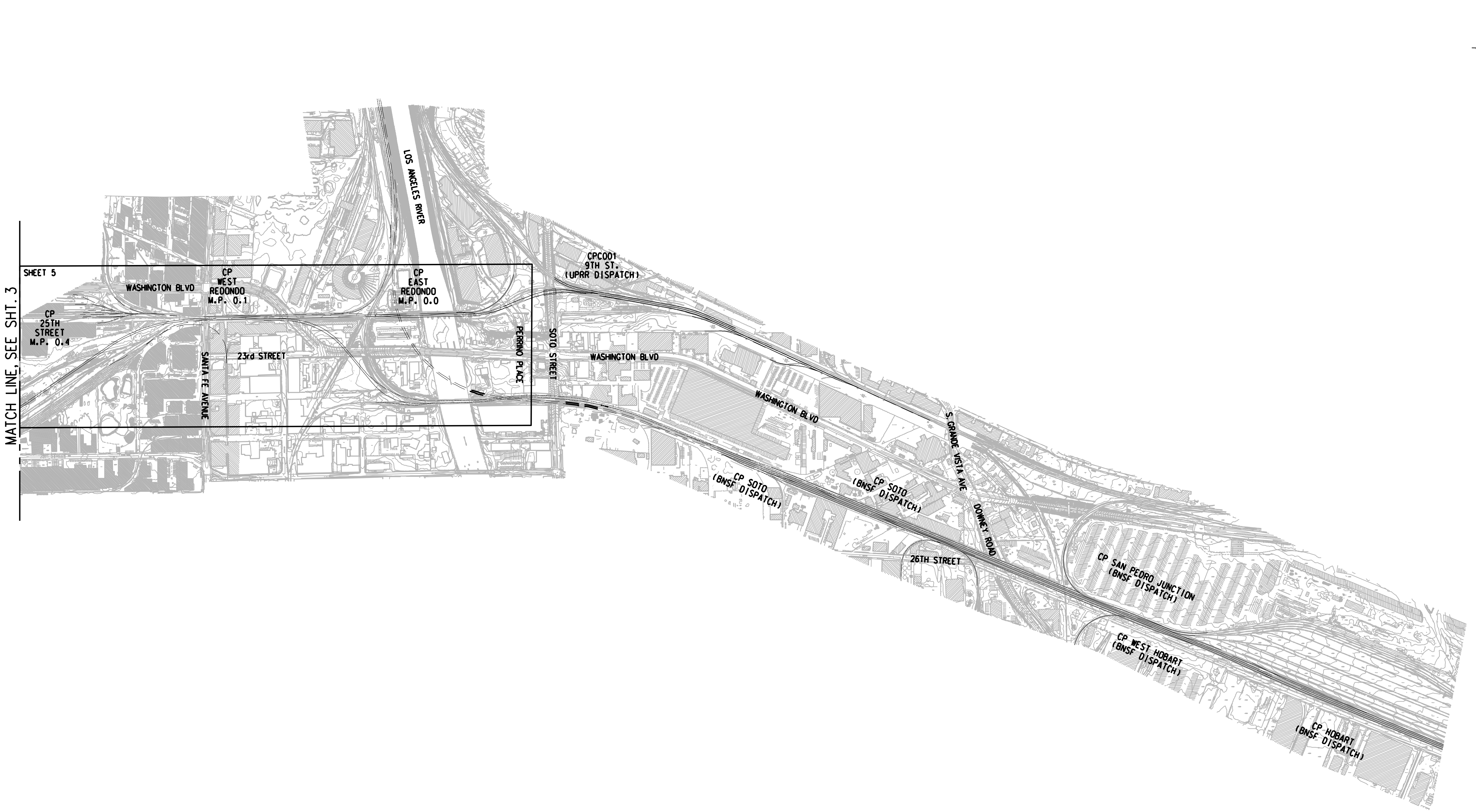

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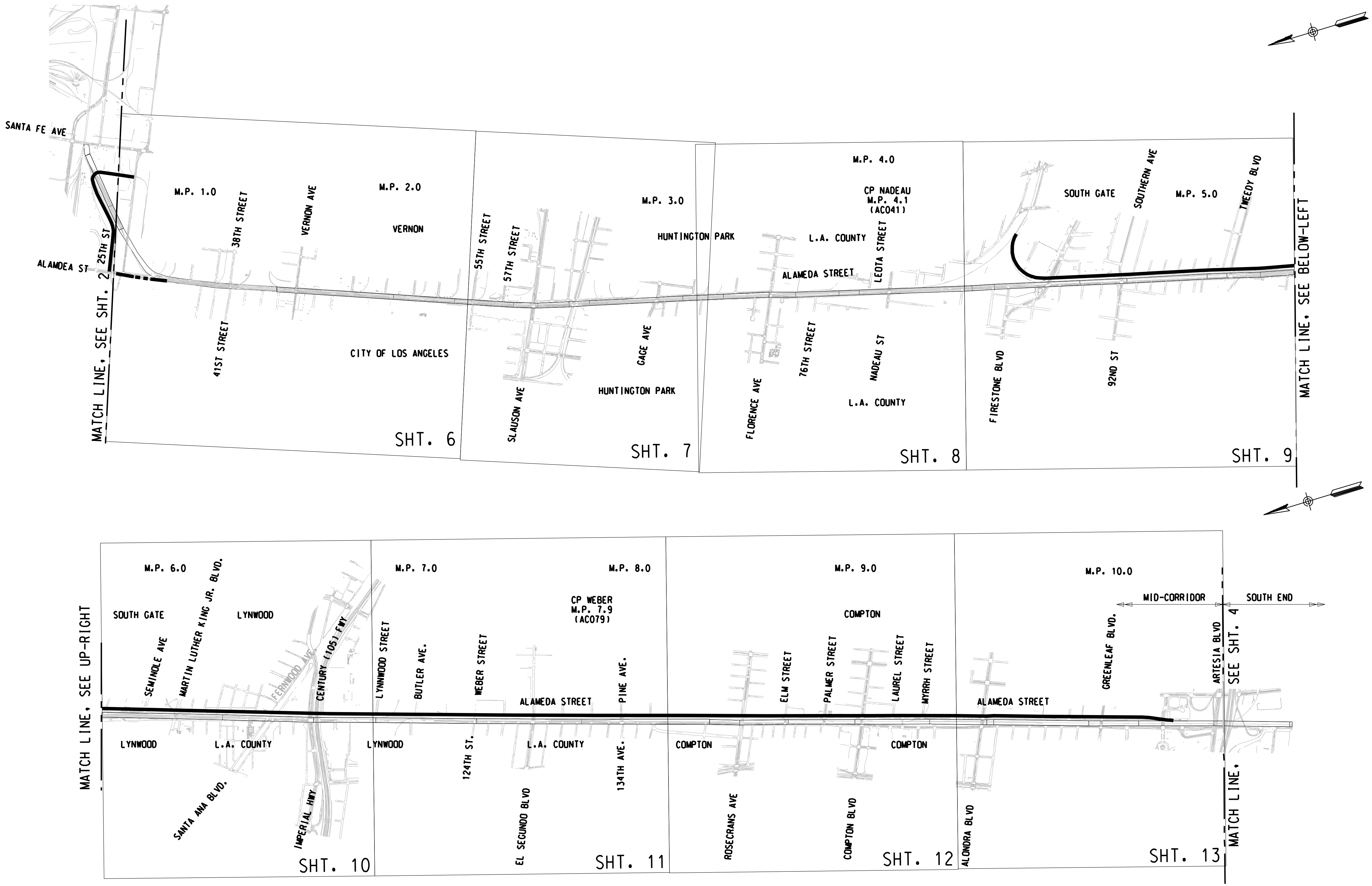

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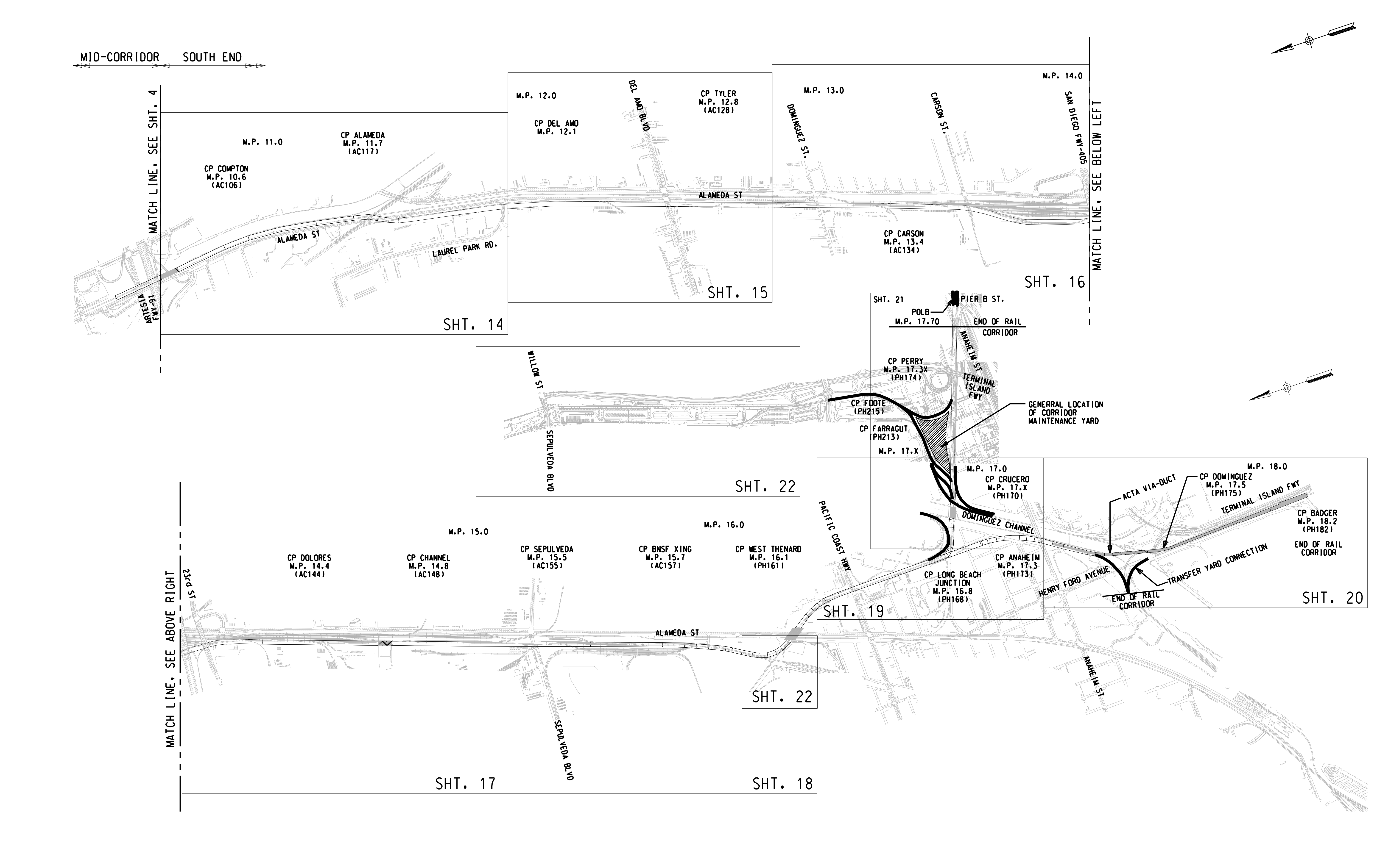

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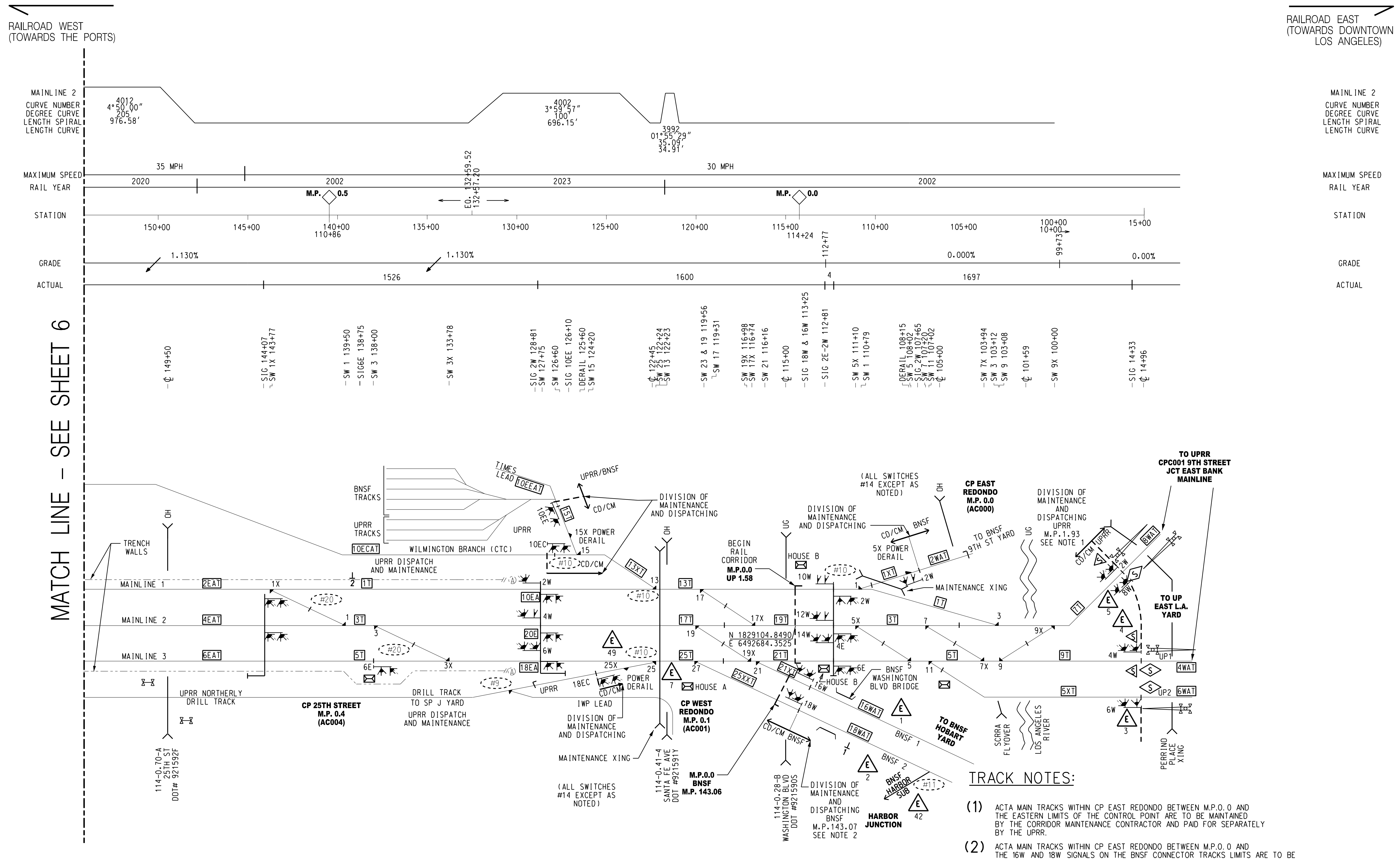

TRACK NOTES:

(1) ACTA MAIN TRACKS WITHIN CP EAST REDONDO BETWEEN M.P.0.0 AND THE EASTERN LIMITS OF THE CONTROL POINT ARE TO BE MAINTAINED BY THE CORRIDOR MAINTENANCE CONTRACTOR AND PAID FOR SEPARATELY BY THE UPRR.

(2) ACTA MAIN TRACKS WITHIN CP EAST REDONDO BETWEEN M.P.0.0 AND THE 16W AND 18W SIGNALS ON THE BNSF CONNECTOR TRACKS LIMITS ARE TO BE MAINTAINED BY THE CORRIDOR MAINTENANCE CONTRACTOR AND PAID FOR SEPARATELY BY THE BNSF. RAIL IN CURVES WITHIN THESE LIMITS IS 141RE.

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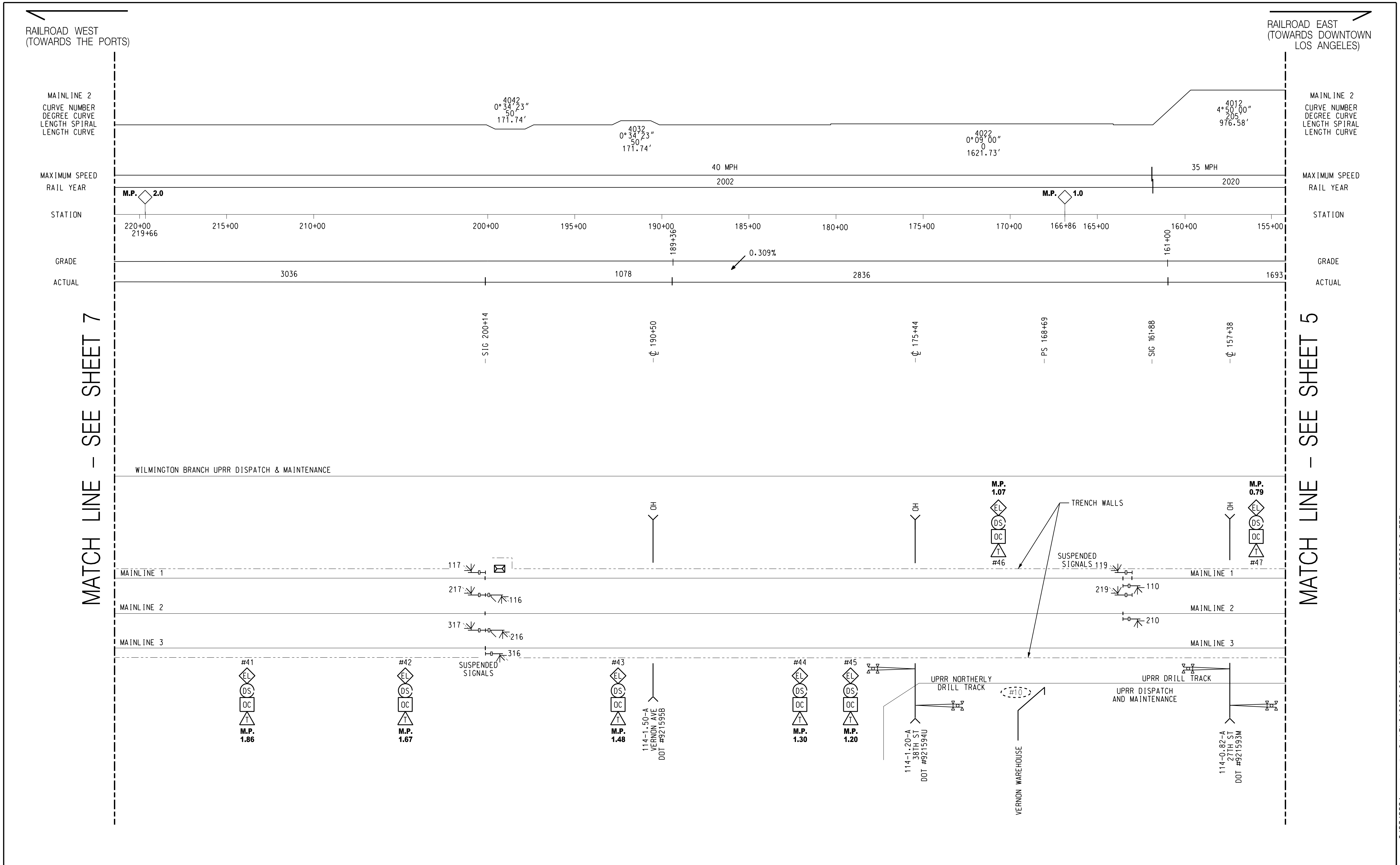

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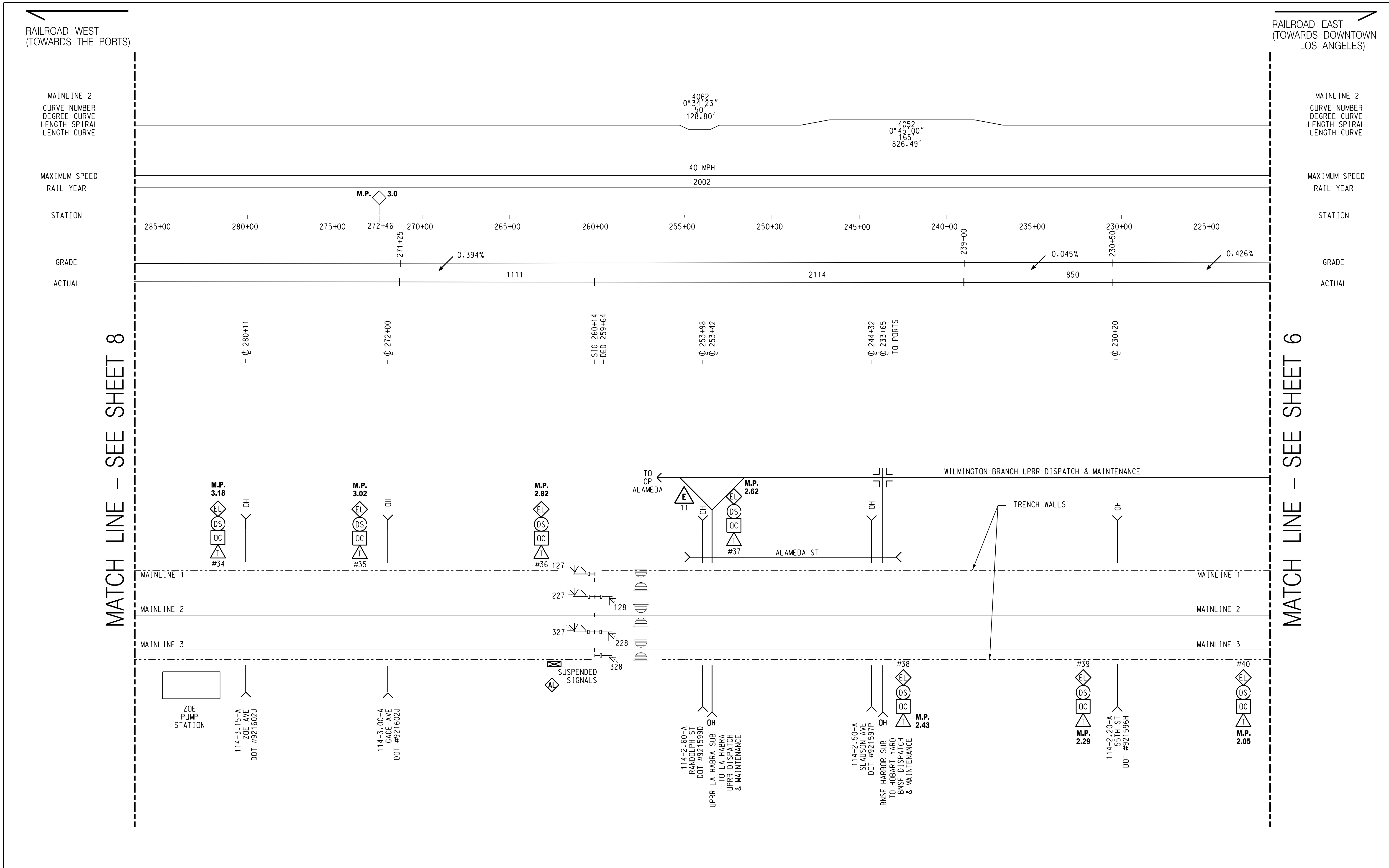

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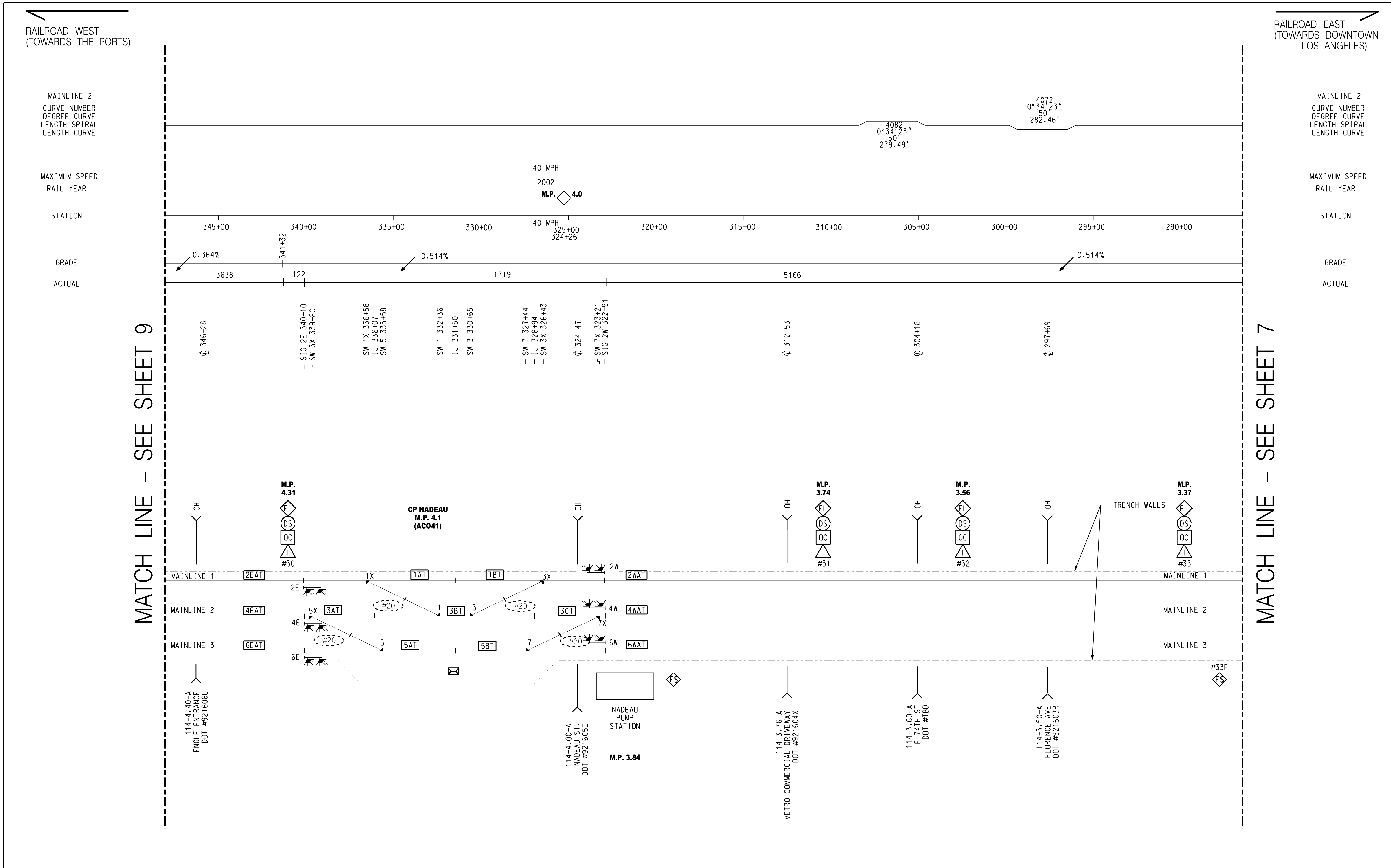

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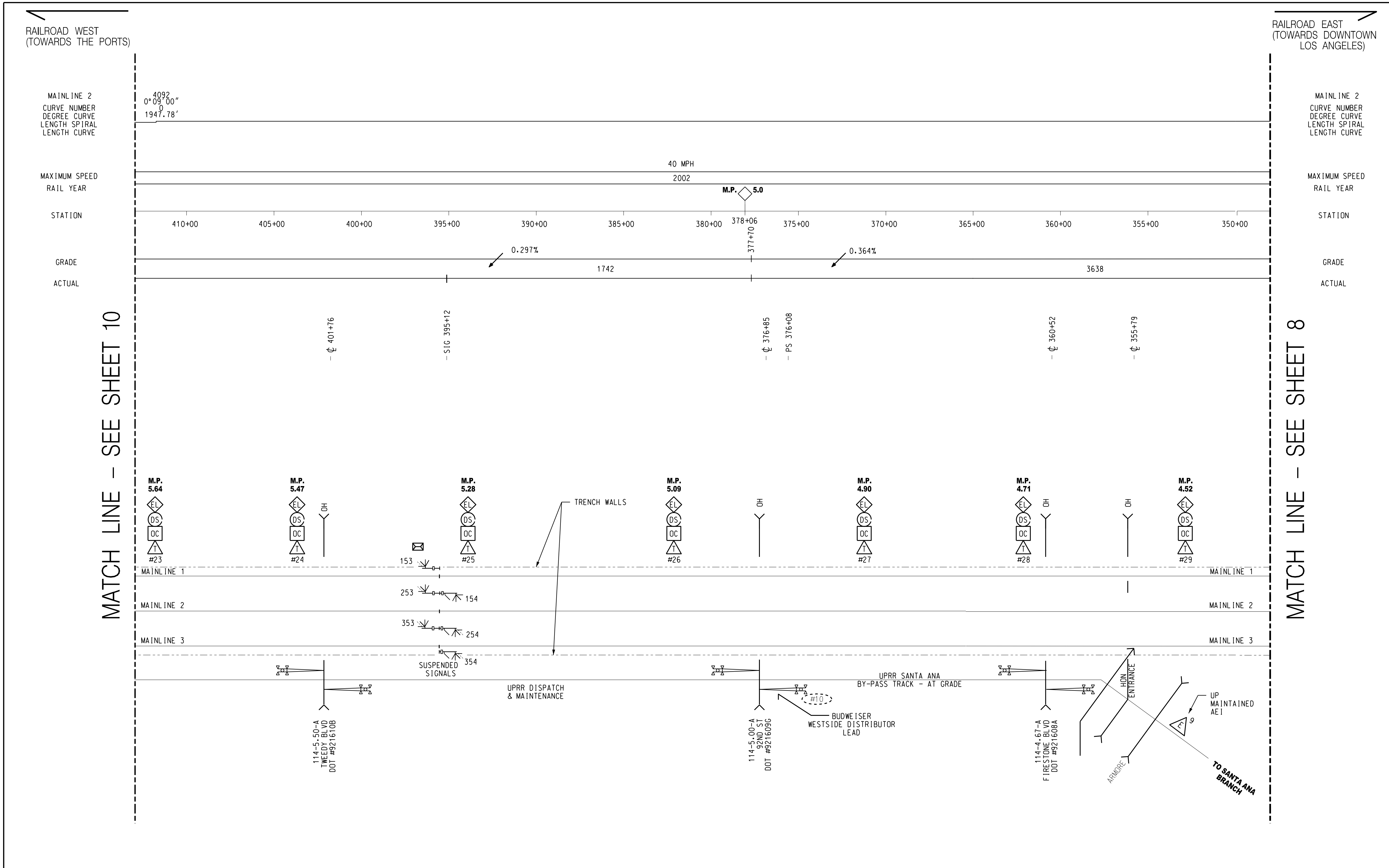

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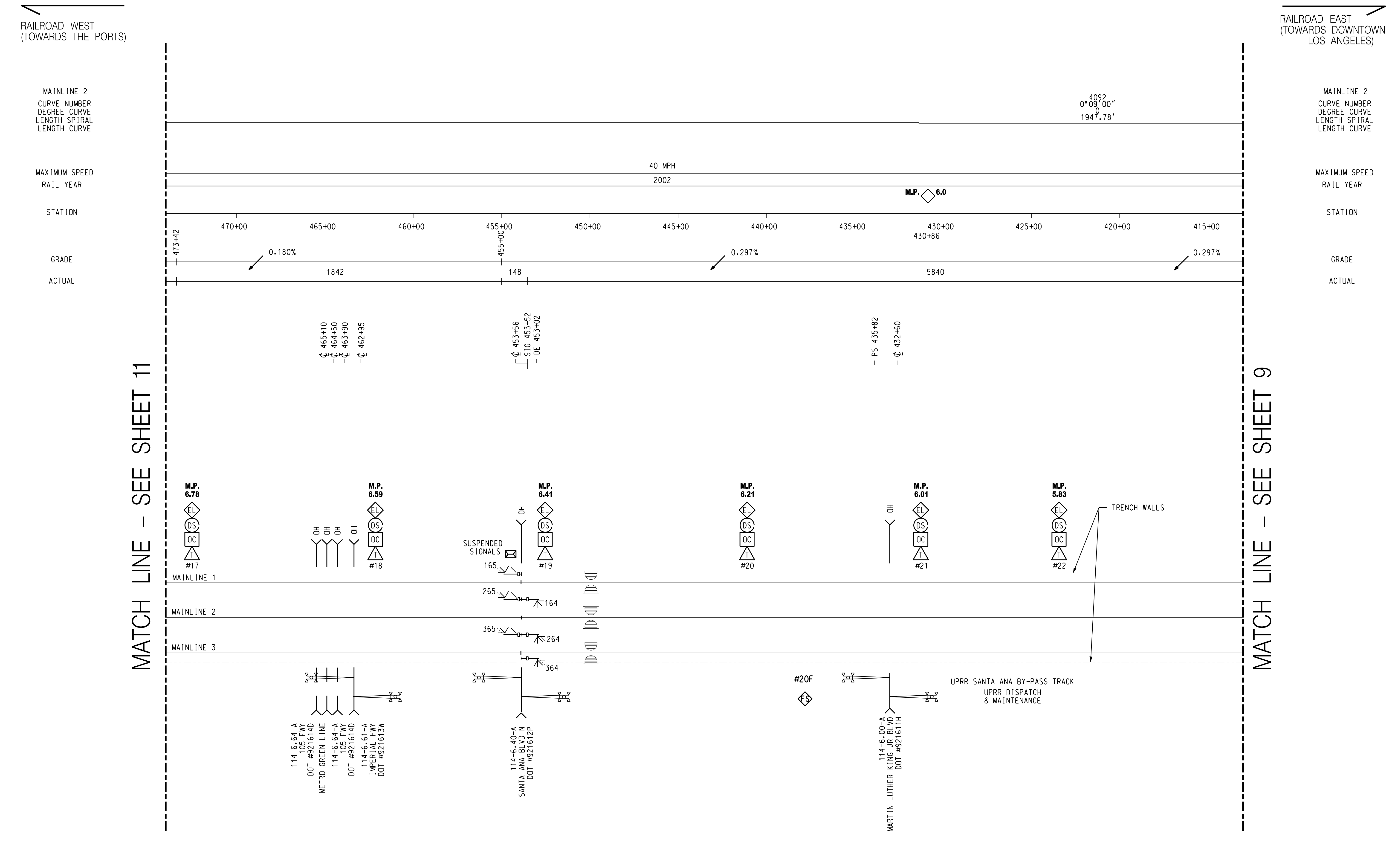

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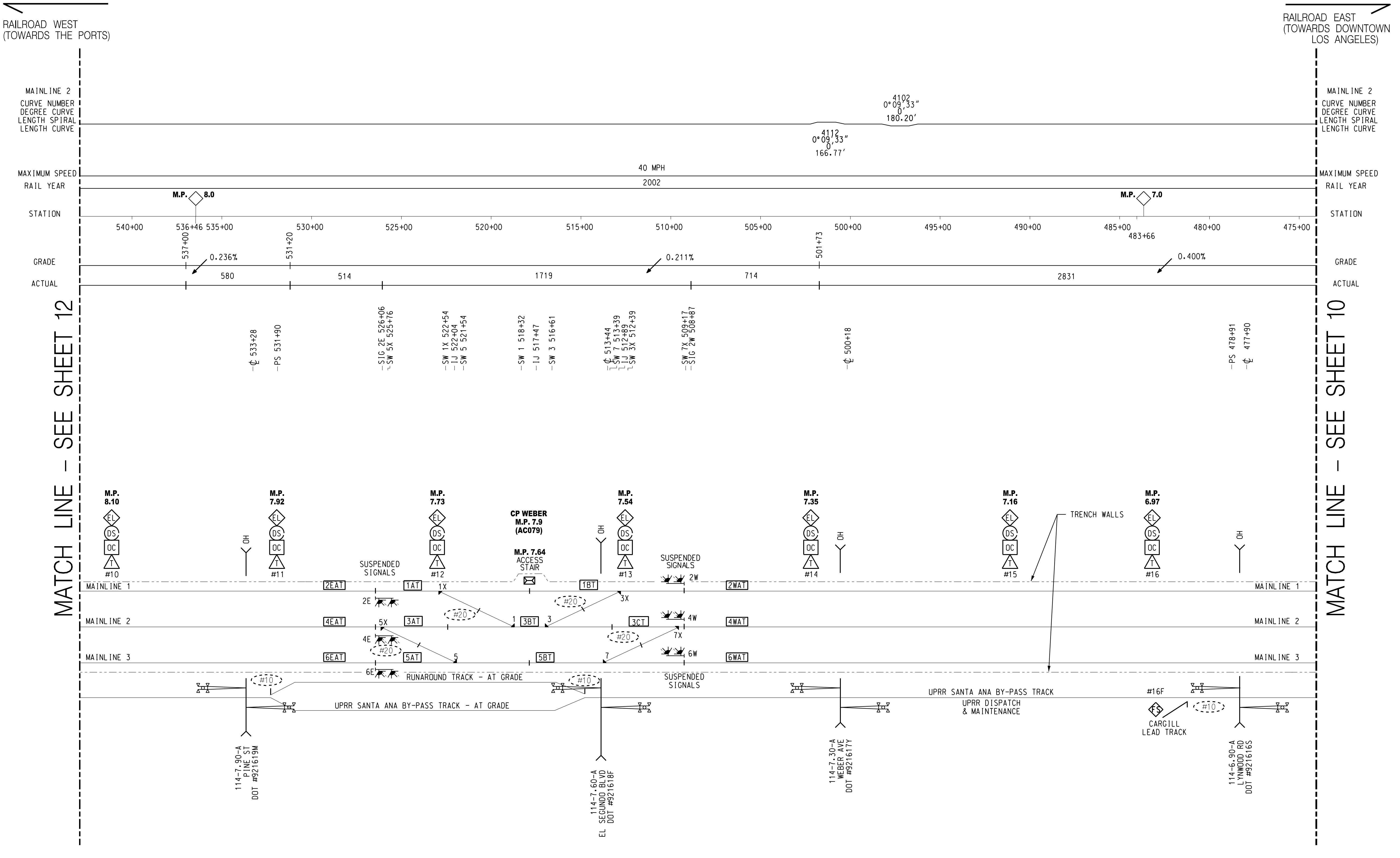

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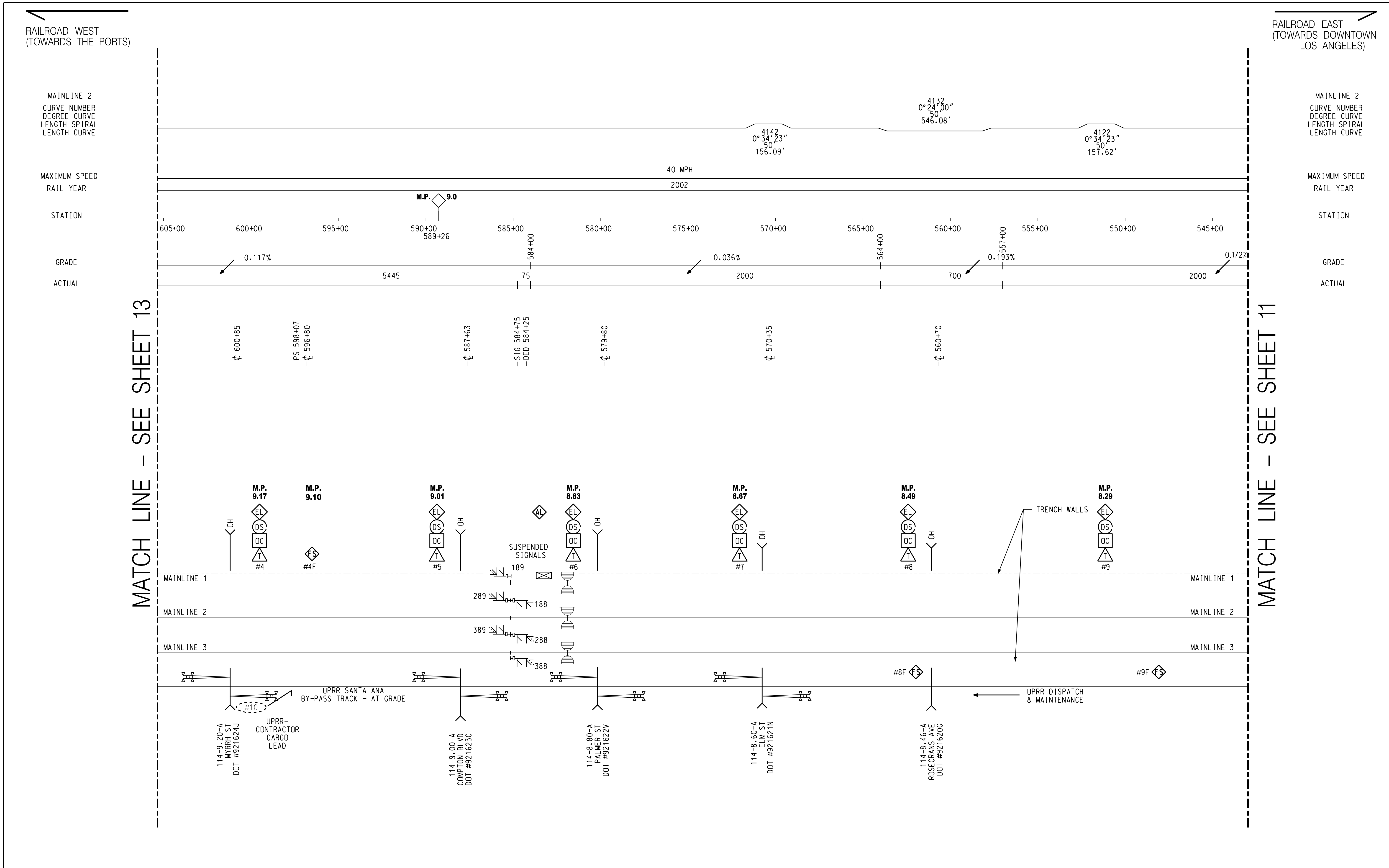

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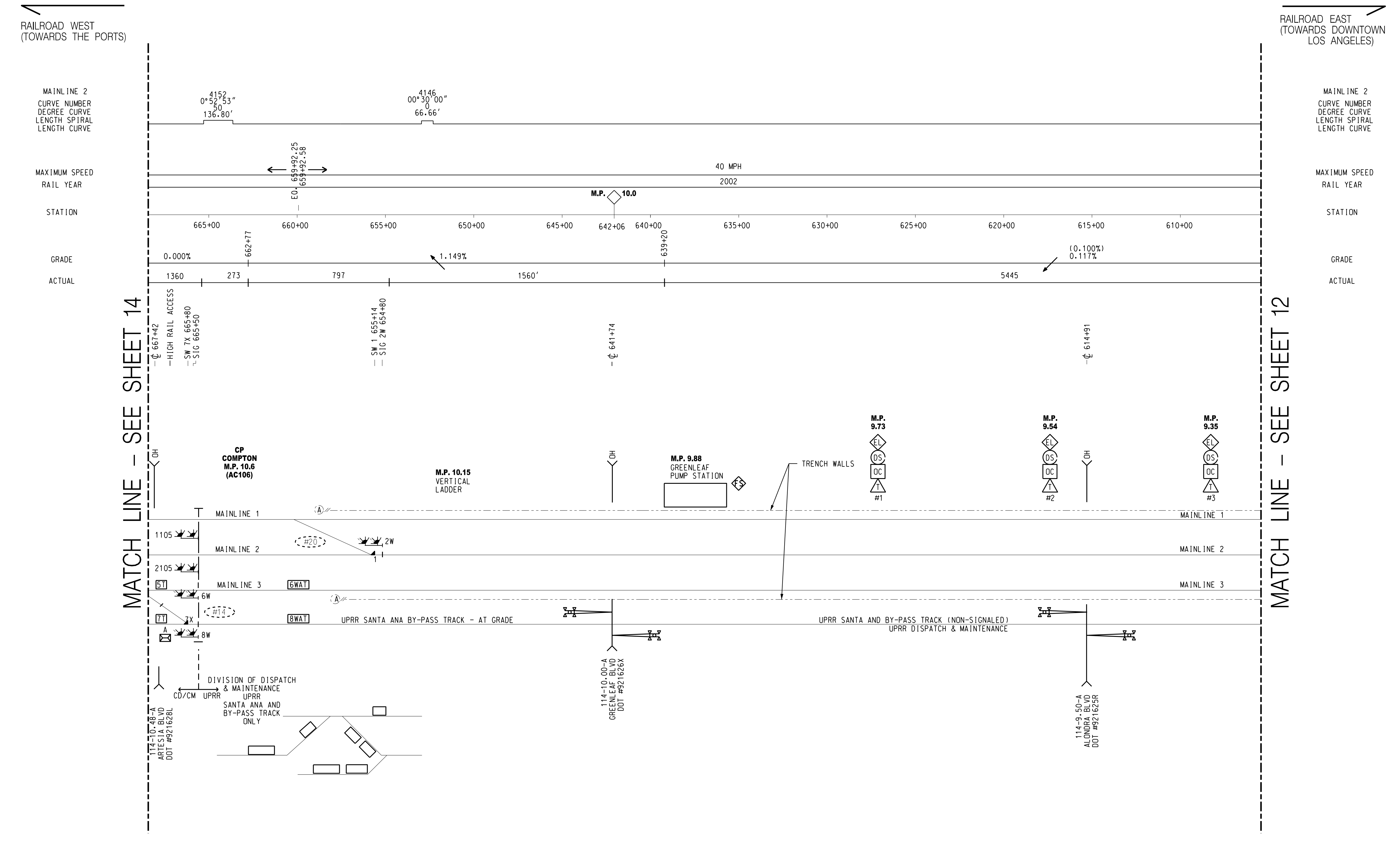

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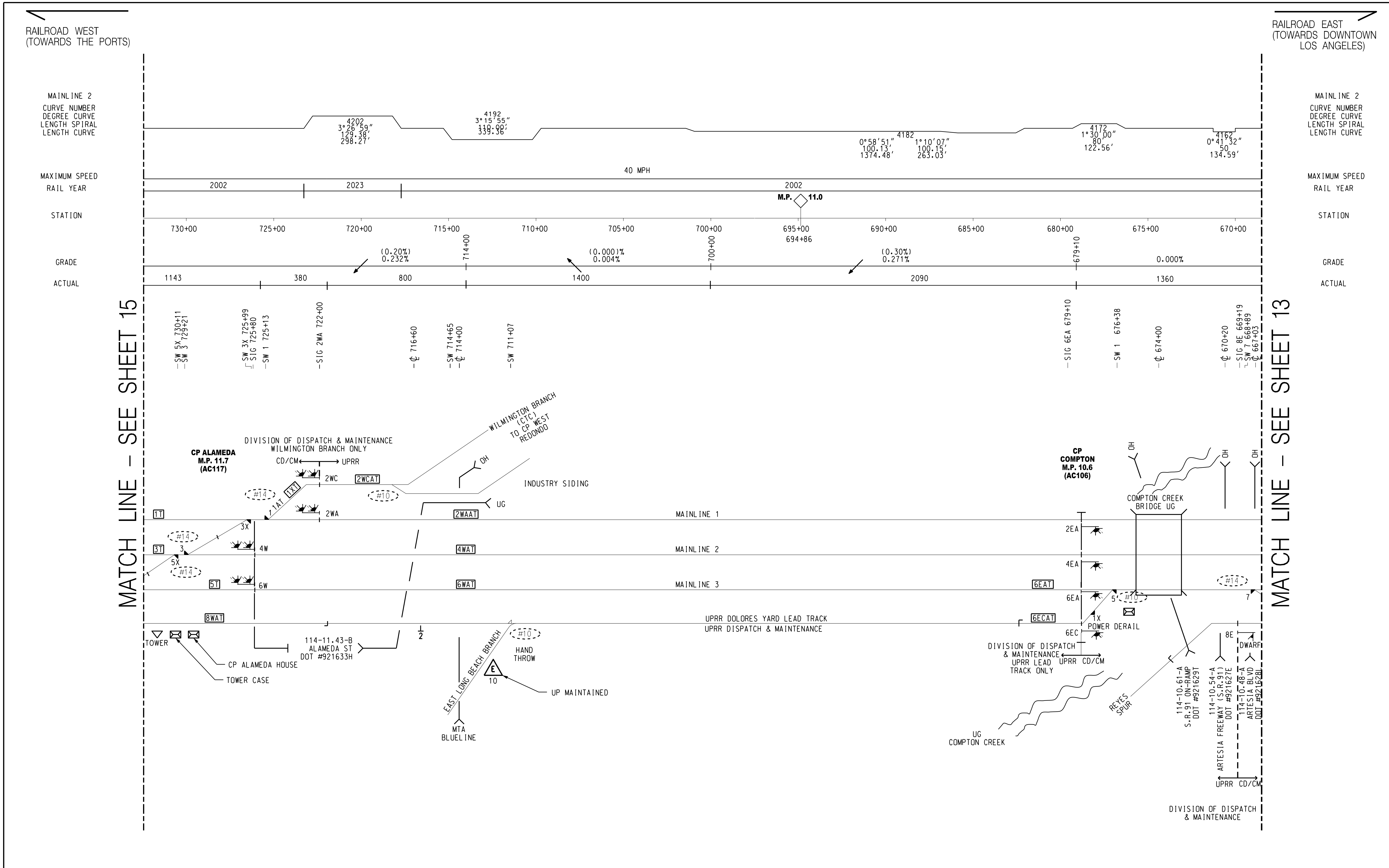

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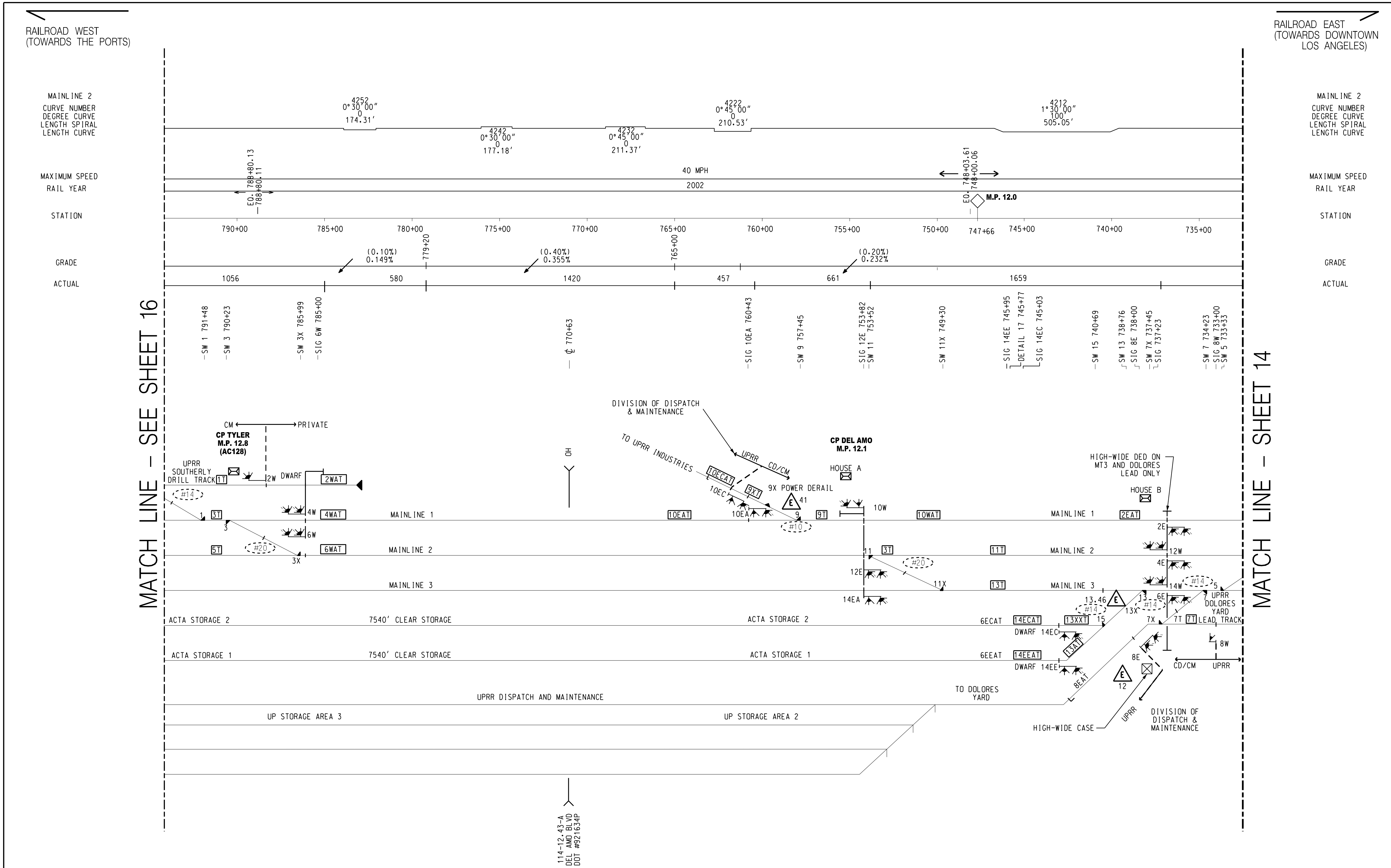

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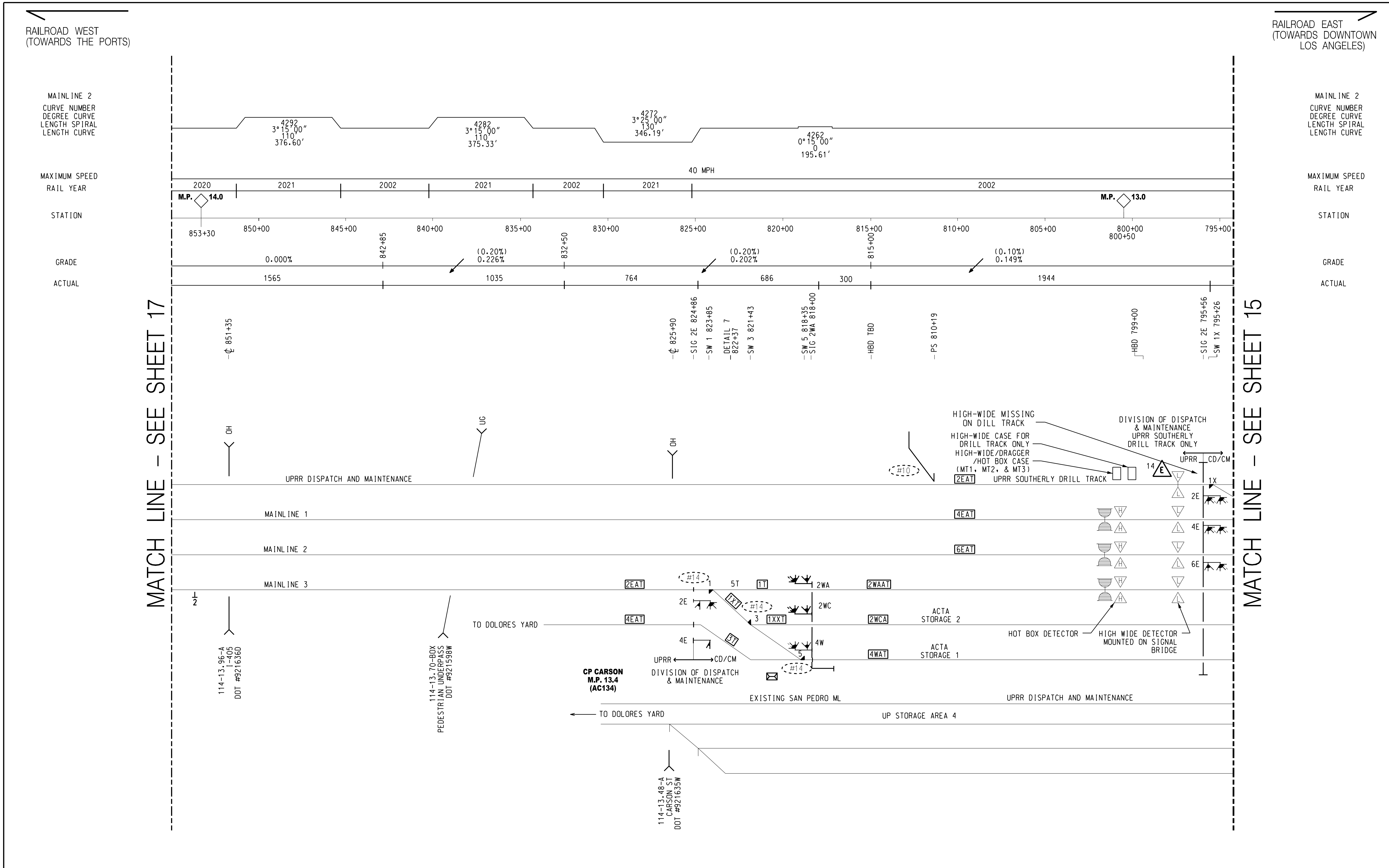

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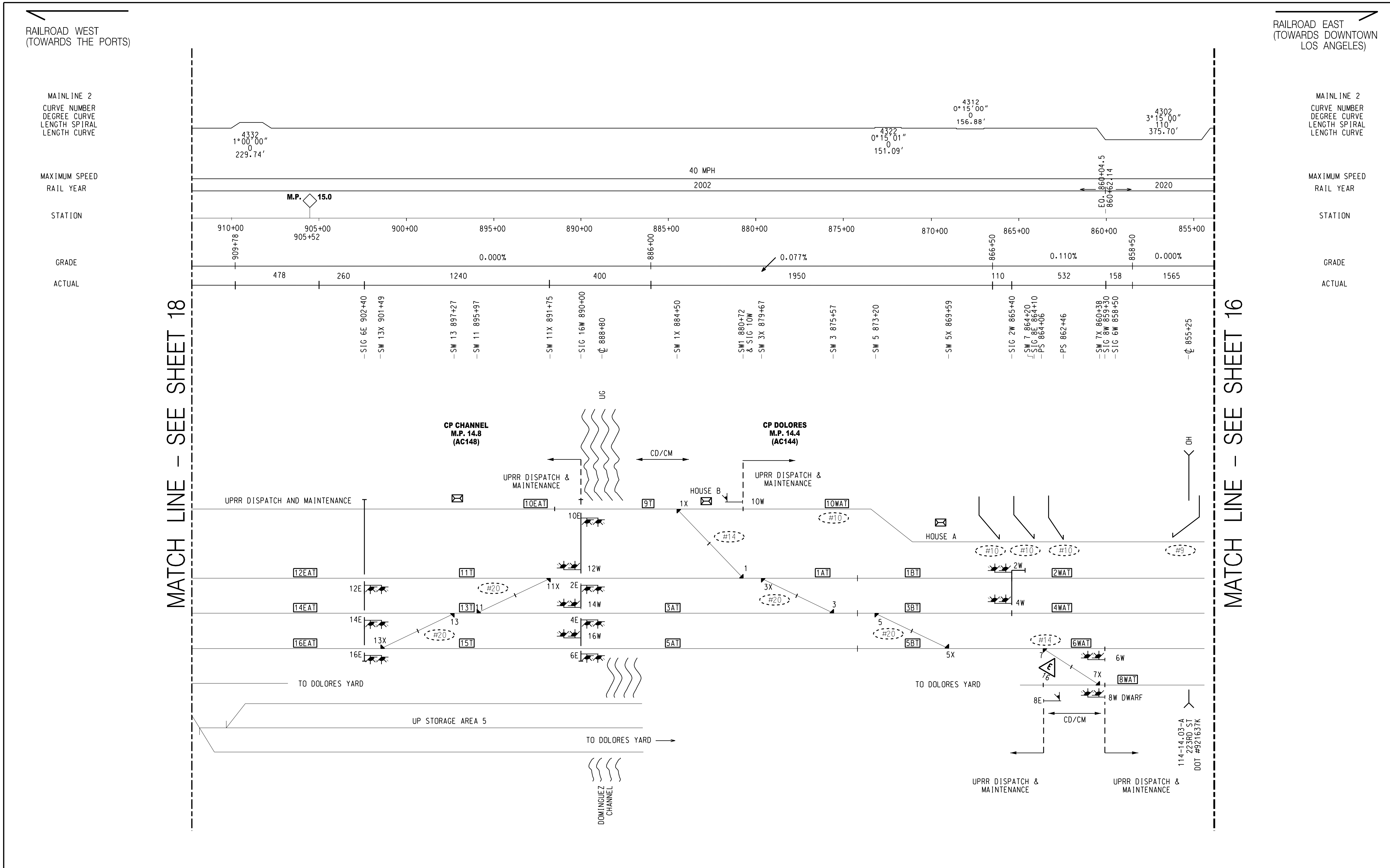

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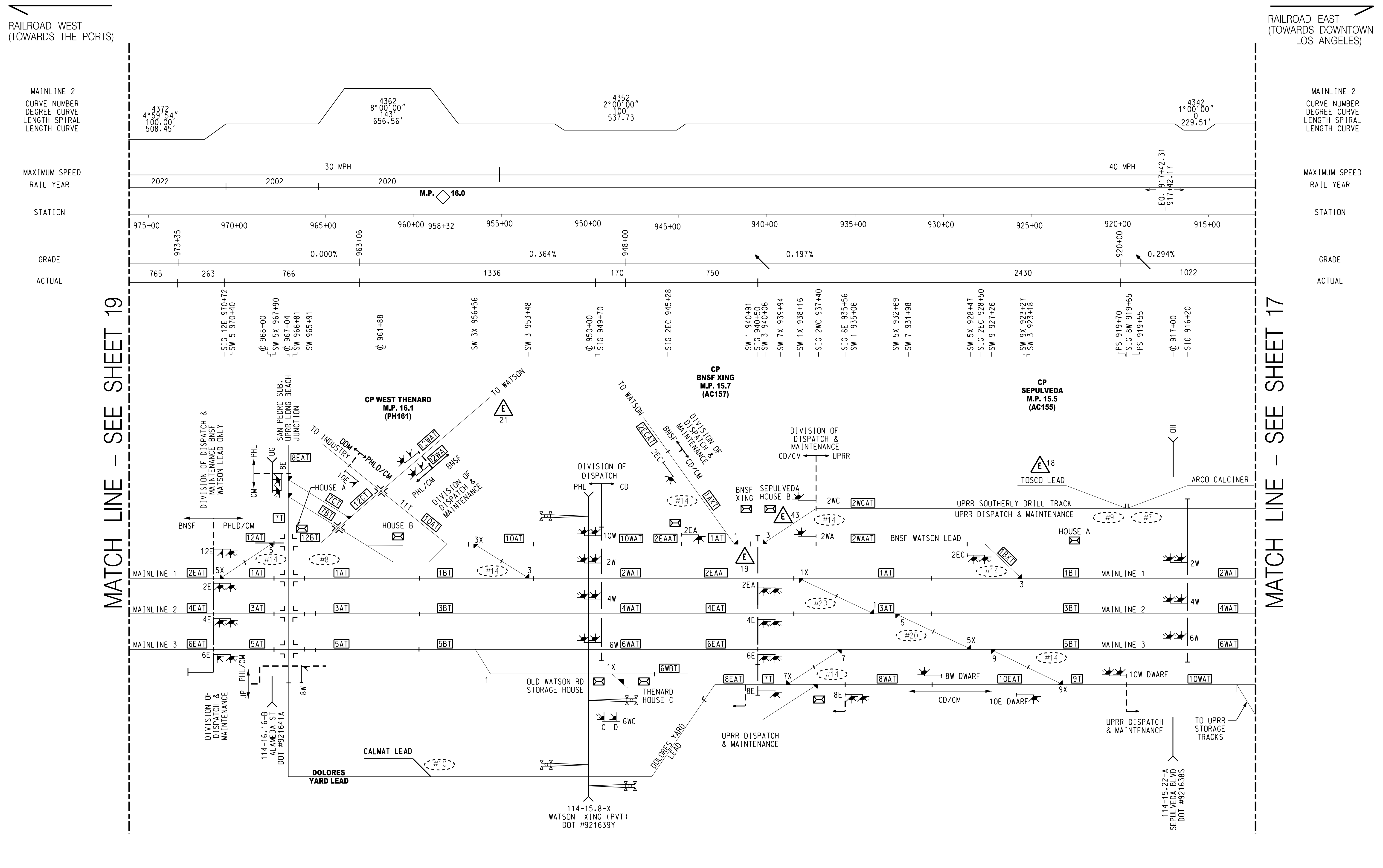

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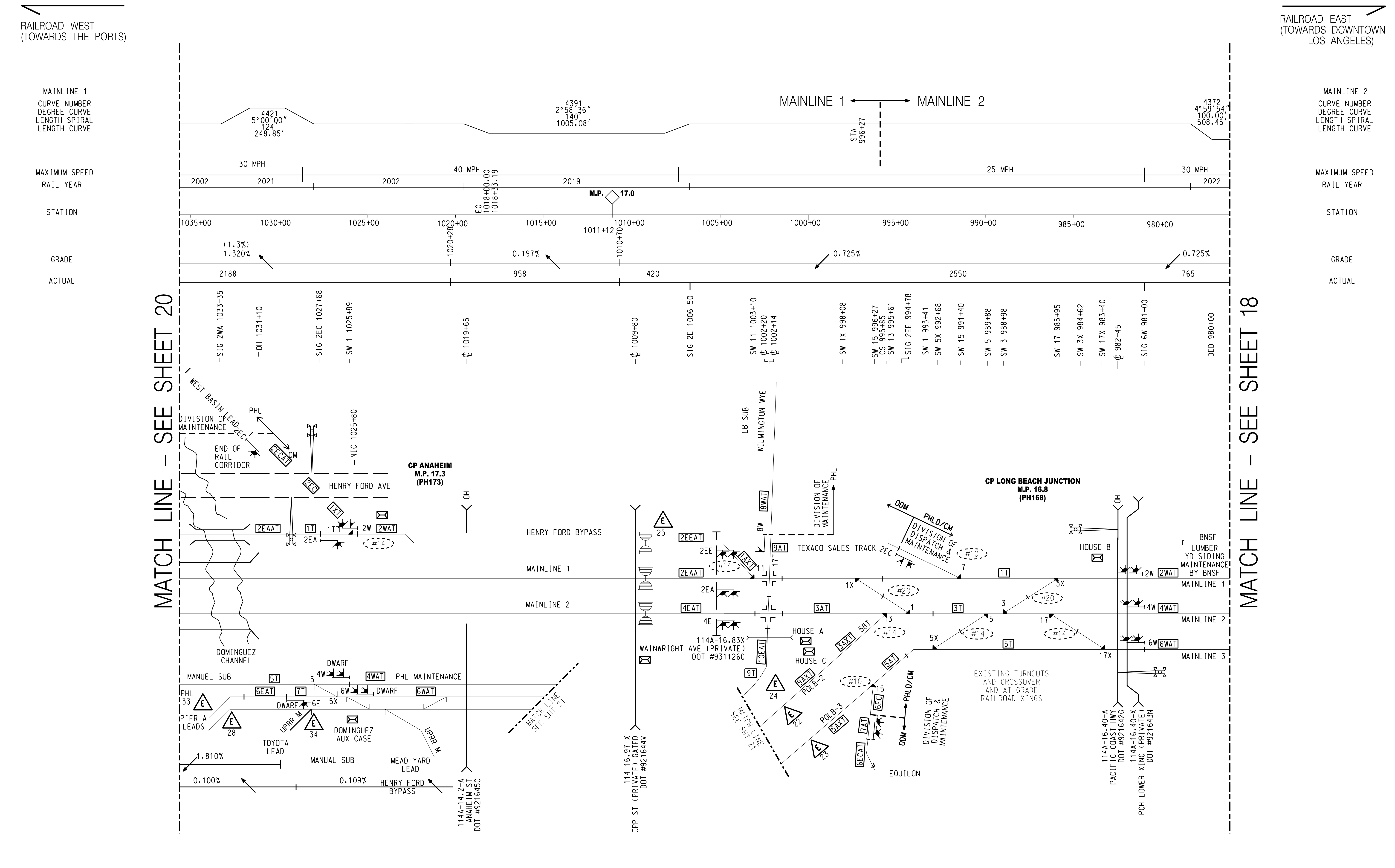

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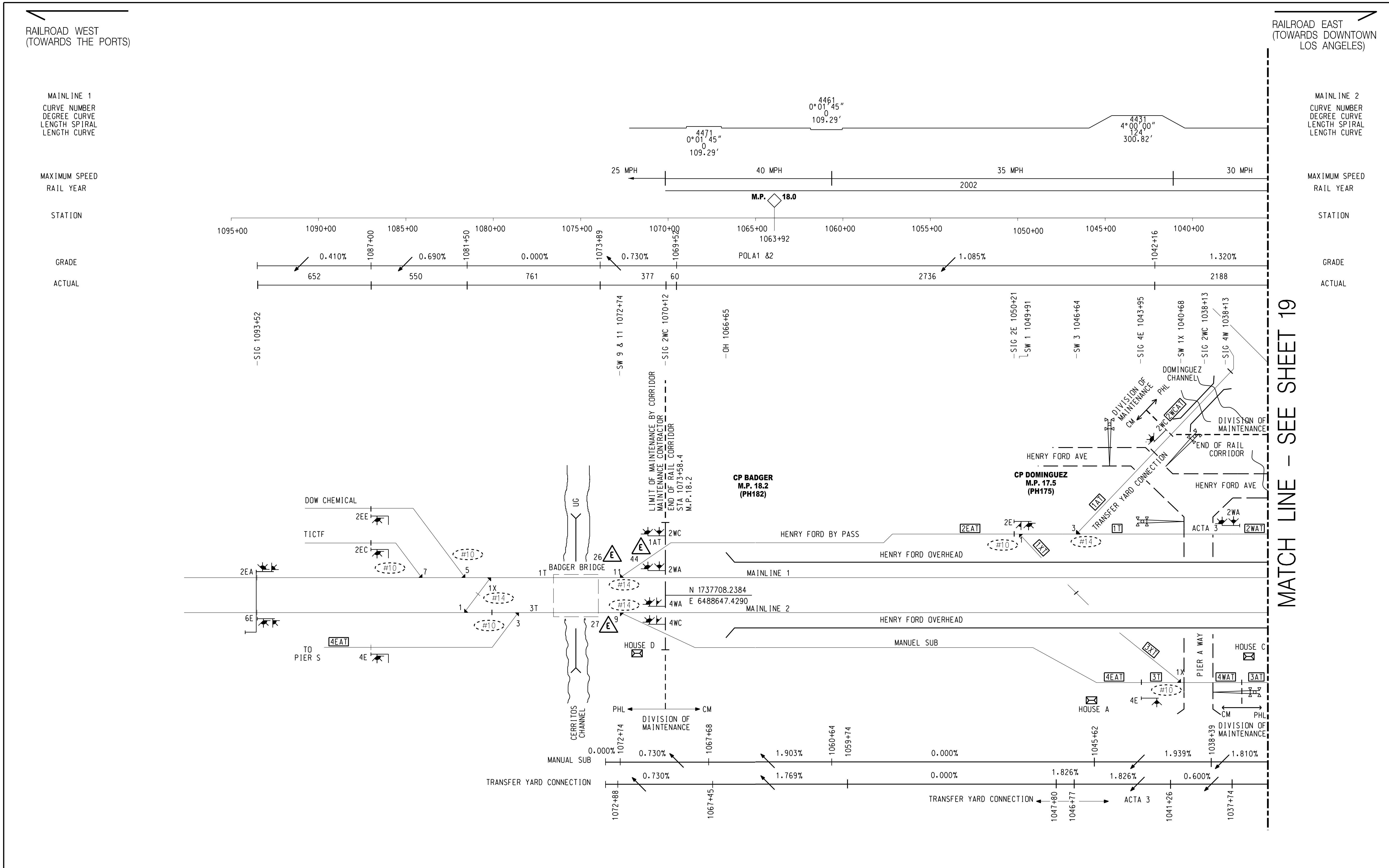

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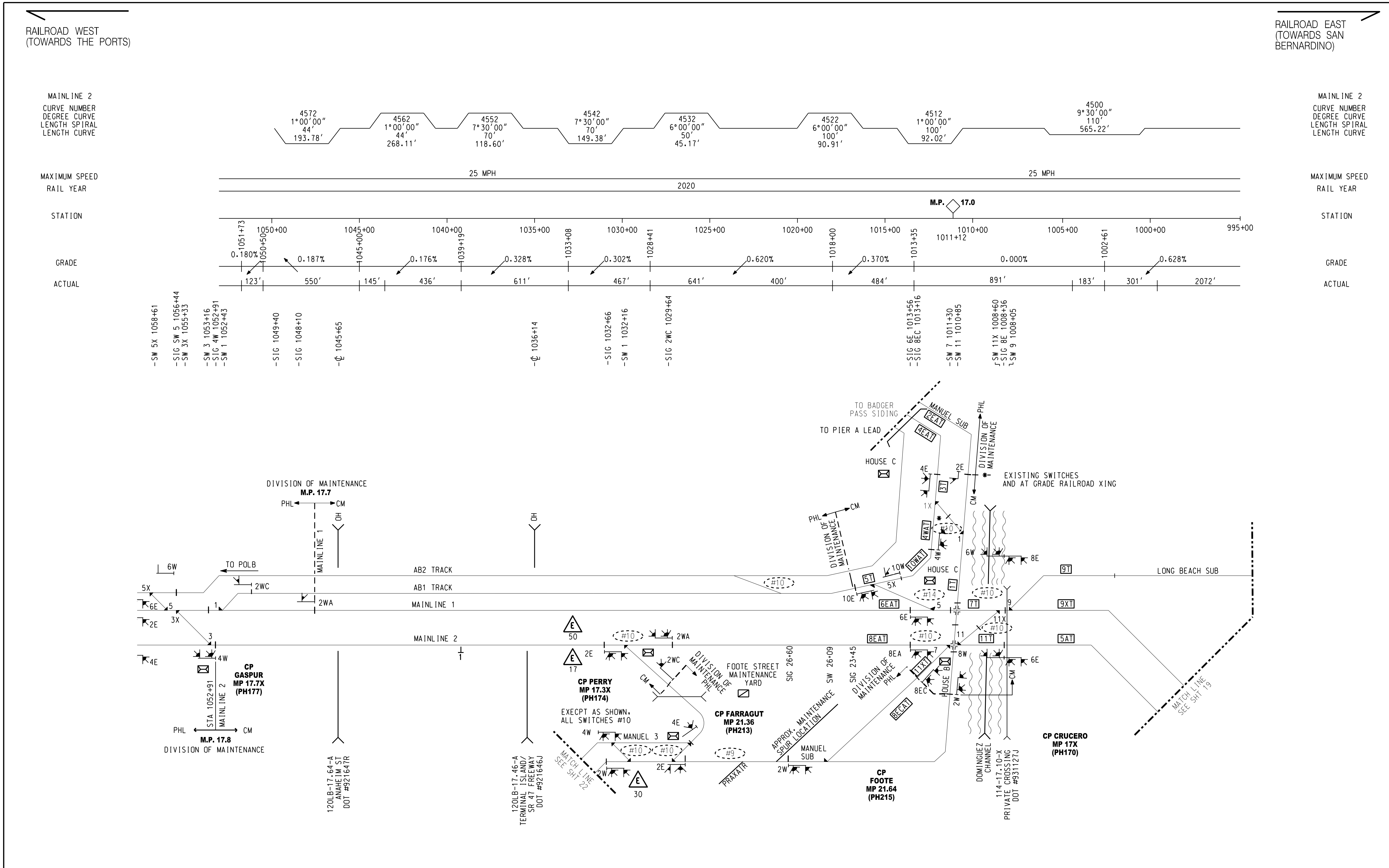

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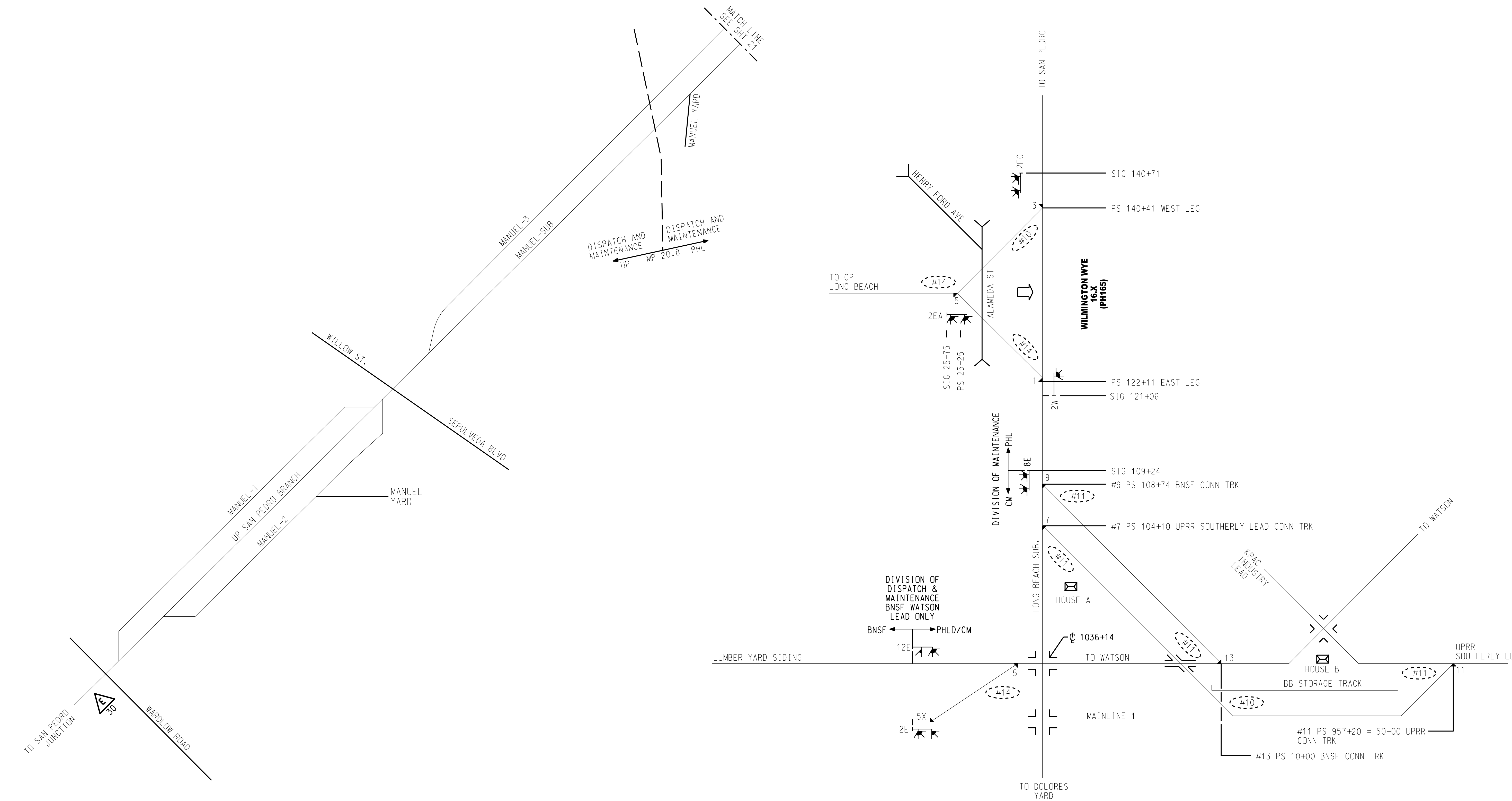

ALAMEDA CORRIDOR TRANSPORTATION AUTHORITY TRACK CHART | **REVISED: 09/23/2024** | **SCALE: 1" = 500' (HORIZONTAL ONLY)** | **SHEET # 22**

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Maintenance of Way Services

Appendix C

ACTA Maintenance Yard Location

Corridor Maintenance Facilities
Yard
Pkg
Bldg
Foote Ave.
Opp St.
Farragut Ave.
Grant St.
Terminal Island Fwy
Access from IT Fwy
I St.
Access from Anaheim St.
Terminal Island Fwy
Anaheim St
Google earth
Gray Buildings © 2011 CyberCity
900 ft
N

Maintenance of Way Services

Appendix D

Department of Industrial Relations (DIR) Form

DIR FORM 01

For the Contractor and all subcontractors listed in a proposal, provide the information requested below and submit this form with the proposal along with a page showing DIR registration confirmation from the DIR website for each listed firm.

	Firm Name	DIR Registration Number	Work Categories
Proposing Firm			
Subconsultants			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

Add additional pages as necessary.

Maintenance of Way Services

Appendix E

Sample Annual Budget Forms

Sample Alameda Corridor - Maintenance of Way (MOW) Budget

(Number and title of positions, estimated hours, and cost shares shown below are examples only and are subject to revision based on actual work)

1. LABOR COSTS			20xx	R.R. M&O - Rail Cost	Res. Acct. Non-Rail Cost	ACTA Operating Budget Cost	Previous Year
	SUBTOTAL 1:	18.5 Staff Positions	$ -	$ -	$ -	$ -	$ -

2. OPERATIONS MAINTENANCE				20xx	R.R. M&O - Rail Share	R.R. M&O - Rail Cost	Res. Acct. Non-Rail Share	Res. Acct. Non-Rail Cost	ACTA Operating Budget Share	ACTA Operating Budget Cost	Previous Year
2.b	Pump Station Maintenance			$ -	0.0%	$ -	100.0%	$ -	0.0%	$ -	$ -
2.b.i	Pump Station Repairs and Supplies (Subcontractor)			$ -	0.0%	$ -	100.0%	$ -	0.0%	$ -	$ -
2.c	AEI & Other Communications Maintenance			$ -	62.3%	$ -	0.0%	$ -	37.7%	$ -	$ -
2.d	Rail Flaw Detection (Subcontractor)			$ -	100.0%	$ -	0.0%	$ -	0.0%	$ -	$ -
2.e	Graffiti Control			$ -	0.0%	$ -	100.0%	$ -	0.0%	$ -	$ -
2.f	Weed Abatement (Subcontractor)			$ -	80.0%	$ -	20.0%	$ -	0.0%	$ -	$ -
2.g	Safety Training (Subcontractor)			$ -	85.0%	$ -	15.0%	$ -	0.0%	$ -	$ -
2.h	Safety Management			$ -	85.0%	$ -	15.0%	$ -	0.0%	$ -	$ -
2.i	Vehicles			$ -	75.0%	$ -	25.0%	$ -	0.0%	$ -	$ -
2.l	Full-Time Equipment			$ -	100.0%	$ -	0.0%	$ -	0.0%	$ -	$ -
2.m	Maintenance Program Rail Grinding - (50% of Total Cost)			$ -	100.0%	$ -	0.0%	$ -	0.0%	$ -	$ -
2.n	Track Materials / Supplies / Rentals			$ -	100.0%	$ -	0.0%	$ -	0.0%	$ -	$ -
2.o	Signal Maintenance (Subcontractor)			$ -	100.0%	$ -	0.0%	$ -	0.0%	$ -	$ -
2.p	Ladder / Fence / Traffic Support (Subcontractor)			$ -	0.0%	$ -	100.0%	$ -	0.0%	$ -	$ -
2.q	Security - Trench Cameras			$ -	70.0%	$ -	25.0%	$ -	5.0%	$ -	$ -
2.r	Security / Yard & Office Maintenance & Support (Subcontractor)			$ -	100.0%	$ -	0.0%	$ -	0.0%	$ -	$ -
2.s	Underwater Bridge Inspection (Completed in 2023. Occurs again in 2028)			$ -	100.0%	$ -	0.0%	$ -	0.0%	$ -	$ -
2.t	Trench Ditch Cleaning			$ -	0.0%	$ -	100.0%	$ -	0.0%	$ -	$ -
2.w	Railroad Reporting and Record Keeping Software System (Subcontractor)			$ -	100.0%	$ -	0.0%	$ -	0.0%	$ -	$ -
2.x	Railroad Emergency Drill Exercise			$ -	100.0%	$ -	0.0%	$ -	0.0%	$ -	$ -
2.dd	Bridge Inspections (Subcontractor)			$ -	100.0%	$ -	0.0%	$ -	0.0%	$ -	$ -
2.ee	Communication System Repair			$ -	100.0%	$ -	0.0%	$ -	0.0%	$ -	$ -
	SUBTOTAL 2:			$ -		$ -		$ -		$ -	$ -

3. CAPITAL COSTS				20xx	R.R. M&O - Rail Share	R.R. M&O - Rail Cost	Res. Acct. Non-Rail Share	Res. Acct. Non-Rail Cost	ACTA Operating Budget Share	ACTA Operating Budget Cost	Previous Year
3.a	Surfacing & Mobilization			$ -	0.0%	$ -	100.0%	$ -	0.0%	$ -	$ -
3.c	Reballast Program - Labor & Equipment			$ -	0.0%	$ -	100.0%	$ -	0.0%	$ -	$ -
3.d	Reballast Program - Ballast			$ -	0.0%	$ -	100.0%	$ -	0.0%	$ -	$ -
3.f	Capital Program Rail Grinding - (50% of Total Cost)			$ -	0.0%	$ -	100.0%	$ -	0.0%	$ -	$ -
3.h-2	Replace 20 Frogs			$ -	0.0%	$ -	100.0%	$ -	0.0%	$ -	$ -
3.h-3	Replace 40 Switch Points and Stock Rails			$ -	0.0%	$ -	100.0%	$ -	0.0%	$ -	$ -
3.h-5	Insulated Joint Replacement			$ -	0.0%	$ -	100.0%	$ -	0.0%	$ -	$ -
3.o	Pump Station Upgrades (Subcontractor)			$ -	0.0%	$ -	100.0%	$ -	0.0%	$ -	$ -
3.r	Trench Emergency Ladder, Stair Study, & Repairs (Subcontractor)			$ -	0.0%	$ -	100.0%	$ -	0.0%	$ -	$ -
3.aa-1	Replace Long Beach Diamonds			$ -	0.0%	$ -	100.0%	$ -	0.0%	$ -	$ -
3.gg-3	Curve Rail Replacement			$ -	0.0%	$ -	100.0%	$ -	0.0%	$ -	$ -
3.ll	Fixed Trench Ladders (Subcontractor)			$ -	0.0%	$ -	100.0%	$ -	0.0%	$ -	$ -
3.mm	Miscellaneous Trench Structure Repairs (Subcontractor)			$ -	0.0%	$ -	100.0%	$ -	0.0%	$ -	$ -
3.nn	Compton Bridges - Replace Deck Ties			$ -	0.0%	$ -	100.0%	$ -	0.0%	$ -	$ -
3.oo	Replacement of M23A Switches Machines			$ -	0.0%	$ -	100.0%	$ -	0.0%	$ -	$ -
3.qq	Furnish and Replace Rail Lubricator Systems			$ -	0.0%	$ -	100.0%	$ -	0.0%	$ -	$ -
3.rr	Corridor Signal Maintenance - Construction			$ -	0.0%	$ -	100.0%	$ -	0.0%	$ -	$ -
	SUBTOTAL 3			$ -		$ -		$ -		$ -	$ -
	GRAND TOTAL 1, 2, 3:			$ -		$ -		$ -		$ -	$ -

1. Sample ACTA Labor Costs

(Number and title of positions, estimated hours, and cost shares shown below are examples only and are subject to revision based on actual work)

1. LABOR		Positions	Needed Portion	EST Hours	20xx Hourly RATE	OT RATE	OT * VALUE	DT RATE	DT ** VALUE	20xx VALUE	R.R. M & O Rail Share	R.R. M & O Rail Cost	R.R. M & O Rail Hours	Reserve Account Non-Rail Share	Reserve Account Non-Rail Cost	Reserve Account Non-Rail Hours	ACTA Operating Budget Share	ACTA Operating Budget Cost	ACTA Operating Budget Hours	Previous Year Approved Budget
MANAGEMENT POSITIONS																				
1.a.i	Contract Manager	1	100.0%	2000	$ -	N/A	N/A	N/A	N/A	$ -	70.0%	$ -	1,400	20.0%	$ -	400	10.0%	$ -	200	$ -
1.a.ii	Track Supervisor	1	100.0%	2000	$ -	N/A	N/A	N/A	N/A	$ -	80.0%	$ -	1,600	20.0%	$ -	400	0.0%	$ -	-	$ -
1.a.iii	Safety Supervisor	1	100.0%	2000	$ -	N/A	N/A	N/A	N/A	$ -	80.0%	$ -	1,600	20.0%	$ -	400	0.0%	$ -	-	$ -
1.a.iv	Office Manager	1	100.0%	2000	$ -	N/A	N/A	N/A	N/A	$ -	50.0%	$ -	1,000	50.0%	$ -	1,000	0.0%	$ -	-	$ -
1.a.v	Office Assistant	0	100.0%	0	$ -	N/A	N/A	N/A	N/A	$ -	50.0%	$ -	-	50.0%	$ -	-	0.0%	$ -	-	$ -
																			-	
STAFF POSITIONS																			-	
1.b	Track Inspector	1	100.0%	2000	$ -	$ -	$ -	$ -	$ -	$ -	100.0%	$ -	2,000	0.0%	$ -	-	0.0%	$ -	-	$ -
1.b.i	Track Foreman	2	100.0%	4000	$ -	$ -	$ -	$ -	$ -	$ -	100.0%	$ -	4,000	0.0%	$ -	-	0.0%	$ -	-	$ -
1.b.ii	Assistant Foreman	0	100.0%	0	$ -	$ -	$ -	$ -	$ -	$ -	100.0%	$ -	-	0.0%	$ -	-	0.0%	$ -	-	$ -
1.b.iii	Track Laborers	4	100.0%	8000	$ -	$ -	$ -	$ -	$ -	$ -	97.5%	$ -	7,800	2.5%	$ -	200	0.0%	$ -	-	$ -
1.b.iv	Equipment Operators	1.5	100.0%	3000	$ -	$ -	$ -	$ -	$ -	$ -	92.5%	$ -	2,775	7.5%	$ -	225	0.0%	$ -	-	$ -
1.b.v	Welder	2	100.0%	4000	$ -	$ -	$ -	$ -	$ -	$ -	100.0%	$ -	4,000	0.0%	$ -	-	0.0%	$ -	-	$ -
1.b.vi	Welder Helper	1	100.0%	2000	$ -	$ -	$ -	$ -	$ -	$ -	100.0%	$ -	2,000	0.0%	$ -	-	0.0%	$ -	-	$ -
1.b.vii	Laborer (Non-Rail)	1	100.0%	2000	$ -	$ -	$ -	$ -	$ -	$ -	0.0%	$ -	-	100.0%	$ -	2,000	0.0%	$ -	-	$ -
1.b.viii	Foreman (Non-Rail)	1	100.0%	2000	$ -	$ -	$ -	$ -	$ -	$ -	0.0%	$ -	-	100.0%	$ -	2,000	0.0%	$ -	-	$ -
1.b.ix	Track Superintendent	1	100.0%	2000	$ -	$ -	$ -	$ -	$ -	$ -	50.0%	$ -	1,000	50.0%	$ -	1,000	0.0%	$ -	-	$ -
		18.5		37000					SUBTOTAL 1:	$ -		$ -	29,175		$ -	7,625		$ -	200	$ -

* OT Value Based on Working 80 Hours of OT During Calendar Year = 3.85% of Base Hours

**DT Value Based on Working 24 Hours of DT During Year = 1.2% of Base Hours

Note: all rates are Fully Burden Labor Rate. Additional detail is available upon request.

2. Sample ACTA Operations Maintenance Budget Detail

2.o	Signal Maintenance	U of M	QTY	Rate	Split	Total
	Materials					
	Material Ongoing Purchases Total = LS (RWKS purchase)	LS	1	$ -	100%	$ -
	Materials - Signal Battery Replacements	Ea	1	$ -	100%	$ -
	Subtotal - Materials					$ -
	RailWorks Labor & Equipment					
	HiRail Bucket Truck	Monthly		$ -	100%	$ -
	Foreman	HR		$ -	100%	$ -
	Foreman - OT	HR		$ -	100%	$ -
	Subtotal - RWs Labor & Equipment					$ -
	Subcontractor					
	Office Administrator	HR	1800	$ -	100%	$ -
	Signal / Comm Supervisor	HR	1800	$ -	100%	$ -
	Signal / Comm Supervisor - OT (Based on 1Q&2Q2022)	HR	75	$ -	100%	$ -
	Signal / Comm Supervisor - DT (Based on 1Q&2Q2022)	HR	25	$ -	100%	$ -
	Signal Test Maintainer	HR	2000	$ -	100%	$ -
	Signal Test Maintainer - OT (Based on 1Q&2Q2022)	HR	75	$ -	100%	$ -
	Signal Test Maintainer - DT (Based on 1Q&2Q2022)	HR	25	$ -	100%	$ -
	Signal Maintainer (4) - HBS Requesting a 5th Maintainer	HR	9500	$ -	100%	$ -
	Signal Maintainer - OT (Based on 1Q&2Q2022) - 900	HR	900	$ -	100%	$ -
	Signal Maintainer - DT (Based on 1Q&2Q2022) - 350	HR	350	$ -	100%	$ -
	Vehicle - Signal / Comm Supervisor	Monthly	12	$ -	100%	$ -
	Vehicle - Signal Test Maintainer	Monthly	12	$ -	100%	$ -
	Vehicle - Signal Maintainers (4) - HBS Requesting a 5th	Monthly	12	$ -	100%	$ -
	Vehicle - Signal Test Maintainer &/or Signal Maintainer for Call-Outs	HR	1350	$ -	100%	$ -
	Vehicle - Sig/Comm Supv &/or Signal Engineer for Call-Outs	HR	100	$ -	100%	$ -
	Vehicle - Safety Manager	Monthly	12	$ -	100%	$ -
	Equipment - Bucket Truck	Monthly	12	$ -	100%	$ -
	Safety Manager - ST	HR	1080	$ -	100%	$ -
	Safety Manager - OT	HR	0	$ -	100%	$ -
	Safety Manager - DT	HR	0	$ -	100%	$ -
						$ -
	Subtotal - Subcontractor					$ -
					SUBTOTAL:	$ -
			Materials	10%	Markup:	$ -
			Subcontractor	5%	Markup:	$ -
			Supplies	15%	Markup:	$ -
					TOTAL:	$ -

2.p	Ladder / Fence / Traffic Support	U of M	QTY	Rate	Split	Total
	Materials					
	Ladder Replacement Parts	LS	1	$ -	100%	$ -
	Subtotal - Materials					$ -
	Subcontractor					
	Traffic Support	LS	1	$ -	100%	$ -
	Fence Repair / Replacement	LS	1	$ -	100%	$ -
	Subtotal - Subcontractor					$ -
					SUBTOTAL:	$ -
			Materials	10%	Markup:	$ -
			Subcontractor	5%	Markup:	$ -
			Supplies	15%	Markup:	$ -
					TOTAL:	$ -

2.q	Security - Trench Cameras	U of M	QTY	Rate	Split	Total
	Motion Detector Replacement Parts	LS	1	$ -	100%	$ -
	Wire Replacement Subcontractor	LS	1	$ -	100%	$ -
	Camera Replacement Parts	LS	1	$ -	100%	$ -
					SUBTOTAL:	$ -
			Materials	10%	Markup:	$ -
			Subcontractor	5%	Markup:	$ -
			Supplies	15%	Markup:	$ -
					TOTAL:	$ -

3. Sample ACTA Capital Program

3.o	Pump Station Upgrades	U of M	QTY	Rate	Split	Total
	Materials	LS	1	$ -	100%	$ -
	Subcontractor	LS	1	$ -	100%	$ -
					SUBTOTAL:	$ -
			Materials	10%	Markup:	$ -
			Subcontractor	5%	Markup:	$ -
			Supplies	15%	Markup:	$ -
					TOTAL:	$ -

3.r	Trench Emergency Ladder, Stair Study, & Repairs	U of M	QTY	Rate	Split	Total
	Materials - Parts and other materials	LS	1	$ -	100%	$ -
	Subcontractor	LS	1	$ -	100%	$ -
					SUBTOTAL:	$ -
			Materials	10%	Markup:	$ -
			Subcontractor	5%	Markup:	$ -
			Supplies	15%	Markup:	$ -
					TOTAL:	$ -

3.aa-1	Replace Long Beach Diamonds (procurement into 2024)	U of M	QTY	Rate	Split	Total
	RailWorks Labor & Equipment					
	Foreman	Hour	100	$ -	100%	$ -
	Laborers (x4)	Hour	400	$ -	100%	$ -
	Operators (x2)	Hour	200	$ -	100%	$ -
	Welder	Hour	100	$ -	100%	$ -
	Welder Helper	Hour	100	$ -	100%	$ -
	Flagger	Hour	100	$ -	100%	$ -
	Foreman Truck	Hour	100	$ -	100%	$ -
	Welding Truck	Hour	100	$ -	100%	$ -
	CWR Rail Heater / Vibrator	Hour	40	$ -	100%	$ -
	Rail Saw	Hour	80	$ -	100%	$ -
	Rail Drill	Hour	80	$ -	100%	$ -
	Mobile Power Pack	Hour	80	$ -	100%	$ -
	Flagger Truck	Hour	100	$ -	100%	$ -
	Subtotal - RWs Labor & Equipment					$ -
	Materials					
	Thermite Welds	EA	24	$ -	100%	$ -
	Ballast	Ton	150	$ -	100%	$ -
	Diamonds	LS	1	$ -	100%	$ -
	Insulated Joint Plug Rails	EA	12	$ -	100%	$ -
	Subtotal - Materials					$ -
	Subcontractor					
	Signal Support	Day	5	$ -	100%	$ -
	Subcontract Tamping	Day	2	$ -	100%	$ -
	Subcontract Tamping Mobilization	LS	1	$ -	100%	$ -
	Subtotal - Subcontractor					$ -
	Supplies & Rental					
	Front End Loader Rental (2x)	Month	2	$ -	100%	$ -
	Front End Loader Mobilization	Ea	4	$ -	100%	$ -
	Subtotal - Supplies & Rental					$ -
					SUBTOTAL:	$ -
			Materials	10%	Markup:	$ -
			Subcontractor	5%	Markup:	$ -
			Supplies	15%	Markup:	$ -
					TOTAL:	$ -

Maintenance of Way Services

Appendix F

UPRR Track and Signal Standards and Exceptions

ALAMEDA CORRIDOR TRANSPORTATION AUTHORITY

Track Exceptions from UPRR Track Standards

Section 3.1 Ties

Table 3-A
Concrete ties are to be used on all ACTA Main and Storage Tracks.

Nine-foot timber ties are to be used on all others, including industry leads.

Section 3.1.5

Table 3.K

The transition between concrete and timber ties shall use the standard for speeds 30 to 50 mph, regardless of the track.

Section 3.2

Table 3.Q

The tie pad used shall be the 3-piece poly pad, with a 1.4 mm steel plate on all concrete ties.

All maintenance is Class 4 or better.

Signal Exceptions from UPRR Signal Standards

1. Section 9.1.2.F Bonding:
   All bonding of switch points, heel block joints, and rail connections must be made in accordance with ACTA Standard Drawings.

2. Section 12.1.2.E Underground Cables:
   Track wires and underground cables shall be installed not less than 36 inches below the surface of the ground. Care shall be exercised to prevent sharp projections, such as rocks, from coming into contact with the wire or cable.

Rev. 11-23-2016

UNION PACIFIC

BUILDING AMERICA®

ENGINEERING TRACK MAINTENANCE

Field Handbook

Revision: June 21, 2016

PB-22000H2

DO YOU KNOW WHERE YOUR *RED ZONES* ARE?

A Red Zone is defined to be that area, within an arm's length of the track or any physical position, which places the employee in a life-threatening situation.

Every job or task will have its own set of Red Zones.

Make sure to identify the Red Zones in your job briefing and then be aware of entering the Red Zones as work progresses.

<u>Examples of Red Zones in Engineering are:</u>

- **Working within 15 feet of an adjacent live track.**
- **Working within 15 feet (in front of or behind) of a piece of on-track equipment.**
- **Working within 10 feet of the radius of any crane in use.**
- **Working within 20 feet of any switch / track panel being loaded or unloaded.**
- **Working on any bridge more than 12 feet above the ground / water or any other elevated structure more than 6 feet above the ground.**
- **Working at or through road crossings at grade.**
- **Working beneath any jacked, blocked or suspended machines, equipment or cars.**
- **Climbing or working on a pole.**

"Safety is* MY *Responsibility"

UNION PACIFIC

BUILDING AMERICA®

Engineering Department

“Safety is MY *Responsibility”*

<u>**It is my responsibility to:**</u>

- **Come to work with a clear mind and a positive attitude.**
- **Inspect the tools I use and make sure they are safe.**
- **Maintain the proper distance when following track cars, track machines and trains.**
- **Look out for myself and the people working close by.**
- **Use the proper lifting techniques when lifting and moving material. Get additional help or use a crane to lift or handle heavy objects.**
- **Wear my hardhat, hearing protection, eye protection, safety vest and respirator.**
- **Show up to work with the proper attire and protective footwear.**
- **Look out for trains, locomotives, cars or other moving equipment.**
- **Expect movement at any time, on any track, in either direction.**
- **Ensure that all people working with my gang, including contractors, have been included in our Job Briefing.**
- **Keep my work area clean and clean up after I have finished the job.**
- **Always keep my mind on what I am doing – a split second of inattention can result in a serious accident.**

“Shortcuts Hurt”

UNION PACIFIC RAILROAD
Engineering Track Maintenance Field Handbook

The Engineering Track Maintenance Field Handbook provides guidelines, procedures and policies for the maintenance of Union Pacific Railroad owned track and right of way. Engineering personnel responsible for maintaining the track and right of way should maintain a copy of this handbook and keep it available for reference.

The Engineering Track Maintenance Field Handbook is a tool that contains general maintenance information and it is intended to be used in conjunction with Standard Work Management on the UPRR Website. MyUP> UP Way> Standard Work

Engineering personnel responsible for maintenance and inspection of the track and right of way must exercise every effort to correct conditions not found in compliance with this publication. These guidelines, procedures and policies can be superseded by instructions issued via Special Instruction or General Order.

The Federal Railroad Administration's (FRA) Track Safety Standards are the legal minimum requirements to which the track structure is to be maintained and must be complied with at all times. FRA Track Safety Standards supersede any practice or guideline in this manual if less restrictive than FRA Track Safety Standards.

REVISED CONTENT: **The content of this manual will be revised periodically. The latest revision may be found at the Engineering employee website under the Procedures and Standards tab. A Lotus Notes message will indicate when such revisions are available. For additional copies of this manual, request Publication PB-22000H2 for the Field Handbook printed content or PB-22000HB for the Field Handbook binder, on the UPRR e-procurement system.**

CORRECTIONS OR COMMENTS: **This publication may include technical inaccuracies or typographical errors. Please notify the Engineering Methods and Research group of errors/corrections by contacting one of the Senior Managers of Engineering Methods at ETMFH@up.com. This email can also be used for proposed changes.**

Engineering Methods & Research
Union Pacific Railroad
1400 Douglas Street, Stop 0910
Omaha, NE 68179

JOB BRIEFING GUIDELINES

Safety, Quality, and Productivity are the result of well planned and properly conducted job briefings.

STEP 1. Plan the Job Briefing.

A. Develop your own work plan by:
   1. Reviewing work or task to be accomplished.
   2. Checking the job location and work area.
   3. Breaking the work or task down into step-by-step procedures.
   4. Determining tool, equipment, and material requirements.
   5. Determining which safety rules or procedures are applicable.
   6. Determining proper form of On-track Safety, if it's necessary to foul the track.

B. Consider existing and potential hazards that might be involved as a result of:
   1. Job and weather conditions.
   2. The nature of the work to be done.
   3. The job location.
   4. The tools, equipment, and materials used.
   5. Equipment to be worked on.
   6. Traffic conditions and visibility.
   7. Time of day.
   8. Safety or personal protective equipment required.

C. Consider how work assignments will be made.
   1. Group assignments.
   2. Individual assignments.
   3. According to the abilities and experiences of individuals.

STEP 2. Conduct the Job Briefing

A. Explain work or task to employees.
   1. What is to be done.
   2. Why it is to be done.
   3. When it is to be done.
   4. Where it is to be done.
   5. How it is to be done.
   6. Who is to do it.
   7. What safety precautions are necessary.
   8. Type of On-Track Safety, including OTS for adjacent tracks.

B. Discuss existing or potential hazards and ways to eliminate or protect against them. Identify your Red Zones.

C. Make definite work assignments.
   1. Make sure employees understand assignments.
   2. Ask questions of the "how" and "why" type.

D. If special tools, materials, equipment, or methods are to be used, make sure employees know how to proceed safely.

E. Issue all instructions clearly and concisely; check to see that they are understood.

STEP 3. Job Briefing for Special Conditions.

A. Complex jobs.
   1. Brief only a portion of the job.
   2. Give additional briefing as the job progresses.

B. Changes in job conditions-when it becomes necessary to change plans and procedures as the job progresses, brief employees on these changes. (As an example: the weather condition changes.)

C. Changes in type of On-Track Safety.

STEP 4. Follow up by Supervisor.

It is important that frequent checks be made as the job progresses to be sure that:

A. Your plans are being followed and correct work methods used.

B. Each person is carrying out the assigned responsibilities.

C. Any hidden hazards have been identified and action initiated to eliminate; or determine what precautions are required.

STEP 5. Individual Responsibility.

All employees are responsible to see that the work plan is carried out according to the job briefing or modified when conditions changes.

TABLE OF CONTENTS

What is updated in the 2016 ETMFH?

2016 Engineering Track Maintenance Field Handbook Updates			
Section	**Page**	**Section Title**	**Update**
1.6.4	**1-10**	Distribution	Added item number for adapter hose and updated note on Herzog information
2.3.4	**2-7**	Gauge Limits	Urgent wide gauge updated
2.4.1	**2-9**	Measuring Track Centers	Remove contact number 402-544-2094 from notes
2.4.2	**2-9**	Minimum Track Centers	Added bullet item to note 1
2.4.4	**2-11**	Minimum Clearances	Remove contact number 402-544-2094 from notes
2.7.2	**2-24**	VTI Thresholds	Revise description of Combo Cluster (CCL)
2.7.3	**2-25**	Handling of VTI Exceptions	Revised second bullet item
3.1.1	**3-3**	Types and Applications	Added item number for UP11 (Rail.One) crossing pad
3.1.10	**3-12**	Program Maintenance For Wood Ties	Added number 13
3.2.1	**3-16**	Rail Seat Abrasion	Detail added for optimal time to visually inspect RSA
3.4.3	**3-34**	Elastic Fastener Plates	Updated to reflect current Standard for Elastic Fastener Plates
3.5.3	**3-36**	Spike Pattern	Updated 3-LL, adding Victor plates to patterns 4 and 5
3.5.4	**3-37**	Lag Screw Application	Changed section title, updated Std. Dwg. Reference to 0454, changed "coach" to "lag" in table
3.5.5	**3-34**	Evergrip Lag Screw	Updated reference to requirements to match title of 3.5.4
3.5.6	**3-38**	Defective Fastener Repair	Added Section
4.2.4	**4-5**	Rail Chemistry	Updated Table 4-B: 'WHEELING PITT' changed to 'W-P (WHEELING PITT) and Table 4-C 'WP' to 'W-P'
4.3.4	**4-9**	Curve Rail Wear Limits	Added Black Butte, La Grande, Provo, Spokane and Valley to Subdivision List, Updated table 4-G, Move CCW to section from 4.18.1, add bullets to note 5
4.3.5	**4-10**	Curve Rating Process	Revised wording of portions of section
4.5.1	**4-15**	Laying CWR	Added sub section "D" for VERSE Testing For Track Construction
4.11.3	**4-28**	I-Bond Installation	Added table 4-M-1 for Insulated Joint Colors
4.12	**4-28**	Cutting Rail	Added row to bottom of table, added new no. "2"
4.13.1	**4-29**	Standard Thermite Welds	Updated content in items 4 and 7
4.13.2	**4-31**	Head Repair Thermite Welds	Added sub sections to section - original content is now 4.13.1, new content in 4.13.2
4.15	**4-32**	In-Track Welding	Updated entire section
4.16	**4-34**	Weld Tolerance Specifications	Updated table 4-N-1 b and 4-O-1 a
4.18.1	**4-40**	Defect Descriptions	Remove 'S' - moved to section 4.3.4
4.18.6	**4-49**	Remedial Action Required	Removed note for quick link to updated matrix
4.18.6	**4-57**	Remedial Action Required	Removed "or defective weld" from DPW and DIW remediation
4.18.7	**4-57**	Certified Plug Rail Purchased From Outside Parties	Removed column for Rail Type from table 4-S
4.18.11	**4-61**	Service Failure Broken Rail Reporting	Removed note for service failure call desk
4.19.3	**4-62**	Locations for Rail Lubrication Application	Revised wording of portions of section, add bullets
4.19.4	**4-63**	Suspension of Lubrication for Maintenance Work and Grinding	Revised wording of portions of section, removed table 0-V
4.20.1	**4-63**	Rail Grinding General	Revised wording of portions of section
4.20.2	**4-63**	Corrective, Maintenance and Preventitive Grinding	Revised wording of portions of section
4.20.3	**4-63**	When to Grind and Type of Grinding	Revised wording of portions of section
4.20.5	**4-64**	Classification of Rail Condition for Grinding	Revised entire section
4.20.6	**4-65**	Preparation for Grinding	Revised entire section
4.20.7	**4-65**	Switch Grinder Responsibilities	New section inserted, all following sections renumberd accordingly
4.20.8	**4-66**	Grinding on Bridges	section renamed to 4.20.8 from 4.20.7 (new 4.20.7)
4.20.9	**4-67**	Service Unit Requirements for Assisting Production Rail Grinding	Revised wording of portions of section
4.20.10	**4-67**	Service Unit Requirements for Assisting Switch Rail Grinding	Revised wording of portions of section
5.2.9	**5-8**	Switch Point Rollers	Revised section to reference only the Eko-Slide switch point roller
5.5.5	**5-22**	Frog Guard Rail Size and Length	No. 10 and No. 14 updated per the Standard
5.5.10	**5-25**	Jump Frogs	Car counts, gouge depth and distance from curve added to reflect Standard update
5.8	**5-41**	Foul Point	Added insturction for painting of ties and cone placement, updated paint detail
6.4.5	**6-6**	End of Track Sign	Added Section
6.4.6	**6-6**	HTUA Sign (High Threat Urban Area)	Added SEction
6.10	**6-10**	PTC - Critical Asset Change Management	Added section
7.9.4	**7-23**	Placing Pull Back Reference Marks	Removed "spanning" ahead of "reference marks" in note 1
7.10.2	**7-30**	Report Rail Service Failed Broken Rail	Removed note for service failure call desk
7.10.10	**7-33**	Rail Laying Temperature for CWR Table and Blanket Speed Restrictions	Updated table 7-J to include missing subdivisions
8.2	**8-3**	Standards and Compliance	Updated title of ETMFH for insert and binder
8.4.5	**8-5**	Manager Track Maintenance Inspection Guidelines	Revised notes, updated table 8-B
8.5.1	**8-6**	Track Inspection Frequencies	Added rows to table for main track and sidings, class 1-6, and connecting tracks, requiring inspection of curves every 90 days
8.5.3	**8-7**	Track Inspector Documents	Updated title of ETMFH for insert and binder
8.6.6	**8-11**	Crossties	Removed bullet item stating that when defect remains in track after remedial action of repairs is used, speed to be reduced by one class 30 days after action was made
8.6.19	**8-14**	Rail Fastenings	Added required actions for defects
8.6.22	**8-15**	Main Line Curves	Added new no. 5
8.10.9	**8-25**	FRA Electronic Inspection Record Review Guidelines	Updated paragraph to include further instruction for activating FRA user ID

*These updates and enhancements are highlighted in grey throughout the Engineering Track Maintenance Field Handbook (ETMFH)

*Please email ETMFH@up.com if you have any changes to propose.

1.0 ROADBED

1.0 Roadbed

1.1 Cross Section

Maintain roadbeds, embankments, and excavations according to Standard Drawing Nos. 0001, 0002 and 0003, when practical.

1.2 Drainage

1.2.1 General Considerations

Roadbed drainage is the most important component of good track maintenance. To achieve proper drainage that diverts water away from the track, either direct the water parallel to and/or across the roadbed, or intercept and divert the water before it reaches the roadbed. To provide adequate drainage, consider the following:

- Maximum expected runoff from rain, melting snow, or other sources
- Track and roadbed conditions that will develop during freezing temperatures

Follow these requirements:

1. Keep water-carrying devices clear of debris to make sure that water can flow freely. Notify the Manager Track Maintenance if obstructions outside the railroad right of way interfere with water flow.
2. During heavy rainfall or runoff, monitor water-carrying devices to make sure they handle the flow of water. Enlarge any devices that cannot handle the water flow. Report such devices to the Manager Track Maintenance.
3. Do not allow adjacent land owners or other parties to divert water from their property into existing water-carrying devices or to construct such devices on the railroad right of way. Immediately report such activities to the Manager Track Maintenance.

1.2.2 Grade

The slope of the grade adjacent to the track structure directs water away from the track toward natural or man-made water-carrying devices.
Follow these requirements to ensure the correct grade:

1. Construct and maintain subgrade to a 2% cross slope. Ditches, subsurface drains, perforated pipe, rock drains, or other water-carrying devices should be installed and maintained at a minimum slope of 3 inches in every 100 feet of length.
2. When water-carrying devices run parallel to the track, make sure they conform to whichever of the following requirements is **greater**:
   - The requirements in step 1 above
   - The established grade of the track

1.3 Surface Drainage

1.3.1 Ditch Construction and Maintenance

IMPORTANT: At least 48 hours before performing work, call Union Pacific's *Call Before You Dig* hotline (800-336-9193) to determine if there are any fiber optic cables or other utilities in the work area.

After the UPRR Hotline has been contacted, each State has a one-call hotline that must also be contacted at least 48 hours before performing any work. Call the North American One Call Referral System (888-258-0808) to obtain the appropriate state one-call number. Call the state one-call center, who will notify all utility owners within the work area.

***Do not* begin excavation or construction along the railroad's right-of-way until all utilities in the work area have been located and protected by their owners.**

Follow these requirements when constructing and maintaining ditches:

1. Maintain side ditches that parallel the track to a depth of 3 feet below the top of the subgrade as shown in Figure 1-A.
2. Maintain ditches in earthen soils with a flat bottom as shown in Figure 1-A.

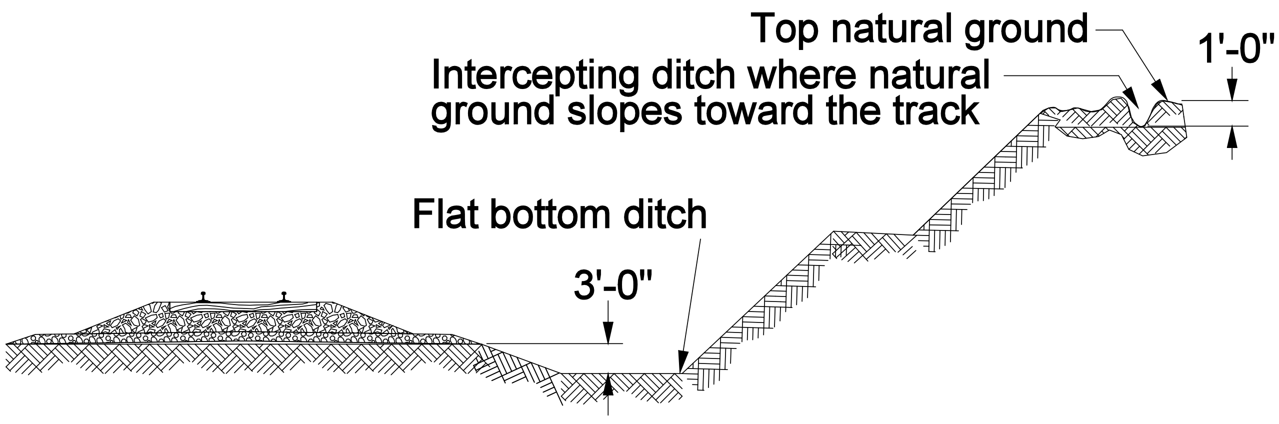


Figure 1-A

3. Maintain intercepting ditches to a minimum depth of 1 foot on top of slopes through deep cut sections where runoff from higher elevation erodes slopes as shown in Figure 1-A.
4. Direct the outlet ends of ditches away from the track structure to prevent erosion to ditches or the roadbed.
5. Cut ditches through heavy snow wherever a sudden thaw could cause excessive runoff toward the track structure.

NOTE: If grading or disturbing the soil will affect 1 acre or more; construction permits are required. Consult the Environmental Policy Guide prior to performing work to ensure that all requirements are met. Direct questions about grading/dirt work affecting storm water run-off to the Environmental Engineering Group.

1.3.2 Ditch Cleaning

Follow these requirements when cleaning ditches:

1. Start removing waste material from the outlet or bottom end of the ditch.
2. Whenever possible, use removed material to widen narrow embankments or replace material eroded from the roadbed.
3. When placing material on an embankment, distribute it evenly on the face of the slope by terracing up from the base of the fill.
4. When removing waste material from ditches, do **not** put it in the following locations:
   - On the slopes of cuts or other locations where it will wash back into the ditch or track
   - On the right of way where it will obstruct natural roadbed drainage
   - On the track's ballast section
5. When disposing of removed earthen material:
   - Grade it smoothly.
   - Do not raise shoulders above the existing subgrade.
6. If the waste material could be environmentally dangerous:
   - Isolate the waste material from the waterway.
   - Cover the material with plastic.
   - Get advice from the environmental representative on how to dispose of the material.

1.3.3 Culverts

Follow these requirements to ensure that culverts provide adequate drainage:

NOTE: Ensure the cover thickness over the top of the culvert to the bottom of the tie is at least one-half the thickness of the culvert diameter.

1. Keep culverts clear of obstructions at all times.
2. Make sure there are enough culverts and they are large enough to handle the maximum anticipated water flow.
3. If the roadbed appears to block the flow of water from one side of the track to the other, consider installing additional or larger culverts.
4. When a washout occurs during heavy runoff, determine whether existing devices are obstructed.
   - If they are, remove the obstructions.

     or
   - If they are not, install additional or larger culverts.

1.3.4 Grade Crossing Drainage

A. Surface Drainage at Grade Crossings

Follow these requirements to establish surface drainage at grade crossings:

1. Make sure that the first or second fully exposed tie crib off each end of a grade crossing has ballast removed for its entire length to a depth even with the bottom of the ties. See Figure 1-B.

NOTE: Box anchor wood ties next to all open cribs.

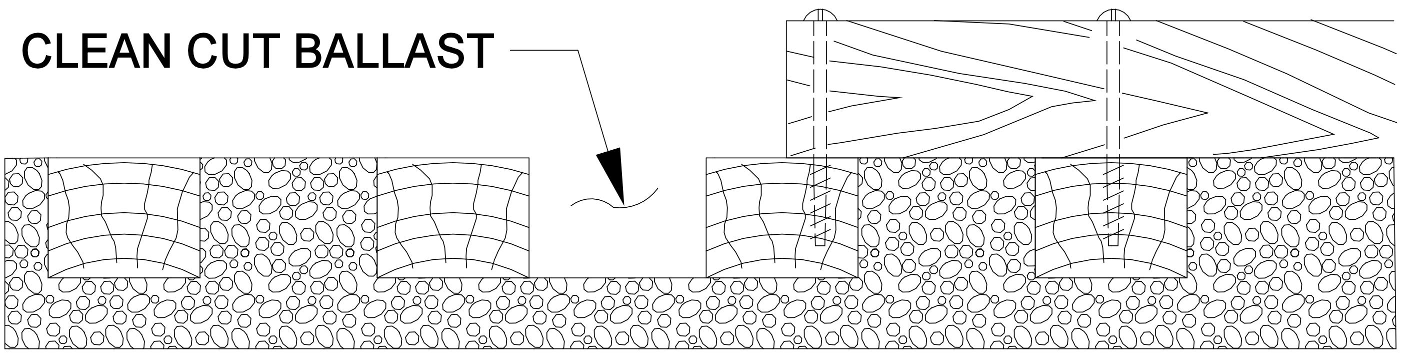


Figure 1-B

2. Slope trenches leading away from the end of each open tie crib on the four corners of the crossing to allow water to drain from the track.

B. Surface Drainage at Multiple Grade Crossings

Follow these additional requirements to establish surface drainage at multiple track grade crossings:

1. Make sure that open tie cribs line up in a straight line with adjacent tracks.
2. Trench between tracks to connect the open tie cribs as one continuous trench as shown in Figure 1-C.
3. Where the roadway does not cross the track at right angles, connect the open tie cribs as shown in Figure 1-D.

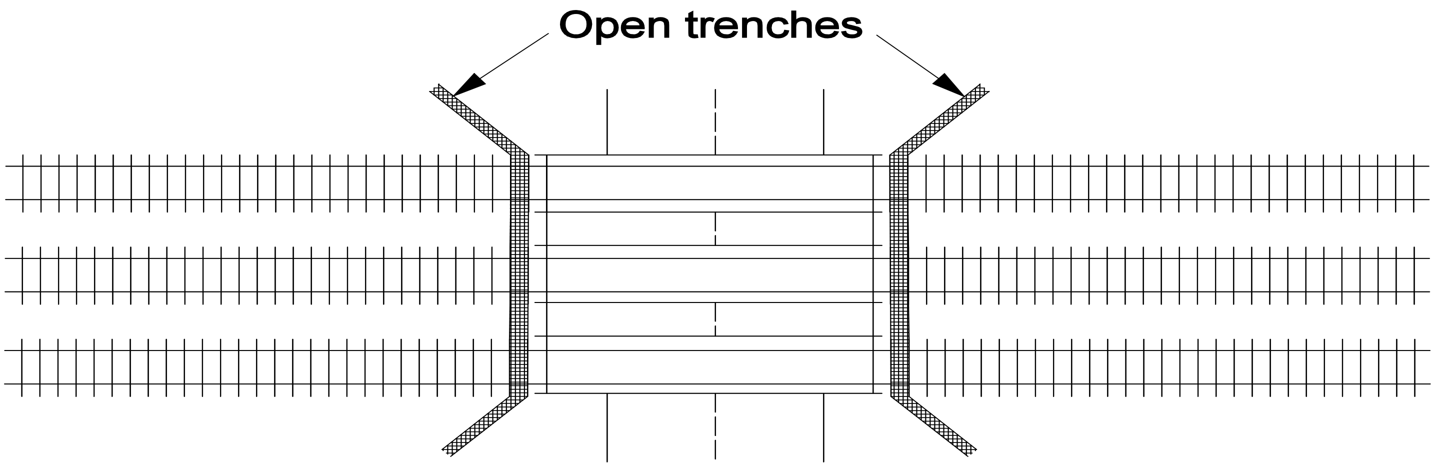


Figure 1-C

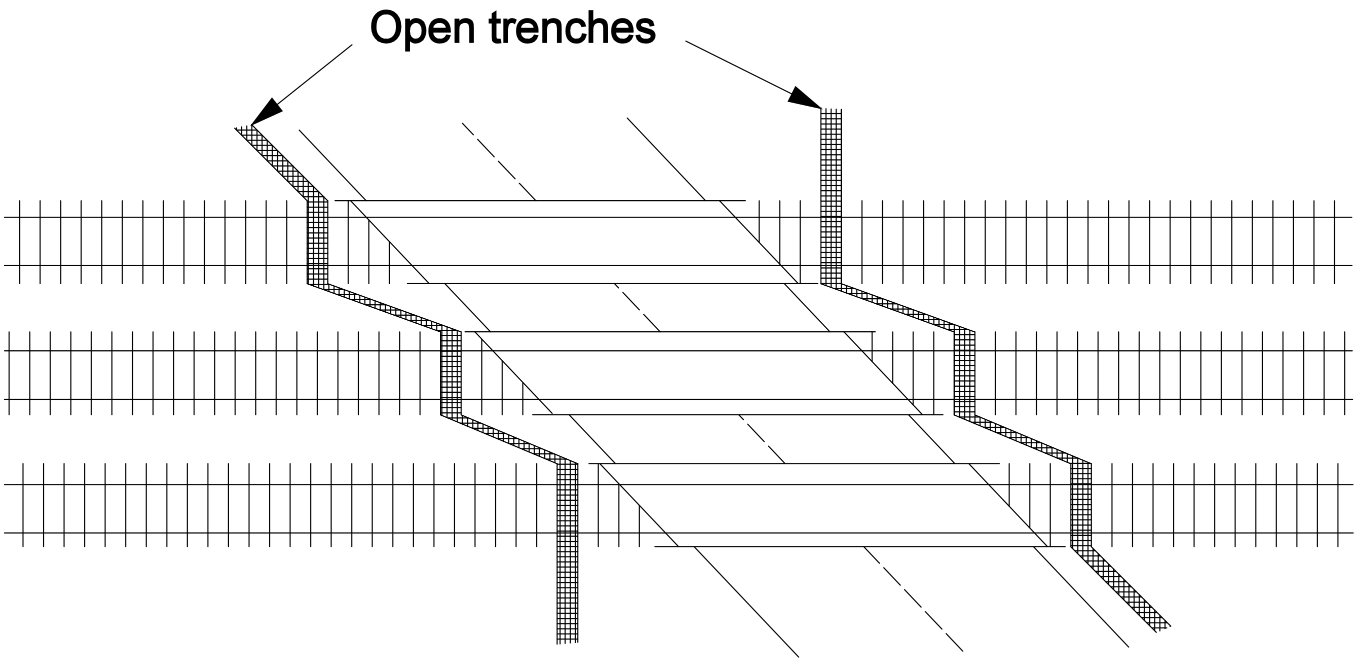


Figure 1-D

C. Subsurface Drainage at Grade Crossings

Follow these requirements to establish subsurface drainage at grade crossings:

1. Excavate trenches in the subgrade from the four corners of a grade crossing. Use a slope that provides drainage from the lowest point dug out when cross ties are renewed as shown in Figure 1-E.

2. Backfill trenches with clean ballast to a height even with the subgrade.

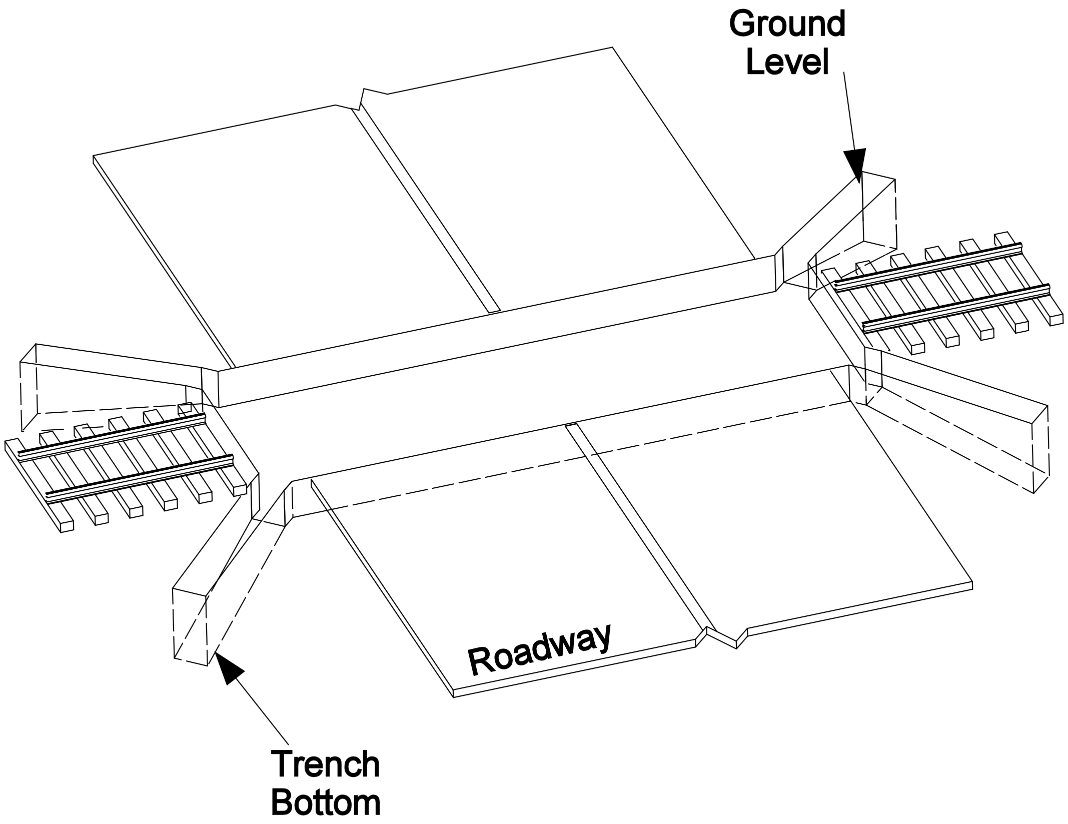


Figure 1-E

D. Removal From Service

Follow these requirements when retiring grade crossings from service:

1. Remove roadway approaches to grade crossings for at least 20 feet from the centerline of the track.
2. Contour the roadbed for drainage according to Standard Drawing Nos. 0001, 0002 and 0003.

1.3.5 Culvert Installation

The Track Department inspects and maintains culverts less than 48 inches in diameter.

1. When the open cutting method of installation is used, UPRR trenching and shoring standards must be complied with. Refer to CE Bulletin 124.0.
2. Establish flow line elevations to ensure proper drainage. Outlet elevation must be lower than inlet elevation.
3. Bedding for pipe needs to be an engineered select material (i.e. approved road base material) and well compacted in place.
4. If continuous length pipe cannot be used and the use of bands and/or connectors would be needed consult the Manager Bridge Maintenance for proper material and procedures.
5. Backfill pipe evenly with a select, compactable material.

1.3.6 Culvert Identification

All culverts on main tracks or industrial leads less than 48 inches in diameter must be identified per the following guidelines.

1. Tie closest to the center of a culvert location to be painted blue. In locations with multiple culverts, tie closest to the center of the culvert group is to be painted.
2. Krylon OSHA blue paint to be utilized to paint tie. Paint can be ordered in one gallon buckets in e-procurement item number 353-1450.
3. Entire exposed top surface of the tie to be painted. Do not paint the plates or rail.

1.3.7 High Water Levels

Follow these requirements at locations where water passes under the track structure during high water flow:

1. Take measurements at bridges, culverts, and other locations where water passes through the track at unusually high levels.
2. Record the distance between the surface of the water flow and the bottom of the track structure.
3. Report this information to the Manager Track Maintenance.

1.3.8 Berms and Levees

Construct and maintain berms or levees to divert water away from the roadbed or toward water-carrying devices in areas with high runoff.

1.3.9 Erosion Control

Follow these requirements to control erosion:

1. Seed embankments or other locations graded on the right of way with native grasses.
2. Use an apron of concrete or rock to protect the outlet ends of perforated pipes that direct water onto embankments.
3. Do not excavate material from the slopes of embankments.
4. Place rock or riprap at locations where material is being eroded and the water flow cannot be slowed or diverted.
5. When selecting the best size of material for controlling erosion, consider the following:
   - The amount and force of the water the material will be exposed to.
   - The equipment available for handling the material after it is unloaded.

See Table 1-A for stock materials for erosion control.

Stock Materials for Erosion Control	
Size	**Description**
2 to 5 in.	B stone
12 in. minus	A stone
4” x 12” minus	Class 1 riprap
12” x 24” minus	Class 2 riprap
24” x 36” minus	Class 3 riprap
36” x 36” minus	Class 4 riprap

Table 1-A

1.4 Subsurface Drainage

Install underground drainage systems in locations where side ditches cannot be effectively maintained, such as wet or narrow cuts, tunnels, station platforms, or yard tracks.

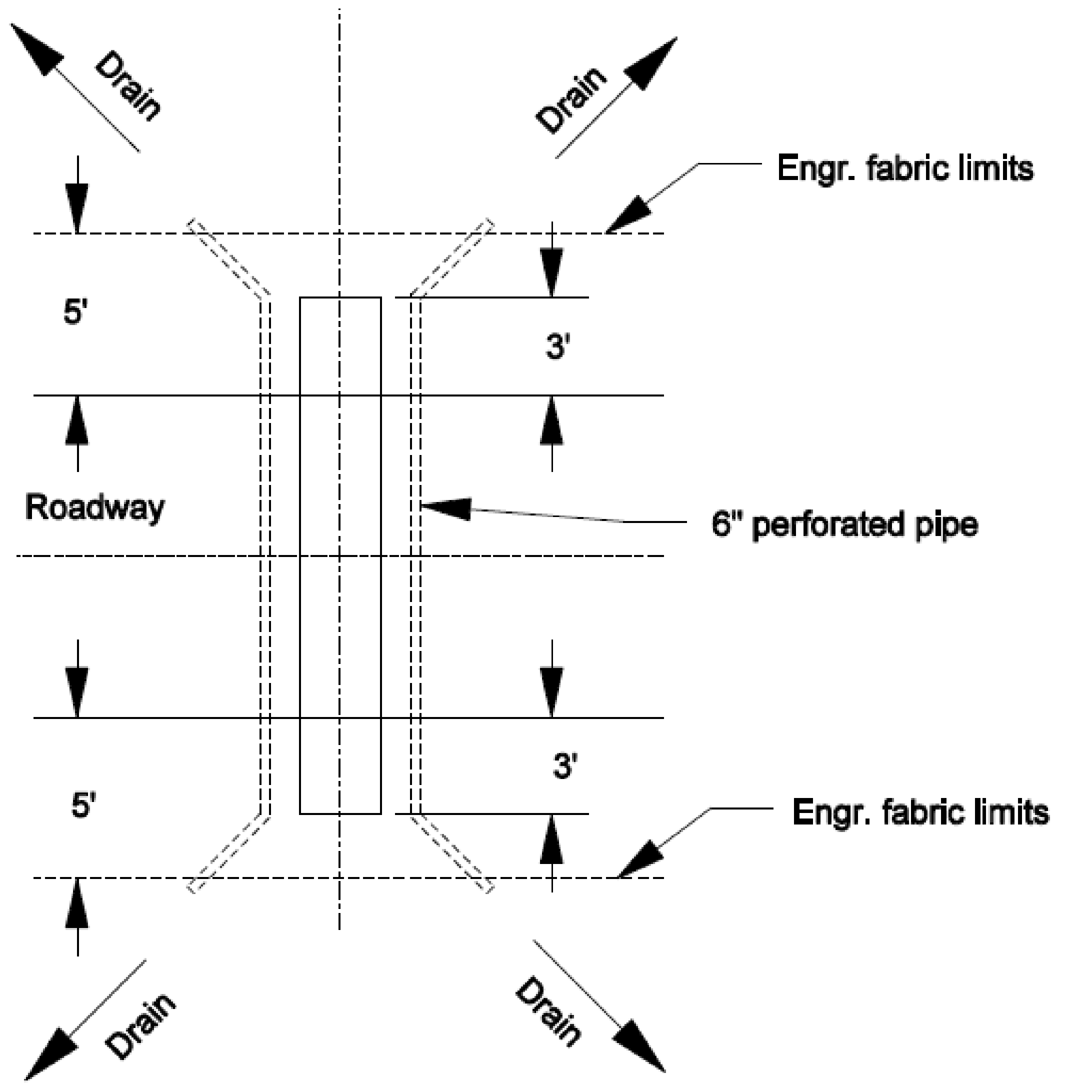
Follow these requirements to install devices for subsurface drainage:

1. When laying pipe as part of a subsurface drainage system, place the pipe at true grade so that the pipe outlet will drain water away from track structure.
2. When installing catch basins, risers, or manholes that are tied to drainage systems, set them at an elevation to adequately drain the intended area.

3. Place subsurface drainpipe at least 18 inches (where practicable) below ground level or the bottom of the rail.
4. When placing pipe into an excavated ditch:
   - Line the bottom of the ditch with compacted material.
   - Place the pipe on top of the compacted material and center it between the ditch sidewalls.
   - Backfill the ditch entirely with coarse ballast and place at least 24 inches of ballast (where practicable) on top of the pipe.

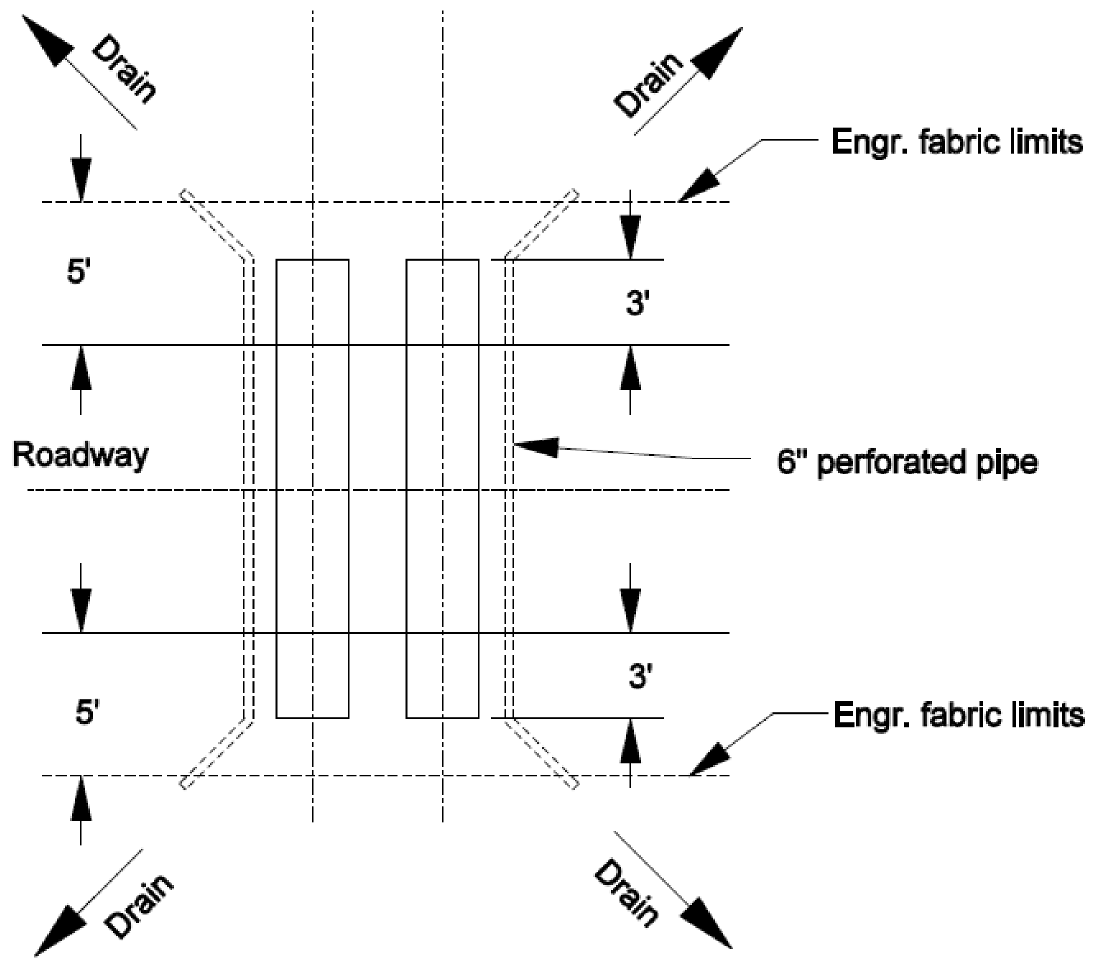
1.4.1 Perforated Pipe

Install perforated pipe in road crossings according to Standard Drawing Nos. 0301 and 0304 where required by contract agreement with public agencies or as otherwise provided in project plans. See Figure 1-F for the single track arrangement for drainage pipe installation and Figure 1-G for the double track arrangement for drainage pipe installation.



Single track arrangement for drainage pipe installation

Figure 1-F



Double track arrangement for drainage pipe installation

Figure 1-G

Follow these requirements to install perforated pipe for subsurface drainage:

1. Make sure that connectors and elbows are the proper size and dimension for connecting standard length pipe sections.
2. Wrap perforated pipe in engineering fabric before installing it.
3. Place perforated pipe with the perforations facing down.
4. Keep perforated pipe ends clear of debris.
5. When burying perforated pipe beneath track to drain water laterally, wrap the open end of the pipe with engineering fabric.

6. Ensure that pipe outlets are installed at proper grade to allow water to flow away from crossing.

NOTE: You may install perforated pipe to supplement rock drains. Backfill all pipe installations with coarse ballast to restore the roadbed to its original profile.

1.4.2 Engineering Fabric

Install engineering fabric in road crossings according to Standard Drawing Nos. 0301 and 0304 where required by contract agreement with public agencies or as otherwise provided in project plans. Place engineering fabric at ground level as shown in Figure 1-H and extend it past the crossing panels as shown in Figure 1-F or 1-G.

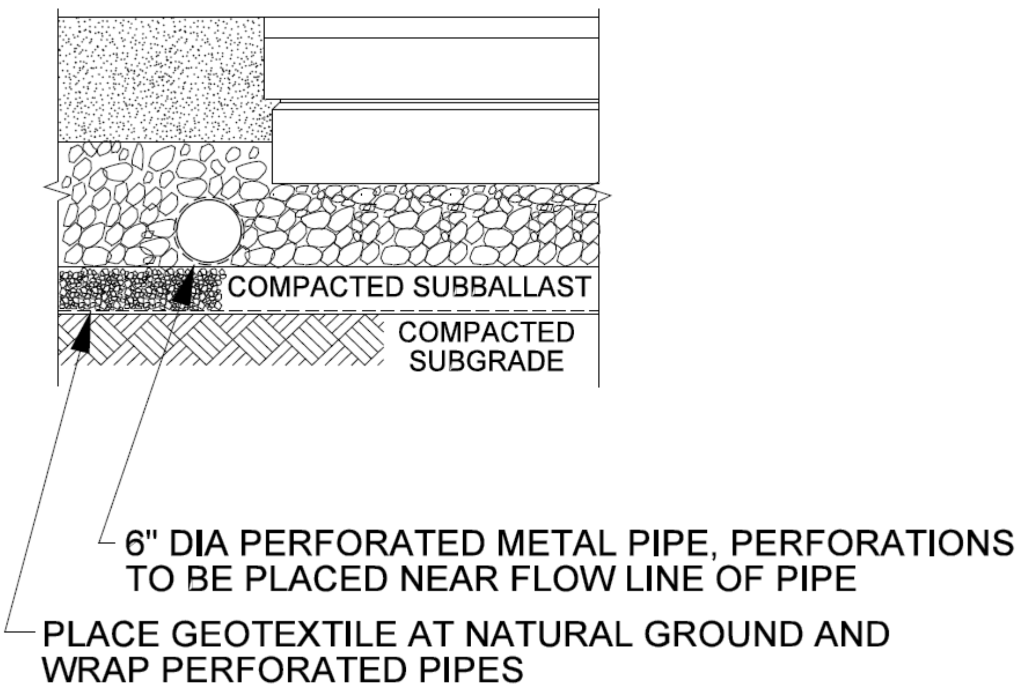


Figure 1-H

Follow these requirements to install engineering fabric for subsurface drainage:

1. Before applying engineering fabric, make sure the roadbed grade is free of sharp rocks and other debris.
2. Be careful not to puncture the fabric during or after installation.
3. Install engineering fabric at least 9 inches below the bottom of ties to keep it from being punctured by automatic tamper tools during insertions.
4. Do not install engineering fabric in multiple layers, except where required to overlap seams.
5. Overlap seams 2 feet when starting a new roll.
6. Before backfilling, stretch engineering fabric tightly to remove wrinkles.

NOTE: Do not use engineering fabric in place of adequate drainage devices or grading.

1.5 Stability

1.5.1 Heaving and Soft Track

Rock drains, or trench drains, may be constructed in place of other subsurface drainage systems to correct heaving and soft track according to Standard Drawing No. 0007. These drains provide a way for trapped water to drain away from the roadbed. The use of perforated pipe is optional.

Follow these requirements to construct rock drains:

1. Construct rock drains by excavating roadbed material and backfilling with coarse ballast.
2. Cut lateral rock drains at intervals of 20 to 50 feet.
3. Make sure the rock drain has an outlet for releasing accumulated water.
4. In cut sections of the roadbed:
   - Excavate rock drains parallel to the track on one or both sides.
   - Make excavations for the full length of the wet ground.
   - Make excavations that meet the following specifications:
     - — 1 to 3 feet wide.
     - — At least 15 inches below the bottom of the water pocket or frost line as shown in Figure 1-I.

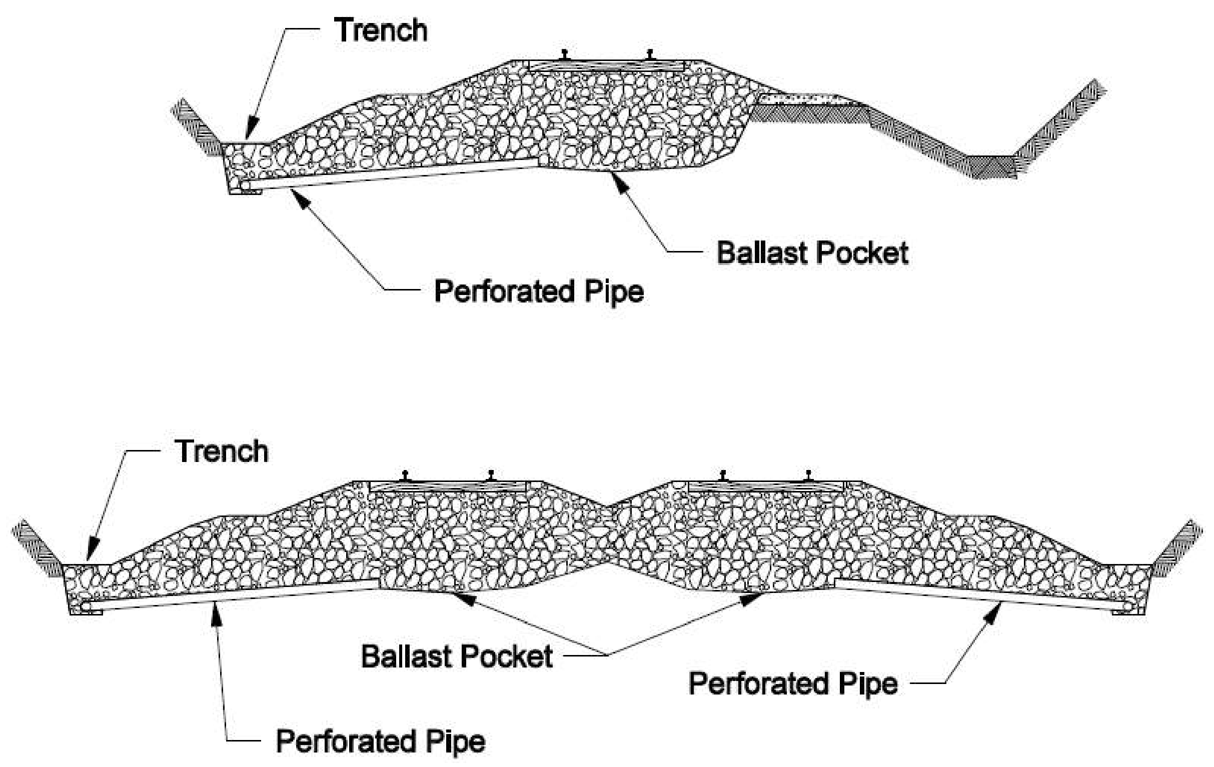


Figure 1-I

5. When cutting drains to both sides of the track, stagger the drains by centering them between the drains cut on the opposite side of the track as shown in Figure 1-J.

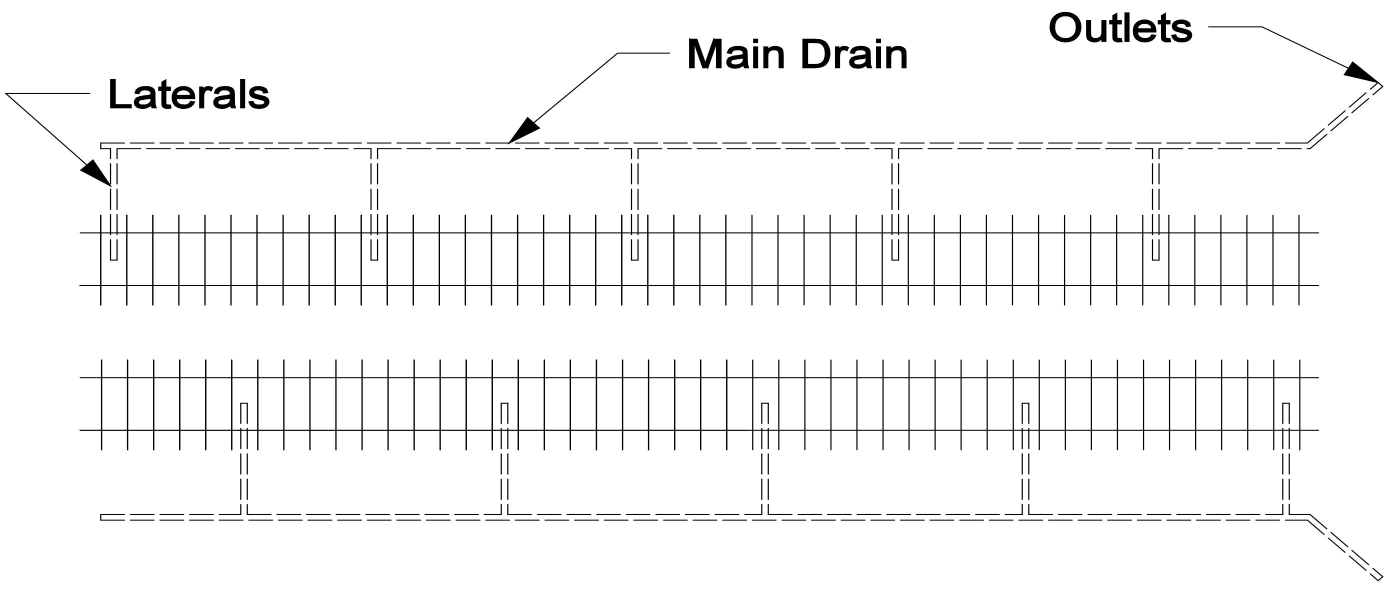


Figure 1-J

6. In fill sections of the roadbed:
   - Excavate rock drains laterally from the centerline of the track to one or both sides.
   - Make excavations that meet the following specifications:
     — 1 to 3 feet wide.
     — At least 15 inches below the water pocket or frost line as shown in Figure 1-K.

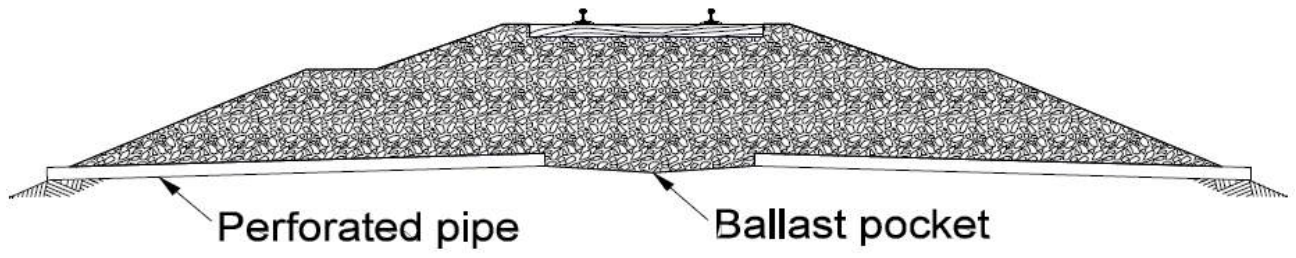


Figure 1-K

1.5.2 Embankment Stability

Follow these requirements when placing materials to stabilize embankments:

1. When unloading material on fills, distribute the material evenly on the face of the slope and terrace it up from the base.
2. **Do not** leave riprap or other fill material in the following locations:
   - On the top of embankments where the additional weight could cause a sudden and catastrophic failure
   - Near track where it could interfere with ballast regulators as they dress shoulders

A. Unexpected Embankment Settling or Failure

Follow these requirements if the roadbed settles unexpectedly or if an embankment fails:

1. Determine the content and stability of the roadbed and embankment before performing work at that location.
2. Report the situation to the Manager Track Maintenance.

NOTE: Do not alter the design of an embankment unless you have the approval of the Chief Engineer.

1.5.3 Borrow Pits

Follow these requirements when borrowing material from the right of way:

1. Borrow dirt for grading from the outer edge of the right of way if material is suitable.
2. Make sure that borrowing will not cause water to collect where the material was excavated.
3. Leave pit excavation side walls no steeper than a 2 horizontal to 1 vertical (2 to 1) slope.

4. Keep at least 10 feet between the toe of embankments and pit excavations.

1.6 Ballast

1.6.1 Purpose

Ballast serves the following purposes:

1. Uniformly transmits and distributes the load of track and railroad rolling stock to the subgrade.
2. Restrains the longitudinal, lateral, and vertical displacement of track under loads imposed by railroad rolling stock and forces exerted by the rail.
3. Allows the track to drain quickly and prevents water from accumulating around the track structure.
4. Retards the growth of vegetation.
5. Reduces frost heaving of track caused by water from the subgrade.
6. Allows employees to correct irregularities in track surface and alignment.

1.6.2 Ballast Section

Maintain the ballast section according to Standard Drawing No. 0001 for wood tie track, No. 0002 for concrete tie track and No. 0003 for industrial track.
Follow these requirements to establish and maintain the ballast section:

1. Maintain tie cribs with ballast to a level 1 inch below the rail base. Maintain the ballast line on an even plane for the full length of the tie.
2. Maintain the side slope of the ballast line from the outermost edge of the shoulder to the top of the subgrade or subballast with a uniform 3 to 1 slope as shown in Figure 1-L.

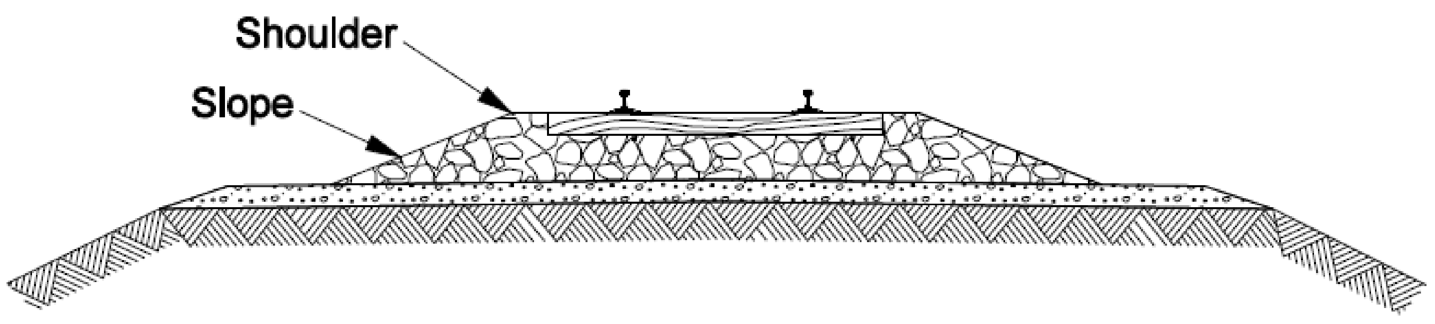


Figure 1-L

3. Construct the intersection of the ballast side slope lines between multiple tracks in a “V” shape as shown in Figure 1-M.

NOTE: This area may be leveled off between the body tracks of yards in terminals or other switching locations where employees frequently perform work between tracks.

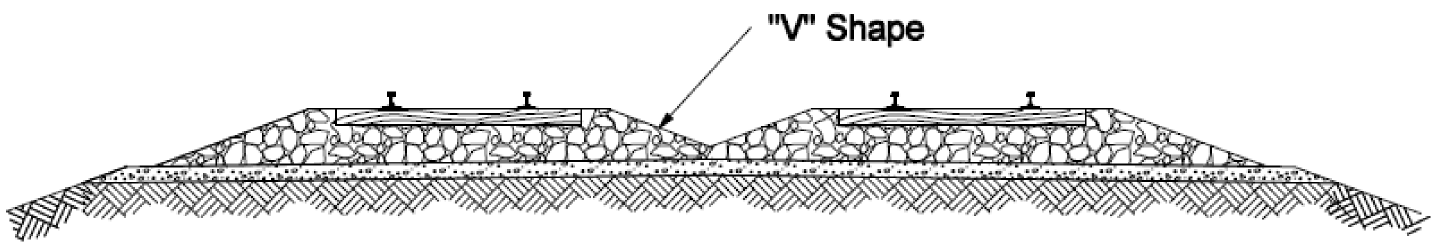


Figure 1-M

4. Keep flangeways clear of ballast through switches, derails, crossing frogs, and grade crossings.
5. Remove ballast from tie cribs to provide a minimum 3-inch clearance between the ballast and the operating linkage of turnouts and other devices. Maintain this clearance for the entire area through which the linkage travels during its operation.
6. Maintain the ballast shoulder to the specified width in Table 1-B as measured outward from the ends of ties.

Tie Type	Rail Type	Minimum Width
Wood/Composite	Jointed	9 in.
Wood/Composite	CWR	12 in.
Steel	CWR	
Concrete	CWR	

Table 1-B

7. Maintain ballast to the specified depth as measured below the horizontal surface of the tie bottom. See Table 1-C.

Tie Type	Traffic Density	Minimum Depth
Wood/Composite	Less than 10 MGT	8 in.
Wood/Composite	10 MGT or more	12 in.
Steel	All locations	10 in. *
Concrete	All locations	12 in.

Table 1-C

** NOTE: Measure downward from the center section of the tie and not from tie ends.*

1.6.3 Sources and Gradation

Obtain ballast from approved ballast pits. Determine the correct ballast size according to track type as shown in Table 1-D.

Track Type	Gradation	Ballast Type
Main and sidings	3/4 to 2-1/4 in.	1
All others	3/8 to 1-3/8 in.	2

Table 1-D

1.6.4 Distribution

1. Follow these requirements when distributing ballast:
   - Avoid moving trains over skeleton track. However, if movement is necessary, ensure that the train speed does not exceed 5 MPH.
   - When handling air dump cars/trains make sure to have adapter hose on hand so proper PSI is available. Item number is 619-3050.
   - Protect trains with a slow order over skeleton track where new ballast has been dumped until track has been surfaced and lined.
   - Distribute enough ballast to provide the designated shoulder width, shoulder slope, depth under ties, and full tie cribs.

     NOTE: Determine the required quantity of ballast based on the grade raise or track profile you want to achieve.

   - Whenever possible, distribute ballast before unloading ties for system tie projects.
2. When unloading ballast:
   - Regulate control-flow doors on ballast cars to minimize the amount of ballast that is redistributed by ballast regulators.
   - If ballast piles or ridges are above the top of the rail where they could be struck by rolling stock equipment, promptly level to top of rail before returning track to service.
   - If unloading heavy amounts of ballast, safely position a fair or better hardwood plow tie in front of the leading wheels of a loaded car.

     NOTE: Immediately remove ballast from bridge walkways, station platforms, grade crossings, and any part of turnouts that interferes with their use.

   - To keep an evenly distributed load in a ballast car with control flow doors, simultaneously regulate ballast flows from opposite sides of the car.

     NOTE: Avoid unloading the ballast car to one side only, particularly in curves. This can cause wheel climb or can cause the car to overturn.

3. Minimize or avoid distributing ballast in segments where:
   - The existing ballast shoulders exceed designated width.
   - There is a large amount of ballast between adjacent tracks.
   - Track raises are restricted to maintaining their existing grade.

     NOTE: These locations include open-deck bridges, snow sheds, station platforms, crossing frogs, interlocking, tunnels, overpasses, grade crossings, or other locations where track raises are restricted by vertical clearances.

4. Plow out and regulate ballast unloaded between rails within 90 days of unloading or before the winter freeze.

   NOTE: Ballast left between rails deteriorates ties, accelerates spikes working up in wood ties, inhibits inspections, and promotes ballast fouling.

5. When regulating ballast into track do not pull fouled ballast or dirt into the track structure.

6. Use Table 1-E to determine typical ballast quantities for program work on standard track.

Track Type	Tie Type	Project Type	Cars Per Mile
Main and sidings	Concrete	New Construction	82
Main and sidings	Wood/Composite	New Construction	68
Industry and yards	Wood/Composite	New Construction	46
Main and sidings	Concrete	TRT	50
Main and Sidings	Concrete	TRT with Undercut	35
Main and sidings	All	Sled/Undercut	30
Main and sidings	Wood/Composite	Ties	6
Main and sidings	All	TS&L	6
Industry and yards	All	Ties/TS&L	5
All	All	Rail Relays	4

Table 1-E

7. For information necessary for the Herzog automated dump trains go to intranet site at: MyUP > Capital Projects > Ballast Management System > Herzog Information or contact the ballast team – Ballast@up.com
8. Use Table 1-F to determine typical ballast quantities for track panels and special track work renewals.

Renewal Type	Number of Cars
Track Panels (3 each)	1
Crossing Frog	1
No. 7, 8.5, 9, 10, 11 Turnouts	2
No. 14, 15 Turnouts	3
No. 20, 24 Turnouts	4
No. 30 Turnout	5

Table 1-F

1.6.5 Stock Piling

Ballast should be kept free of soil and other contaminants. Excavate a pit beneath sidetrack in the following situations:

1. Only one side of a car equipped with control flow doors is accessible.
2. A bottom dump car is provided.

1.6.6 Ballast Car Release

Before releasing ballast cars to normal train service movement:

1. Completely unload ballast cars & lock doors in closed position.
2. Covered hopper cars in wrecker service must have tarp secured in the covered position.
3. Report inoperable (bad order) doors or cars as follows:
   - Obtain the car initial/number and brief defect description.
   - Use work train to set car out and report its number and location to DHCO; and notify MWOC (402-636-7434) and/or Track Planning Engineer - Ballast at (402) 544-5691.

> ***Under no condition should any ballast car with an imbalanced load be released to normal train service movement. You must know this condition does not exist before you release!***

Cars in unit train or wrecker service with inoperable doors, cars or tarps must be reported to MWOC (402-636-7434) when train is released.

Cars in manifest service with inoperable doors, cars or tarps must be reported to the Track Planning Engineer – Ballast at (402) 544-5691, who will report the car to DHCO and bill the car to the designated repair facility. Running repairs (wheels, brakes, safety appliances, etc.) can be made at a local repair track.

1.6.7 Spot Maintenance

Follow these requirements to perform spot maintenance on ballast:

1. If a location is holding water, correct it as soon as possible. Open up the ends of ties and clean them out to allow standing water to drain from the track.
2. Begin tie cribbing two to three tie cribs beyond the location being corrected. Fouled ballast is probably there, although it may not be visible yet.
3. Prevent fouled or muddy locations from growing as follows:
   - Crib ballast out from between one pair of ties at each end of the mud hole.

- Crib out 3 inches below the tie bottom for the full length of the tie and backfill with clean ballast.

> **NOTE: If water does not drain between cribbed ties, you may need to crib additional ties to drain water from the track.**

4. Correct small fouled or muddy locations as follows:
   - Crib ballast out between ties for the full length of the mud hole.
   - Crib out 3 inches below the tie bottom for the full length of the tie.
   - Temporarily shift ties laterally and remove fouled material from under the tie's original location.
   - Re-space ties to their original location and backfill with clean ballast.
   - After cribbing is finished, surface and line track to ensure full bearing on ties.

1.6.8 Program Maintenance

To perform large-scale remediation of fouled ballast use plowing, raking, sledding, or undercutting operations.
Follow these requirements to perform program maintenance:

1. When track is removed for tie renewals or for correcting a fouled ballast condition, remove all ballast to the bottom of the pan on ballast deck bridges. Make sure that all weep holes are open and free of debris.
   - Do not disturb water proofing on ballast deck bridges.
2. Perform ballast shoulder cleaning operations to promote drainage by opening tie ends. Operate the wheels on the shoulder cleaner at least 6 inches below the bottom of ties.
3. Use a ballast regulator to plow shoulders in place of ballast shoulder cleaning for out-of-face surface and lining or tie program work. Pull all clean ballast from shoulders into the track before cutting the shoulder. Plow shoulders to a depth of 2 inches below the bottom of ties and slope down for drainage.
4. Scarify shoulders where shoulder plowing is impractical due to close track centers or other obstructions.

2.0 TRACK GEOMETRY

2.0 Track Geometry

2.1 Geometry Measurements

Geometry measurements indicate the standards to which track conforms when measured under load. When taking measurements on unloaded track to determine compliance with geometry standards, add the rail movement that occurs when track is under load.

Geometry defects, depending on severity are classified in two categories.

- **Urgent Condition:** A track structure irregularity that may or may not require immediate corrective action be taken. This irregularity must be verified within 7 calendar days to determine whether immediate remedial or corrective action is required.

  The following Urgent Defects require corrective action within 30 calendar days or remedial action is then required.

  - **Profile**
  - **Twist in a 31’ Chord**
  - **Variable Tank Car Warp**
  - **Wide Gauge**
  - **Crosslevel**
  - **Warp in a 62’ Chord**
- **Critical Condition:** A track structure irregularity that may require immediate remedial or corrective action be taken prior to any movement of trains.

Note: Both Urgent and Critical defects require closure in the Track Maintenance Planner (TMP) system.

2.1.1 Post Derailment Track Measurements

1. Track measurements will be taken in conjunction with all mainline and siding geometry, Lateral over Vertical forces (L/V) or unknown caused derailments as part of the investigation process.
2. Measurements taken must indicate the condition of the track prior to repairs being made.
3. All references made to left or right rail are determined by facing in the direction that the derailed train was traveling. May not be the same as designated line rail used for derailment and train interaction modeling.
4. Record all measurements in inches to the nearest 1/16".
5. All evident lateral and vertical rail movement is to be added to all measurements taken on unloaded track.
6. Record crosslevel in respect to the amount the left-hand rail is above (+) or below (-) the right hand rail.
7. Record crosslevel measurements under load of engine or other equipment when swinging or improperly tamped ties are noted within the limits where measurements are taken.

These measurements should be documented on Post Derailment Track Measurement form PB-24004. This form may be ordered through e-procurement or found on the Engineering Website. MyUP > Reference > Derailment Investigation System > Post Derailment Track Geometry Measurement Sheet

2.1.2 Determine Designated Rail

When reading geometry or detector car reports and trying to determine which rail is the right rail and which rail is the left rail, position yourself with your back to the lower MP. While facing the higher MP, the rail on your right is the right rail and on your left is the left rail.

2.2 Track Alignment

Track alignment consists of tangent segments of track connected by curves. One rail of each track is designated as the line rail.

2.2.1 Designated Line Rail for Curved Track

The outer or high rail of curves is the line rail for referencing alignment.

2.2.2 Designated Line Rail for Tangent Track

Designate the line rail for referencing alignment on tangent track as follows:

- **Single Main Track—**Use the north rail of east/west tracks and the west rail of north/south tracks.
- **Two Main Tracks—**Use the outside rail of each track.
- **Three Main Tracks—**Use the outside rail of the outer tracks. Use the north rail of east/west tracks and the west rail of north/south tracks as the line rail for referencing alignment on the center track.
- **Four Main Tracks—**Use the outside rail of the outer tracks. Use the inside rail of the inner tracks as the line rail for referencing alignment on the center tracks.

- **All Other Applications**—Use the most practical line rail. Use this same rail throughout the tangent segment.

When lining tangent track between two curves of the same direction that are less than 1/4 mile apart, use the same line reference rail.

When lining into a fixed object that is less than 1/4 mile from the curve, use the same line reference rail as used in a curve.

NOTE: Examples of fixed objects are open deck bridges, crossing frogs, or other immovable objects.

2.2.3 Designated Line Rails for Turnouts and Crossovers

Use the straight side of turnouts as the designated line rail for referencing alignment through the straight side of switches when turnouts exist entirely on tangent track as shown in Figure 2-A.

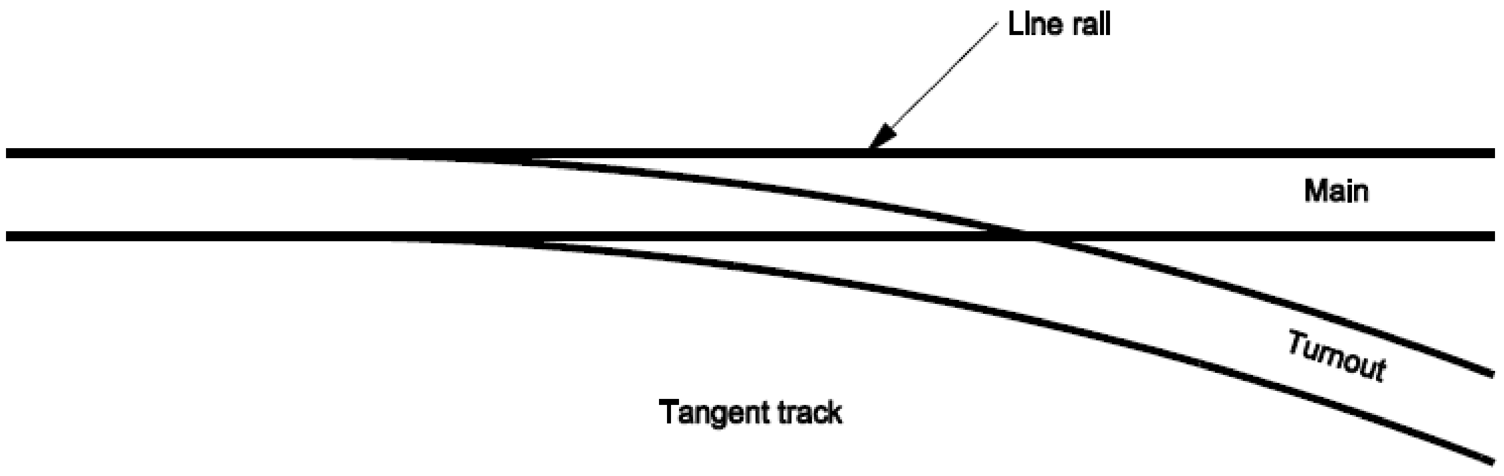


Figure 2-A

When any portion of a turnout is located on a curve, use the high or outer rail of the curve as the designated line rail as shown in Figure 2-B.

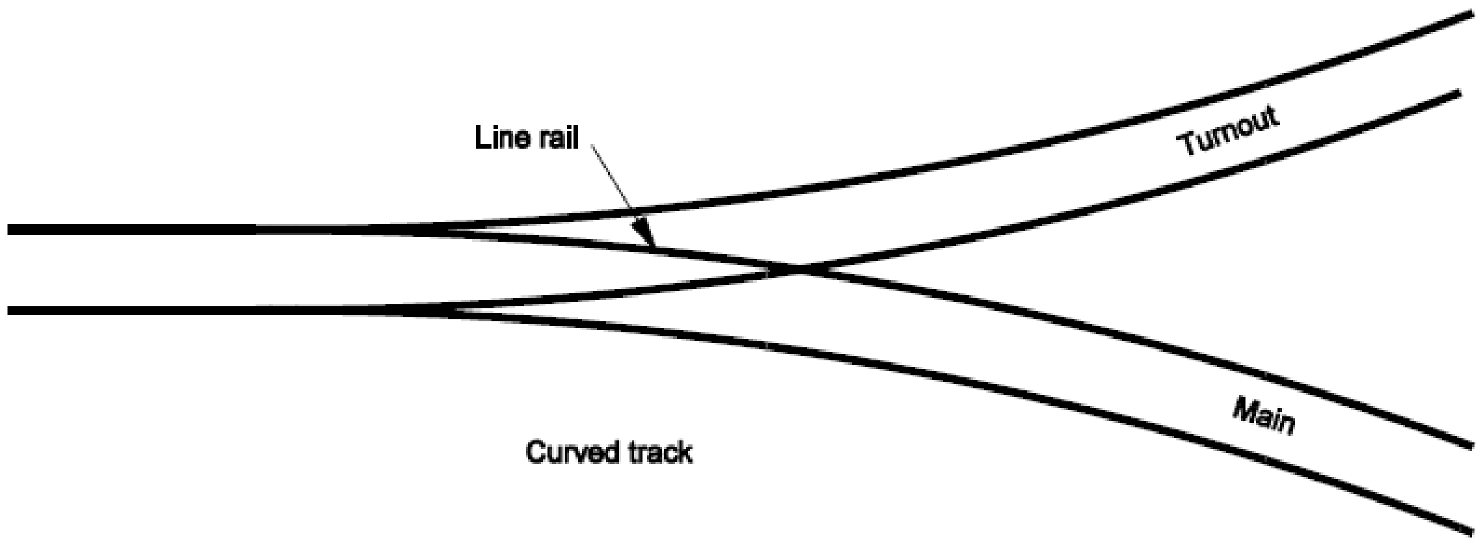


Figure 2-B

2.2.4 Staking Curves

Refer to section 7.9.10 “Monitoring Curve Movement” for Staking Curves

2.2.5 Measuring Alignment

Follow these requirements when measuring alignment:

1. Measure alignment on the designated line rail on the gauge side of the rail head. Measure at a point 5/8 inch below the top of the rail head as shown in Figure 2-C.

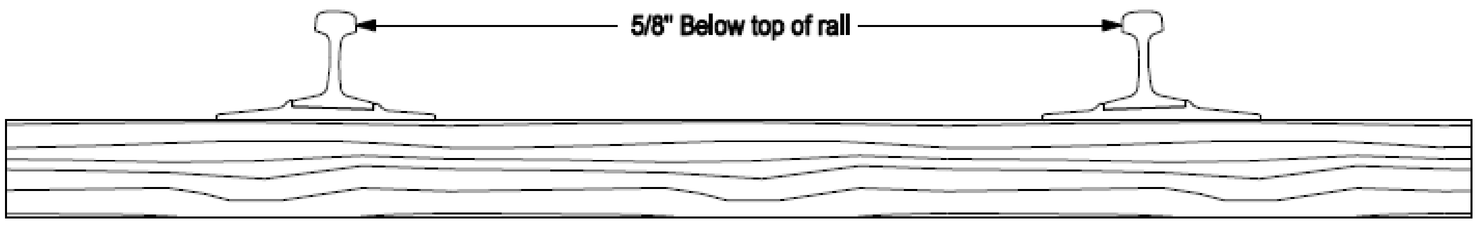


Figure 2-C

2. Record measurements at 15-1/2-foot intervals on the same rail for the full length of tangent and curved segments.
3. Use a 31-foot, 62-foot or 124-foot chord (Class 6 track) length to obtain track alignment measurements as shown in Figure 2-D.

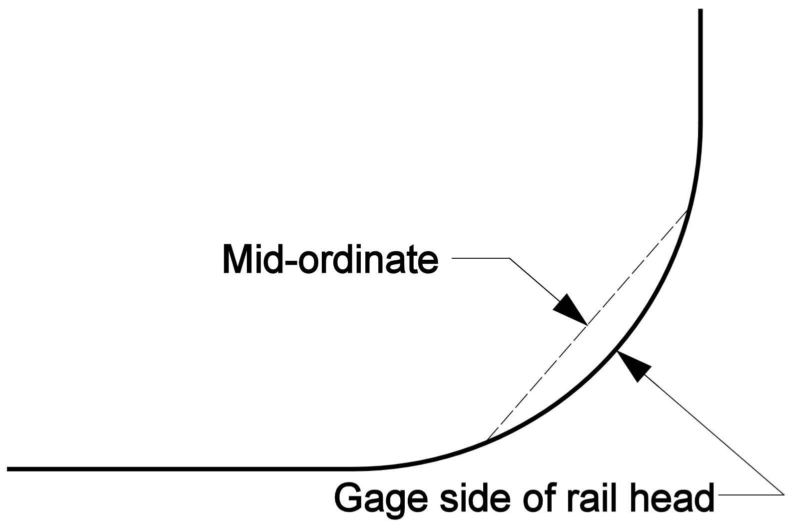


Figure 2-D

NOTE: The distance between the mid-ordinate or center of a 31-foot, 62-foot or 124-foot chord and the gauge side of the rail head determines track alignment.

- When using a 31-foot chord, multiply readings by four.
- When using a 62-foot chord, note that the measurement in inches equals the degree of curvature, as shown in the examples in Table 2-A.

Examples of Converting Measurements to Degrees of Curvature		
Measurement	**31-foot Chord**	**62-foot Chord**
1 inch	4 degrees	1 degree
1-1/4 inches	5 degrees	1 degree – 15 minutes
1-1/2 inches	6 degrees	1 degree – 30 minutes
1-3/4 inches	7 degrees	1 degree – 45 minutes
2 inches	8 degrees	2 degrees

Table 2-A

4. Using Shims
   - To measure alignment on tangent track, you may need to place 1-inch or greater shims at the gauge side of the rail where the ends of the 62-foot chord would normally contact the rail head.

NOTE: Shims offset the 62-foot chord to take the measurement at the mid-ordinate without contacting the rail head along the chord.

   - Subtract the shim thickness from the mid-ordinate measurement to determine the exact reading.

2.2.6 Alignment Limits

Do not allow alignment to deviate from uniformity more than the following thresholds for the applicable class of track. Measure deviations at the mid-ordinate of the designated chord length.

NOTE: The FRA does not consider a track segment with curvature of less than 0.5 degrees to be a curve; however, UPRR utilizes curves less than 0.5 degrees.

1. Single Alignment Deviation

Table 2-C Shows Urgent Conditions:

Class of Track	Tangent Track		Curved Track		All Track
	Deviation from mid-ordinate of 62' chord	**Deviation from mid-ordinate of 31' chord**	**Deviation from mid-ordinate of 31' chord**	**Deviation from mid-ordinate of 62' chord**	**124 chord**
1	4-3/4 inches	*N/A	*N/A	4-3/4 inches	*N/A
2	2-13/16 inches	*N/A	*N/A	2-13/16 inches	*N/A
3	1-5/8 inches	*N/A	1-3/16 inch	1-5/8 inch	*N/A
4	1-3/8 inches	*N/A	15/16 inch	1-3/8 inch	*N/A
5	11/16 inch	*N/A	7/16 inch	9/16 inch	*N/A
6	11/16 inch	7/16 inch	7/16 inch	11/16 inch	1-3/8 inch

Table 2-C **Measurements not applicable*

Table 2-D Shows Critical Conditions.

Class of Track	Tangent Track		Curved Track		All Track
	Deviation from mid-ordinate of 62' chord	**Deviation from mid-ordinate of 31' chord**	**Deviation from mid-ordinate of 31' chord**	**Deviation from mid-ordinate of 62' chord**	**124 chord**
1	5 inches	*N/A	*N/A	5 inches	*N/A
2	3 inches	*N/A	*N/A	3 inches	*N/A
3	1-3/4 inches	*N/A	1 1/4 inches	1-3/4 inches	*N/A
4	1-1/2 inches	*N/A	1 inch	1-1/2 inches	*N/A
5	3/4 inch	*N/A	1/2 inch	5/8 inch	*N/A
6	3/4 inch	1/2 inch	1/2 inch	5/8 inch	1-1/2 inch

Table 2-D **Measurements not applicable.*

2. Multiple Alignment Deviation – Class 6 track only
   - A multiple deviation is considered to exist when three or more non-overlapping deviations occur within a distance five times the specified chord length.
   - Uniformity at any point along the track is established by averaging the measured mid-chord offset values for nine consecutive points centered around that point and which are spaced according to the following chart:

Chord Length	***Spacing***
31’	7’9”
62’	15’6”
124’	31’0”

Table 2-E Shows Severity Conditions for Class 6 Track – Multiple Deviations

Class of Track 6	**Deviation from mid-ordinate of 31' chord**	**Deviation from mid-ordinate of 62' chord**	**Deviation from mid-ordinate of 124' chord**
Urgent	5/16”	7/16”	15/16”
Critical	3/8”	1/2”	1"

Table 2-E

2.2.7 Restoring Uniform Alignment

Follow these requirements to restore uniform alignment:

1. Correct track alignment in ballasted track by laterally shifting the track to uniform alignment while referencing the designated line rail.
2. Use laser systems with automatic tamping machines to align tangent track when provided.
   - Place the laser on fixed track structures such as open deck bridges or other immovable objects.
   - Verify track centers where the laser is placed before starting lining operations.
3. Correct track alignment of fixed track structures such as open deck bridges or other immovable objects by spike lining the designated line rail to uniform alignment.

NOTE: When spike lining to adjust alignment, monitor track gauge and adjust as necessary to conform with established gauge standards.

4. When aligning crossover switches that have long switch ties that extend under both tracks:
   - Reference the designated line rail on the straight side of the crossover switches.
   - To correct alignment of all other designated line rails in the crossover requiring adjustment, spike line the rail to uniformity.
5. When laterally shifting switches to uniform alignment:
   - Reference the designated line rail on the straight side of switches.
   - To correct alignment of the other designated line rail in the turnout requiring adjustment, spike line the rail to uniformity.

2.2.8 Line Ordinates in Turnouts and Crossovers

The designated line rail for referencing alignment through the turnout side of switches is the turnout side closure rail. The closure rail connects the switch point to the frog and continues from the heel of the frog through the last long switch tie.

Follow these requirements when establishing alignment in turnouts and crossovers:

1. To establish alignment through turnout side of switches through the last long switch tie, use line ordinates provided in the Engineering Track Standards book, Sections 5000–5099, Turnouts.

NOTE: Line ordinates denote the specific spread distance between gauge lines of curved closure rails and adjacent rails on the straight side of turnouts. The spread distance establishes the proper alignment for the turnout side of switches.

2. Establish alignment for the turnout side of switches not having published ordinates as follows:
   a. Align the straight side of the turnout to the desired alignment.
   b. Stretch a string between the heel of the switch and the toe of the frog along the gauge line.
   c. Measure the overall distance and divide into four equal parts.
   d. Offset the center ordinate at a right angle to the string 6 inches and spike in place.
   e. Offset each quarter ordinate at a right angle to the string 4-1/2 inches and spike in place as shown in Figure 2-E.

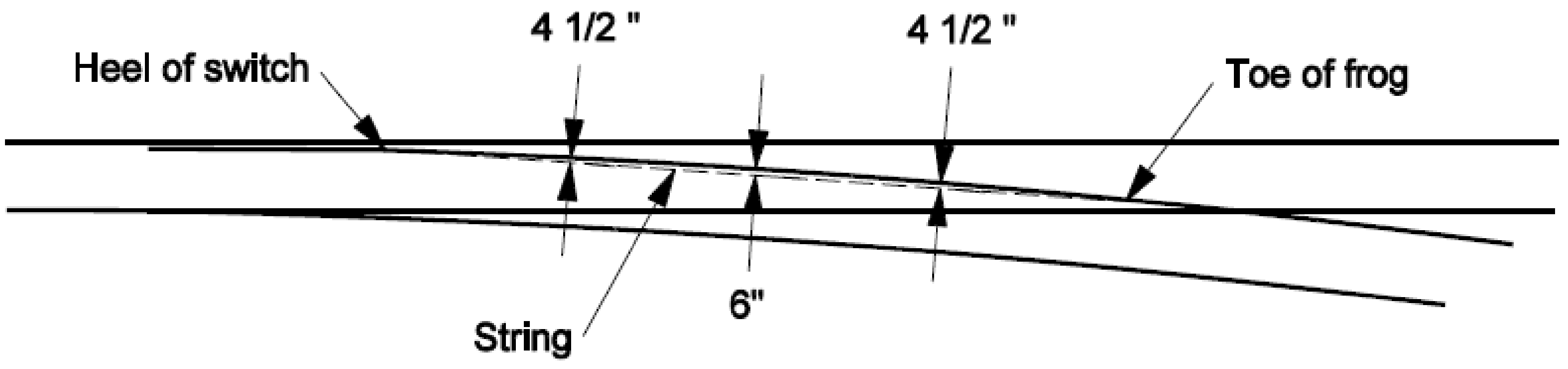


Figure 2-E

A. Line Ordinates Behind Frog

Line ordinates behind the frog spread apart over a given distance at a rate determined by the frog size. See Table 2-F.

If frog size is…	The spread increases 1 foot every…
7	7 feet
8	8 feet
8.5	8.5 feet
9	9 feet
10	10 feet
11	11 feet
14	14 feet
15	15 feet
20	20 feet
24	24 feet
30	30 feet

Table 2-F

When determining line ordinates for behind the frog:

1. Locate the point where the frog's heel spread measures 1 foot between the gauge lines.
2. From this point measure away from it down the straight side of the turnout. Measure the number of feet that equals the frog size.
3. At this point, spread the gauge lines and spike them 2 feet apart.
4. Continue this process until you establish all ordinates and spike through the last switch tie as shown in Figure 2-F.

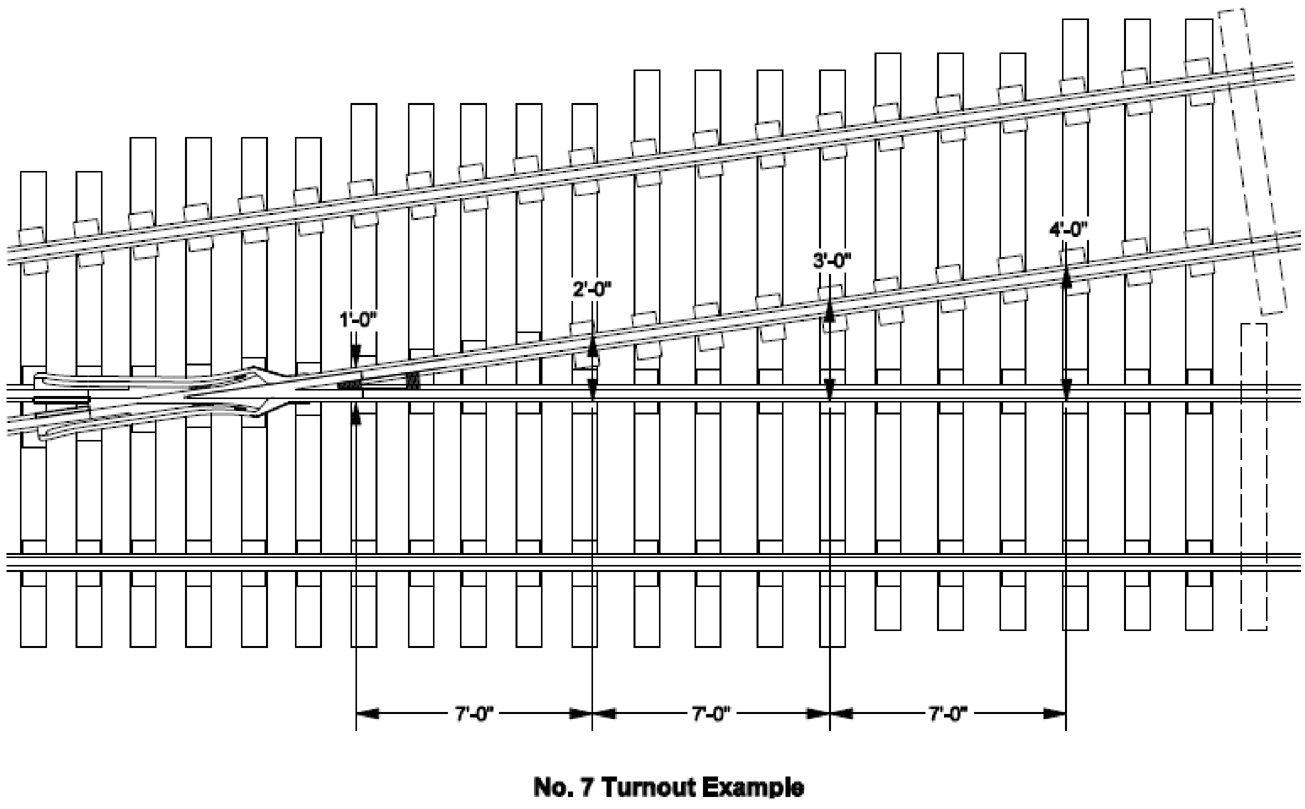


Figure 2-F

2.3 Track Gauge

Track gauge is the distance between the two running rails of the track structure. Properly maintained track gauge provides for a smooth ride, reduces rail wear, retains alignment and surface, and ensures that wheels do not fall between rails.

2.3.1 Designated Gauge Rail

The rail opposite the designated line rail of track or turnouts is the designated gauge rail.

2.3.2 Standard Gauge

Standard track gauge is 56-1/2 inches.

2.3.3 Measuring Gauge

Follow these requirements when measuring gauge:

1. Measure gauge between the heads of the rail at right angles to each other. Measure at a point 5/8 inch below the top of the rail head as shown in Figure 2-G.

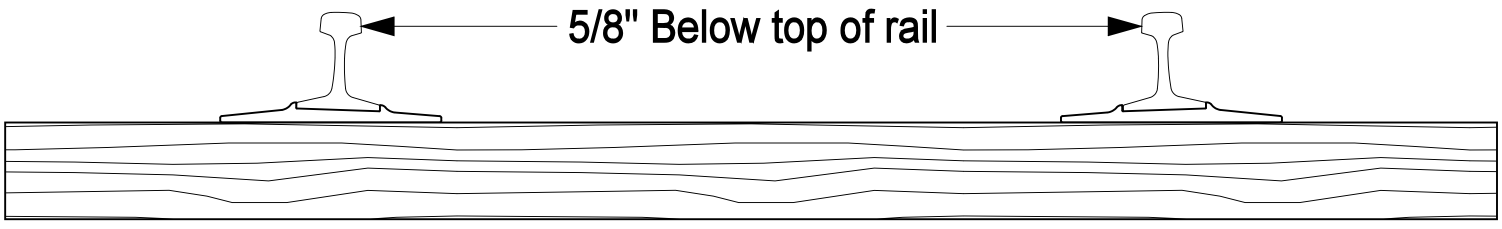


Figure 2-G

2. Use an approved track gauge every fourth tie when adjusting or checking gauge, spiking ties, relaying rail, or constructing new track to conform to standard gauge as shown in Figure 2-H.
   - Measure the track gauge with a tape measure to verify its accuracy before use.
   - Do not force the track gauge between rails.

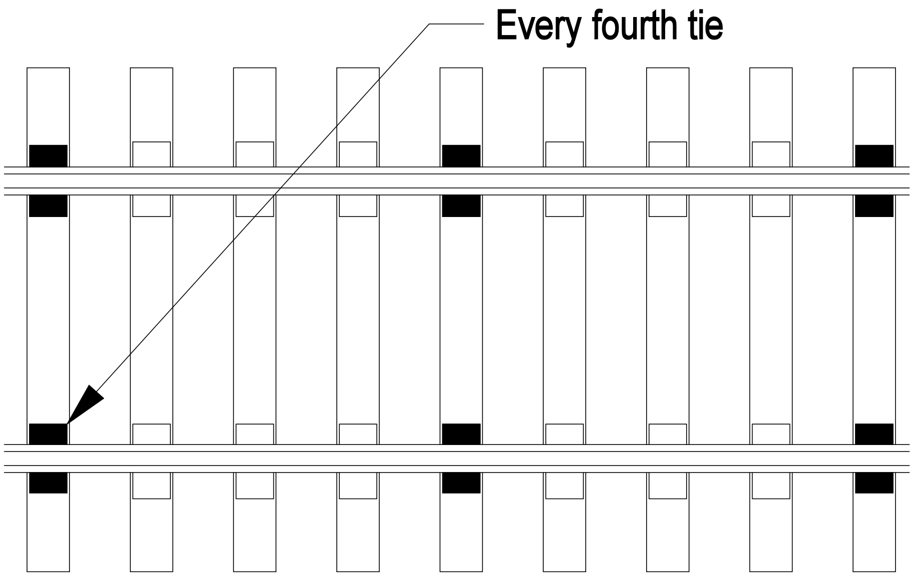


Figure 2-H

3. Before replacing or transposing rail back into tie plates without re-gauging, take inside base-to-base measurements to ensure that installing full-balled rail will not create narrow gauge. Take these measurements as shown in Figure 2-I and Table 2-G.

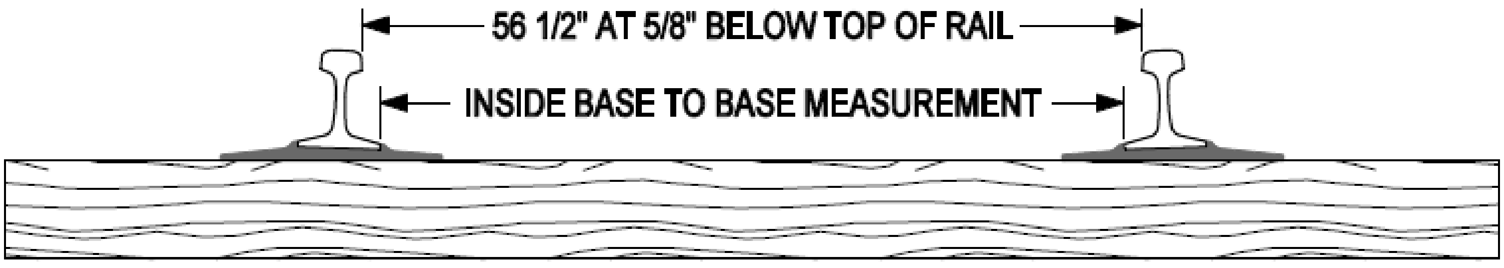


Figure 2-I

Rail Section	Rail Seat Cant	Base-to-Base Gauge	Base-to-Base Gauge Not More Than…
141 lb.	1:40	53-3/4 inches	54-1/4 inches
136 lb.	1:40	53-3/4 inches	54-1/4 inches
133 lb.	1:30	53-7/8 inches	54-3/8 inches
112 to 119 lb.	1:40	54 inches	54-1/2 inches

Table 2-G

2.3.4 Gauge Limits

Urgent Limits for gauge are shown in Table 2-I.

Class of Track	Not More Than...	Max. Change in 31’
1	57-13/16 inches	*N/A
2 and 3	57-5/8 inches	*N/A
4 and 5	57-3/8 inches	*N/A
6	57-1/8 inches	1/2 inch

Table 2-I

Critical Limits for gauge are shown in Table 2-J.

Class of Track	Not less than...	Or More Than...	Max. Change in 31’
1	56 inches	58 inches	*N/A
2 and 3	56 inches	57-3/4 inches	*N/A
4 and 5	56 inches	57-1/2 inches	*N/A
6	56 inches	57-1/4 inches	3/4 inch

Table 2-J

If track gauge measures more than 58 inches, immediately remove the track from service until repairs are made.

2.3.5 Gauge Rods

Follow these requirements when installing gauge rods:

1. Install gauge rods where due to damage or deterioration, wood ties will not effectively maintain gauge or concrete tie shoulders will not effectively secure rail fastenings.

NOTE: If tie plates are severely cut into ties causing reverse canting, do not use gauge rods. Gauge rods will only increase gauge measurement under car loadings. Refer to Figure 2-J

2. Install gauge rods at regular intervals in sufficient quantity to maintain gauge.

NOTE: Do not install gauge rods as a permanent substitute for effective ties to retain gauge.

3. Use insulated gauge rods in circuited or signalized track.
4. Gauge rods are not a substitute for ties.
5. Install insulated gauge rods in wood tie track at hot box detectors. See Figure 2-J.

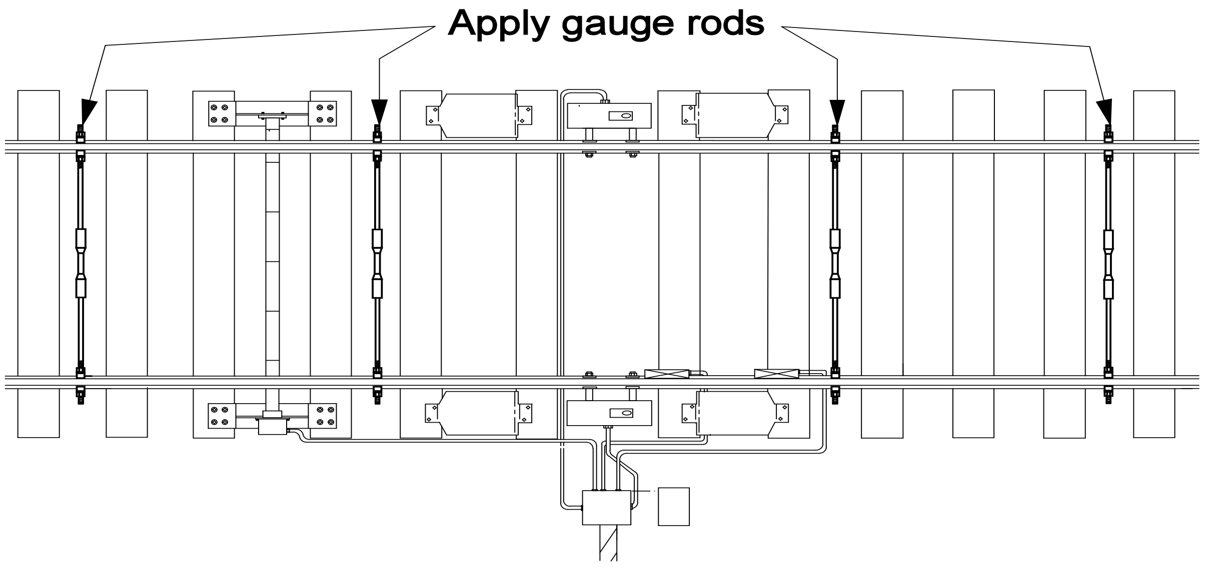


Figure 2-J

2.3.6 Restoring Standard Gauge

A. Follow these requirements when restoring track to standard gauge:

1. Perform spike pulling and re-driving along the designated gauge rail.
2. Plug spike holes before re-driving spikes.
3. When gauging track in curves, you may need to spike line joints on the high rail to correct alignment deviations. You can achieve proper gauge by gauging the low rail to the high rail.
   - At locations where repeat gauging has been performed ensure high rail spikes are pulled and plugged prior to gauging low rail.
4. To correct wide gauge caused by canted or tipped rail from sand or ice build-up between the base of the rail and the top of the tie plate, remove the material to restore the rail to a level plane.
5. To correct wide gauge caused by worn insulators, replace worn insulators in concrete or steel tie track.
6. To correct wide gauge caused by curve rail worn beyond the allowable limits, transpose or replace rail. See Section 4.3.4 Curve Rail Wear Limits
7. To correct narrow track gauge caused by skewed ties, return the ties to right angles to the running rails before adjusting the gauge. Box anchor the tie to prevent recurrence.

NOTE: It may be necessary to replace defective ties in order to restore standard gauge.

B. Follow these requirements when correcting gauge caused by canting deficiencies:

1. Differential plate cutting is another cause of wide or narrow gauge. A differential plate cutting of 3/8” on one rail can cause track to be out of gauge by 3/16”.
2. Nominal cant for 1:40 is +1.42 degrees and 1:30 cant is +1.90 degrees.
3. On wood tie track a differential plate cutting of 3/8" toward the field side will show a cant of 0º. Plate cutting toward the gauge side of 7/16" will show a cant of +3.5º. Refer to Figure 2-K.

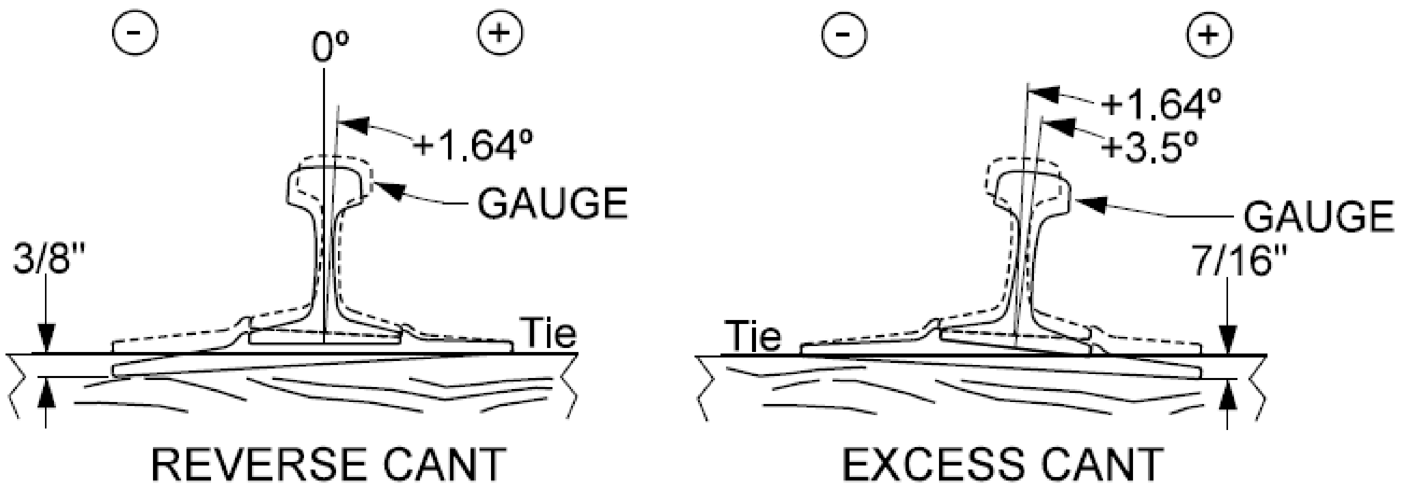


Figure 2-K

4. To correct this type of exception, the tie plates must be removed and the plate-bearing surface of the ties must be adzed to a level plane.

The following thresholds are for rail cant on Wood Ties:
Urgent limit is Negative -1.5 degrees
Critical limit is Negative -2.0 degrees

The following thresholds are for rail cant on Concrete Ties:
Urgent limit for Positive is 3.50 degrees and Negative is -0.50 degrees
Critical limit for Positive is 4.50 degrees and Negative is -1.50 degrees

NOTE: Concrete tie rail cant exceptions must be verified within 48 hours and reported in the TMP.

2.3.7 Program Maintenance

Maintain standard gauge as follows:

1. When track gauge measures 57 inches or greater, adjust it to standard gauge before spiking out-of-face wood tie installations.
2. Restore standard gauge in curves when double transposing or relaying rail back into plates where gauge measures 57 inches or greater.
3. Gauge track to standard 56-1/2” gauge during all rail relays.

NOTE: Gauge of 56-3/4 inches is allowed on wide-gauge concrete ties. These ties are marked 56-3/4 adjacent to the field side shoulder on one end of the tie as shown in Figure 2-L.

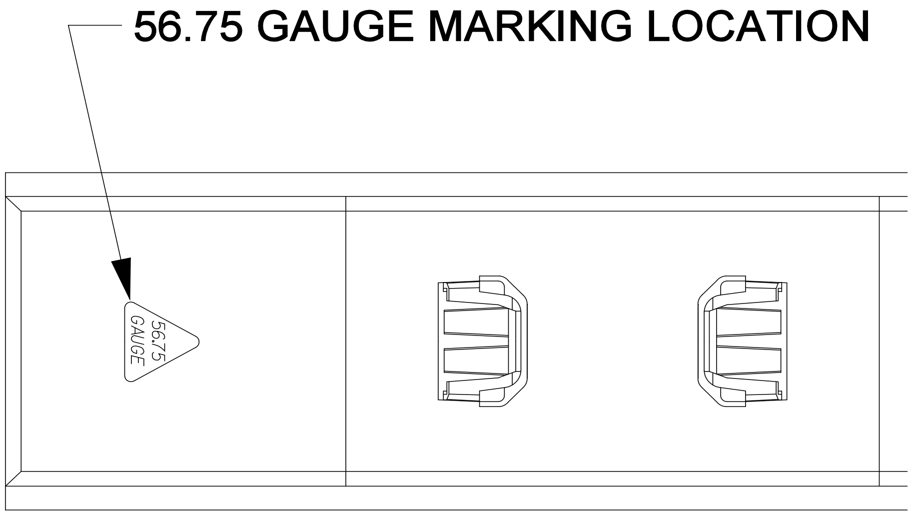


Figure 2-L

2.4 Clearances

Maintain adequate spacing between tracks to enable trains to safely pass or meet rolling stock on adjacent tracks. Maintain sufficient horizontal and vertical clearance to enable trains to clear wayside structures and facilities.

2.4.1 Measuring Track Centers

Follow these requirements when measuring track center:

1. Measure track centers between the centerline of two adjacent tracks. Measure from the gauge line of a rail of one track to the same rail of an adjacent track as shown in Figure 2-M.

Figure 2-M

2. Check track centers at the beginning of surfacing operations and every 660 feet or less behind automatic tamping machines where adjacent tracks are present. Check track centers every 330 feet or less through spirals and the full body of curves.
3. Contact Clearance Department at 402-544-2090 with any questions about track centers or when track centers are changed.
4. When new tracks are constructed, report the new track centers to the Clearance Dept. with measurements every 528’.

2.4.2 Minimum Track Centers

Follow these requirements for track center length:

1. Maintain at least 13 feet between the centerline of main tracks and other adjacent track(s) on tangent track.
   - Track centers less than 13' are a Geometry Car Urgent exception in Class 1-6. These exceptions should be field verified in 48 hours and updated in the TMP.
2. Maintain at least 12 feet 6 inches between the centerline of other than main tracks.
3. Maintain track centers in curves of parallel tracks to allow for car tilt and overhang due to curvature. Maintain track centers through the entire length of the curve and for 80 feet beyond the curve.
4. Use Table 2-K to determine the minimum track centers required for sufficient clearance in curved track.

MINIMUM TRACK CENTERS ON CURVES TO PROVIDE SUFFICIENT CLEARANCE ON ADJACENT TRACKS						
Where curve elevations are	**And curvature is 1 degree**	**And curvature is 2 degrees**	**And curvature is 3 degrees**	**And curvature is 4 degrees**	**And curvature is 5 degrees**	**And curvature is 6 degrees**
1/4"	13' 4-1/8"	13' 7-1/8"	13' 10-1/8"	14' 1-1/8"	14' 4-1/8"	14' 7-1/8"
1/2"	13' 5-1/4"	13' 8-1/4"	13' 11-1/4"	14' 2-1/4"	14' 5-1/4"	14' 8-1/4"
3/4"	13' 6-3/8"	13' 9-3/8"	14' 0-3/8"	14' 3-3/8"	14' 6-3/8"	14' 9-3/8"
1”	13' 7-1/2"	13' 10-1/2"	14' 1-1/2"	14' 4-1/2"	14' 7-1/2"	14' 10-1/2"
1 1/4"	13' 8-5/8"	13' 11-5/8"	14' 2-5/8"	14' 5-5/8"	14' 8-5/8"	14' 11-5/8"
1 1/2"	13' 9-3/4"	14' 0-3/4"	14' 3-3/4"	14' 6-3/4"	14' 9-3/4"	15' 0-3/4"
1 3/4"	13' 10-7/8"	14' 1-7/8"	14' 4-7/8"	14' 7-7/8"	14' 10-7/8"	15' 1-7/8"
2”	14' 0"	14' 3"	14' 6"	14' 9"	15' 0"	15' 3"
2 1/4"	14' 1-1/8"	14' 4-1/8"	14' 7-1/8"	14' 10-1/8"	15' 1-1/8"	15' 4-1/8"
2 1/2"	14' 2-1/4"	14' 5-1/4"	14' 8-1/4"	14' 11-1/4"	15' 2-1/4"	15' 5-1/4"
2 3/4"	14' 3-3/8"	14' 6-3/8"	14' 9-3/8"	15' 0-3/8"	15' 3-3/8"	15' 6-3/8"
3”	14' 4-1/2"	14' 7-1/2"	14' 10-1/2"	15' 1-1/2"	15' 4-1/2"	15' 7-1/2"
3 1/4"	14' 5-5/8"	14' 8-5/8"	14' 11-5/8"	15' 2-5/8"	15' 5-5/8"	15' 8-5/8"
3 1/2"	14' 6-3/4"	14' 9-3/4"	15' 0-3/4"	15' 3-3/4"	15' 6-3/4"	15' 9-3/4"
3 3/4"	14' 7-7/8"	14' 10-7/8"	15' 1-7/8"	15' 4-7/8"	15' 7-7/8"	15' 10-7/8"
4”	14' 9"	15' 0"	15' 3"	15' 6"	15' 9"	16' 0"
4 1/4"	14' 10-1/8"	15' 1-1/8"	15' 4-1/8"	15' 7-1/8"	15' 10-1/8"	16' 1-1/8"
4 1/2"	14' 11-1/4"	15' 2-1/4"	15' 5-1/4"	15' 8-1/4"	15' 11-1/4"	16' 2-1/4"
4 3/4"	15' 0-3/8"	15' 3-3/8"	15' 6-3/8"	15' 9-3/8"	16' 0-3/8"	16' 3-3/8"
5”	15' 1-1/2"	15' 4-1/2"	15' 7-1/2"	15' 10-1/2"	16' 1-1/2"	16' 4-1/2"
5 1/4"	15' 2-5/8"	15' 5-5/8"	15' 8-5/8"	15' 11-5/8"	16' 2-5/8"	16' 5-5/8"
5 1/2"	15' 3-3/4"	15' 6-3/4"	15' 9-3/4"	16' 0-3/4"	16' 3-3/4"	16' 6-3/4"

Table 2-K

Continuation of previous table:

MINIMUM TRACK CENTERS ON CURVES TO PROVIDE SUFFICIENT CLEARANCE ON ADJACENT TRACKS						
Where curve elevations are	**And curvature is 7 degrees**	**And curvature is 8 degrees**	**And curvature is 9 degrees**	**And curvature is 10 degrees**	**And curvature is 11 degrees**	**And curvature is 12 degrees**
1/4"	14' 10-1/8"	15'1-1/8"	15' 4-1/8"	15' 7-1/8"	15' 10-1/8"	16' 1-1/8"
1/2"	14' 11-1/4"	15' 2-1/4"	15' 5-1/4"	15' 8-1/4"	15' 11-1/4"	16' 2-1/4"
3/4"	15' 0-3/8"	15' 3-3/8"	15' 6-3/8"	15' 9-3/8"	16' 0-3/8"	16' 3-3/8"
1”	15' 1-1/2"	15' 4-1/2"	15' 7-1/2"	15' 10-1/2"	16' 1-1/2"	16' 4-1/2"
1 1/4"	15' 2-5/8"	15' 5-5/8"	15' 8-5/8"	15' 11-5/8"	16' 2-5/8"	16' 5-5/8"
1 1/2"	15' 3-3/4"	15' 6-3/4"	15' 9-3/4"	16' 0-3/4"	16' 3-3/4"	16' 6-3/4"
1 3/4"	15' 4-7/8"	15' 7-7/8"	15' 10-7/8"	16' 1-7/8"	16' 4-7/8"	16' 7-7/8"
2”	15' 6"	15' 9"	16' 0"	16' 3"	16' 6"	16' 9"
2 1/4"	15' 7-1/8"	15' 10-1/8"	16' 1-1/8"	16' 4-1/8"	16' 7-1/8"	16' 10-1/8"
2 1/2"	15' 8-1/4"	15' 11-1/4"	16' 2-1/4"	16' 5-1/4"	16' 8-1/4"	16' 11-1/4"
2 3/4"	15' 9-3/8"	16' 0-3/8"	16' 3-3/8"	16' 6-3/8"	16' 9-3/8"	17' 0-3/8"
3”	15' 10-1/2"	16' 1-1/2"	16' 4-1/2"	16' 7-1/2"	16' 10-1/2"	17' 1-1/2"
3 1/4"	15' 11-5/8"	16' 2-5/8"	16' 5-5/8"	16' 8-5/8"	16' 11-5/8"	17' 2-5/8"
3 1/2"	16' 0-3/4"	16' 3-3/4"	16' 6-3/4"	16' 9-3/4"	17' 0-3/4"	17' 3-3/4"
3 3/4"	16' 1-7/8"	16' 4-7/8"	16' 7-7/8"	16' 10-7/8"	17' 1-7/8"	17' 4-7/8"
4”	16' 3"	16' 6"	16' 9"	17' 0"	17'3"	17' 6"
4 1/4"	16' 4-1/8"	16' 7-1/8"	16' 10-1/8"	17' 1-1/8"	17' 4-1/8"	17' 7-1/8"
4 1/2"	16' 5-1/4"	16' 8-1/4"	16' 11-1/4"	17' 2-1/4"	17' 5-1/4"	17' 8-1/4"
4 3/4"	16' 6-3/8"	16' 9-3/8"	17' 0-3/8"	17' 3-3/8"	17' 6-3/8"	17' 9-3/8"
5”	16' 7-1/2"	16' 10-1/2"	17' 1-1/2"	17' 4-1/2"	17' 7-1/2"	17' 10-1/2"
5 1/4"	16' 8-5/8"	16' 11-5/8"	17' 2-5/8"	17' 5-5/8"	17' 8-5/8"	17' 11-5/8"
5 1/2"	16' 9-3/4"	17' 0-3/4"	17' 3-3/4"	17' 6-3/4"	17' 9-3/4"	18' 0-3/4"

Table 2-K (cont.)

2.4.3 Track Centers in Crossover Switches

Follow these track center requirements at crossover switches:

1. Align existing or newly constructed tracks to parallel track centers for at least 660 feet in advance of the crossover being installed.
2. When long switch ties extend under both tracks of a crossover:
   - Spike the ties to the same track center measurement as the track they connect. An example is shown in Figure 2-N.
   - Align the tracks approaching the crossover switch to the same track center measurement as the last long switch tie on each end of the crossover, as shown in Figure 2-N.

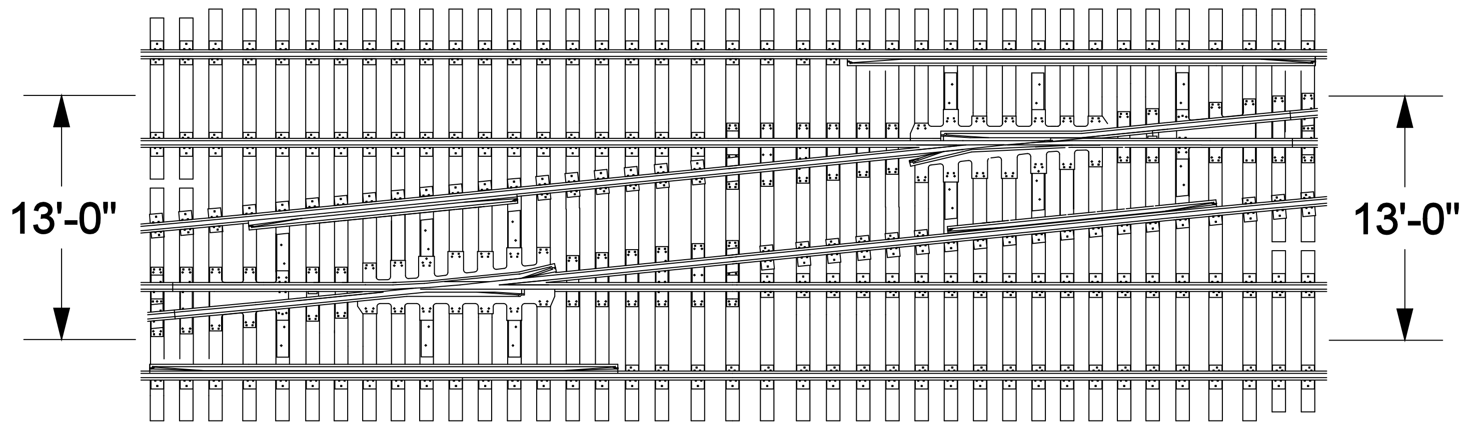


Figure 2-N

2.4.4 Minimum Clearances

Maintain horizontal and vertical clearances according to Standard Drawing No. 0038 and follow these requirements:

1. Maintain appliances not shown on this drawing to a minimum clearance of 9 feet from the centerline of the track and at least 23'4" feet above the top of the rail.
2. Place top-of-rail markers at all structures with 23 feet or less of overhead clearance. Place markers according to Standard Drawing Nos. 0551 and 0552.
3. Where overhead and lateral obstructions are present, such as overpasses, tunnels, bridges, rock cuts, slide fences, platforms etc., minimize track raises and never raise the track above the top of rail markers or alter alignment from stakes.
4. Where markers indicate clearances are close, perform spot surfacing manually.
5. Before raising track above the top-of-rail marker, or aligning track that may create clearance problems, or to report a track shift contact the Clearance Dept. at 402-544-2090.
6. If no top of rail marker is present contact Clearance Dept. prior to raising track.
7. Before the temporary installation of falsework, such as construction scaffolding, that will reduce clearances, the Clearance Dept. must be notified at 402-544-2090. The Clearance Dept. must then protect temporary clearance reduction by recording the falsework modification in the computerized clearance system. Contact the Clearance Dept. when the temporary falsework clearance restriction has been removed.

NOTE: For Clearance information please reference the Clearance Maps and Structures Site (MyUP->Reference->Maps>Clearance Maps and Structures.)

2.4.5 Allowable Superelevation in Adjacent Tracks

To ensure adequate clearance between tracks, maintain adjacent tracks in curves to the limits shown in Table 2-L.

MAXIMUM SUPERELEVATION ALLOWABLE IN ADJACENT OUTSIDE TRACK TO PROVIDE SUFFICIENT CLEARANCE					
Where super-elevation of inside curved track is	**And track centers are 13' 0"**	**And track centers are 13' 6"**	**And track centers are 14' 0"**	**And track centers are 14' 6"**	**And track centers are 15' 0"**
¼"	1/4"	1-1/2"	3"	4-1/2"	5-1/2"
½"	1/2"	1-3/4"	3-1/4"	4-3/4"	5-1/2"
¾"	3/4"	2"	3-1/2"	5"	5-1/2"
1"	1"	2-1/4"	3-3/4"	5-1/4"	5-1/2"
1-1/4"	1-1/4"	2-1/2"	4"	5-1/2"	5-1/2"
1-1/2"	1-1/2"	2-3/4"	4-1/4"	5-1/2"	5-1/2"
1-3/4"	1-3/4"	3"	4-1/2"	5-1/2"	5-1/2"
2"	2"	3-1/4"	4-3/4"	5-1/2"	5-1/2"
2-1/4"	2-1/4"	3-1/2"	5"	5-1/2"	5-1/2"
2-1/2"	2-1/2"	3-3/4"	5-1/4"	5-1/2"	5-1/2"
2-3/4"	2-3/4"	4"	5-1/2"	5-1/2"	5-1/2"
3"	3"	4-1/4"	5-1/2"	5-1/2"	5-1/2"
3-1/4"	3-1/4"	4-1/2"	5-1/2"	5-1/2"	5-1/2"
3-1/2"	3-1/2"	4-3/4"	5-1/2"	5-1/2"	5-1/2"
3-3/4"	3-3/4"	5"	5-1/2"	5-1/2"	5-1/2"
4"	4"	5-1/4"	5-1/2"	5-1/2"	5-1/2"
4-1/4"	4-1/4"	5-1/2"	5-1/2"	5-1/2"	5-1/2"
4-1/2"	4-1/2"	5-1/2"	5-1/2"	5-1/2"	5-1/2"
4-3/4"	4-3/4"	5-1/2"	5-1/2"	5-1/2"	5-1/2"
5"	5"	5-1/2"	5-1/2"	5-1/2"	5-1/2"
5-1/4"	5-1/4"	5-1/2"	5-1/2"	5-1/2"	5-1/2"
5-1/2"	5-1/2"	5-1/2"	5-1/2"	5-1/2"	5-1/2"

Table 2-L

2.5 Grade

Track grade provides a uniform plane that allows trains to negotiate uphill and downhill terrain. Grade is preserved when uniform track raises occur during normal surface and lining operations.

2.5.1 Designated Grade Rail

The inner or low rail of curves is the designated reference rail for maintaining grade.

NOTE: The designated grade rail for referencing grade is the same rail as the designated line rail in tangent track.

2.5.2 Grade Stakes

Grade stakes will be provided for relocated or newly constructed tracks to help establish the proper grade.

When necessary, grade stakes will be provided to re-establish or modify existing grade.

2.5.3 Multiple Track Grade Crossings

Establish and maintain grade crossings to a uniform plane across all tracks as follows:

1. Where practicable, establish and maintain the difference between the top-of-rail elevation of adjacent tracks to within 1 inch of each other:
   - Through grade crossings where track centers are within 20 feet of each other as shown in Figure 2-O.

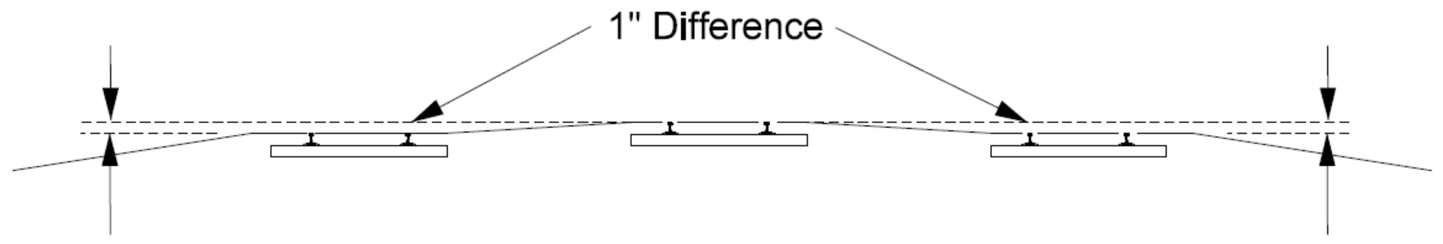


Figure 2-O

   - Through grade crossings that exist in curved track that contains superelevation as shown in Figure 2-P.

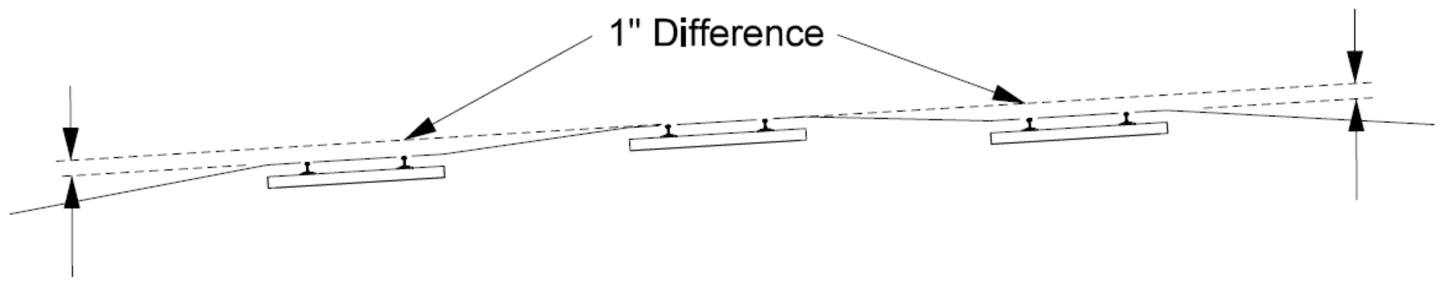


Figure 2-P

2. Stretch a string line across the tops of the rails of all existing tracks to verify the top-of-rail relationship through grade crossings. Use the highest track as a reference to determine that the lower tracks conform.

2.5.4 Turnouts and Crossovers

The top-of-rail elevation of tracks approaching crossover switches should be as level as practicable with each other for at least 660 feet in advance of main line crossovers.

The top-of-rail elevation of main and diverging tracks must be level with each other through the turnout, and, where possible, for 250 feet beyond the signal or fouling point, whichever distance is greater.

2.5.5 Vertical Curves

Vertical curves connect the intersection of different grades. Curves that connect two uphill grades are summit curves, and curves that connect two downhill grades are sag curves.

Design vertical curves according to Standard Drawing No. 0016.

2.6 Surface

Surface is the uniform state of profile, superelevation, and crosslevel as determined by the top-of-rail elevation and the relationship of opposite rails to each other at a specific point.

2.6.1 Measuring Crosslevel and Superelevation

Crosslevel, utilizing a level board, is measured by subtracting the difference in height between the top surface of one rail and the top surface of the opposite rail.

- On tangent track, both rails should be the same height (zero crosslevel).
- On spirals and curves, the outer rail must not be lower than the inner rail (reverse elevation).

Follow these requirements for measuring crosslevel and superelevation:

1. Use an approved track level board to measure crosslevel when track is disturbed for repair work, surfacing, or inspections.
2. Test the level board for accuracy before use as follows:
   a. Set the level board on a nearly level track.
   b. Obtain a reading. Note the following:
      - Which rail is shown to be higher.
      - The location of the right-hand or left-hand edge of the bubble on the graduated scale.

c. Turn the level board end-for-end and place it at the exact location where the previous reading was taken.
d. Obtain a reading. Note the following:
   - Which rail is shown to be higher.
   - The location of the right-hand or left-hand edge of the bubble on the graduated scale.
e. Determine if both readings indicate the same rail being higher and if the bubble's edge stopped at the same location on the graduated scale during each reading.
   - If yes, the level board is properly calibrated. Go to step 3.
   - If no, go to step f.
f. Adjust the bubble screw in a direction to split the difference between the two readings taken. Repeat steps a through e until the level board provides the same reading when placed on the rail in opposite directions.

3. Measure crosslevel across the top of the two running rails of the track at right angles to the track alignment as shown in Figure 2-Q.

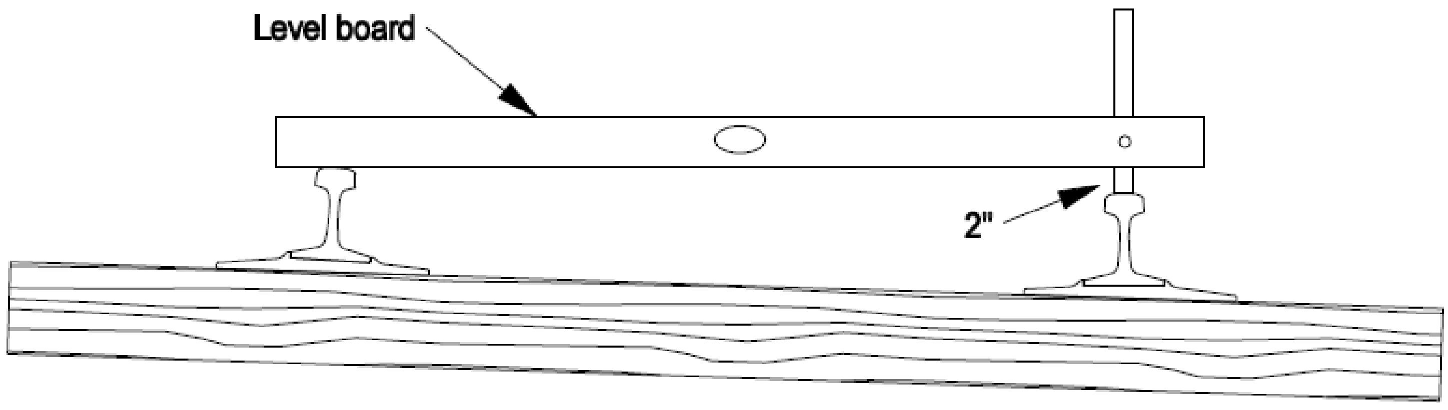


Figure 2-Q

4. Check crosslevel at the beginning of surfacing operations and at regular intervals behind automatic tamping machines.
5. Check tangent track and the full body of curves every 660 feet and at every 1/4-inch superelevation change in spirals of curves.

2.6.2 Measuring Warp (twist)

Warp (twist) is the difference in crosslevel between any two points less than 62 feet apart. Excessive warp contributes to wheel climb derailments.

To determine the amount of warp on tangent track, add the largest two opposite rail measurements within 62 feet, as shown in Figure 2-R.

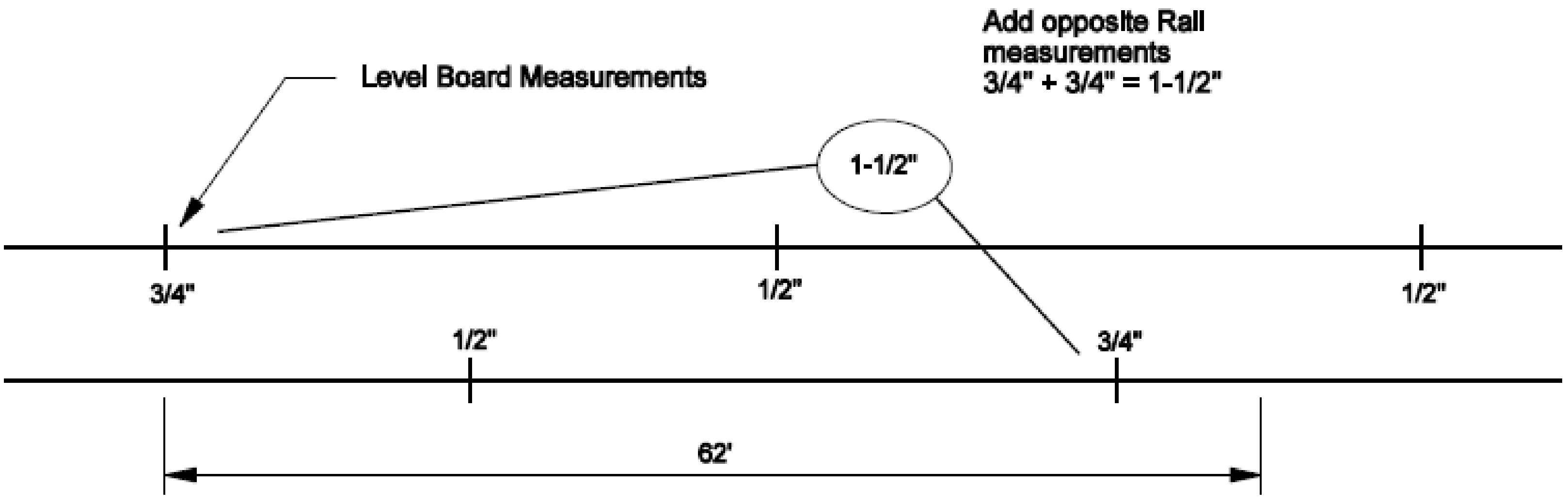


Figure 2-R

To determine the amount of warp in a curve or spiral (Figure 2-S), do one of the following:

- Subtract largest and smallest same rail measurements within 62 feet.

  or

- Add the largest two opposite rail measurements within 62 feet.

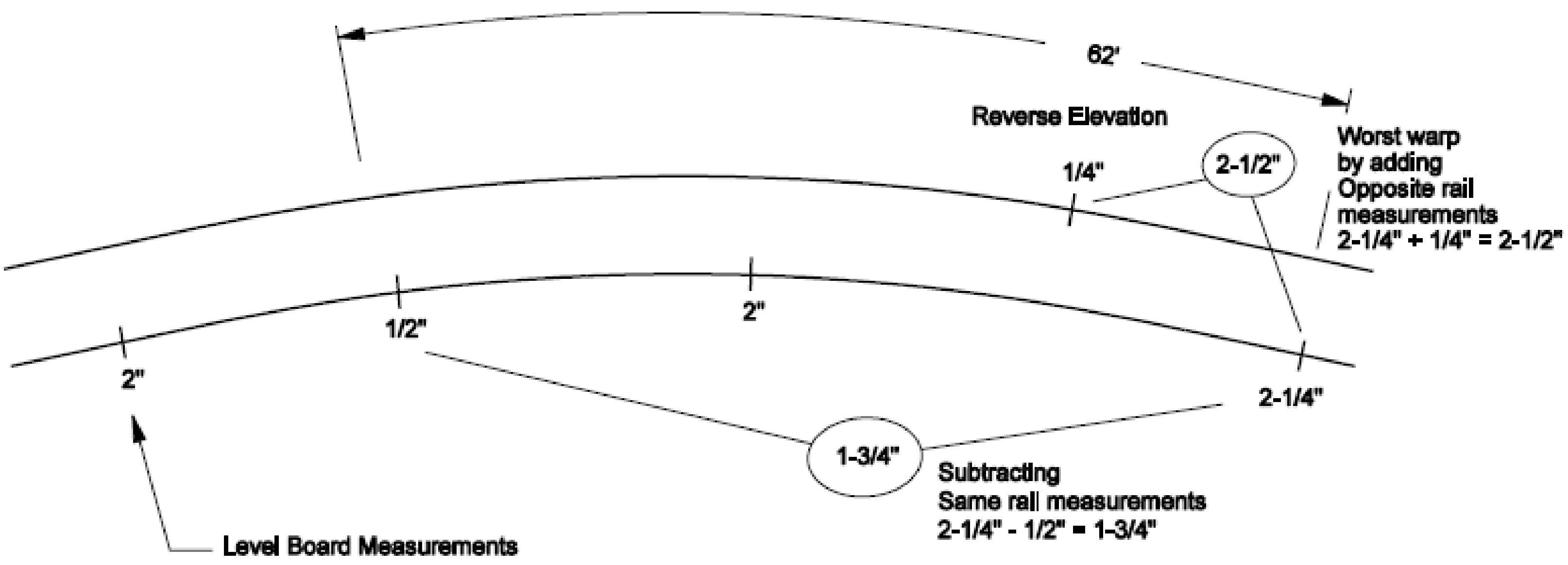


Figure 2-S

- Where the elevation at any point in a curve equals or exceeds 6 inches, the difference (warp) in crosslevel within 62 feet between that point and a point with greater elevation may not be more than 1-1/2 inches regardless of track class. See Figure 2-T.

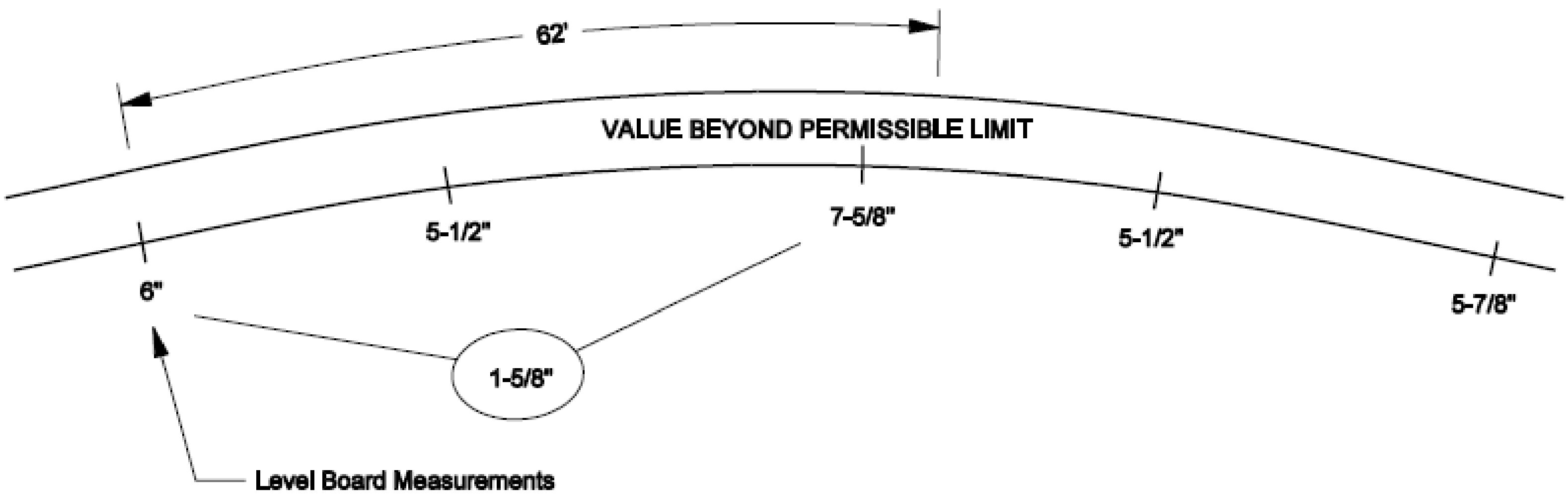


Figure 2-T

- To control harmonics on Class 2 through 5 jointed track with staggered joints, ensure that the crosslevel differences do not exceed 1-1/4 inches in all of six consecutive pairs of joints, as created by 7 low joints. See Figure 2-U.
  - Track with joints staggered less than 10 feet shall not be considered as having staggered joints.
  - Joints within the 7 low joints outside of the regular joint spacing shall not be considered as joints.

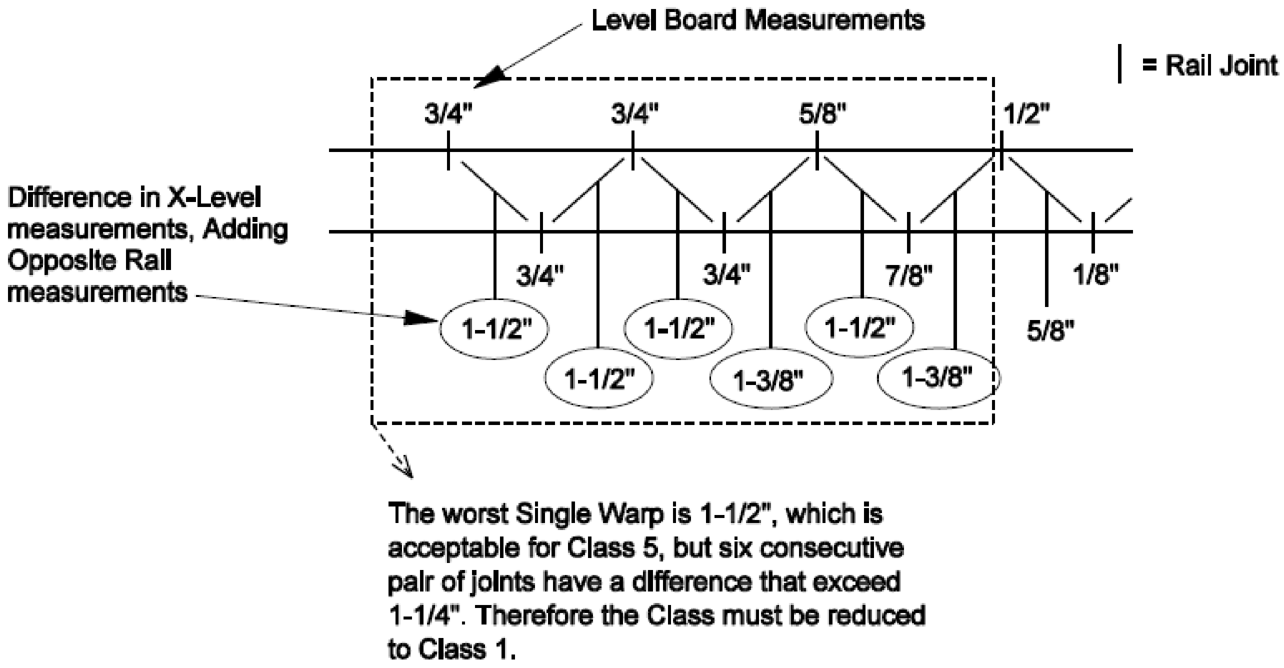


Figure 2-U

2.6.3 Tank Car Warp

Variable Tank Car Warp (VTCW) is based on the rate of change of crosslevel over a certain distance. The exception occurs when the crosslevel rate change (or twist) for any length of track between 32 feet and 61 feet exceeds a certain rate threshold that is prone to cause wheel lift. Most cars (especially tank cars) have truck centers between 30 feet and 57 feet. Curves are designed at a maximum rate of 2.45 inches per 100 feet (1 inch in 44 feet). This exception writes in all curves and on tangents if there is an alignment deviation greater than 3/4 inch within 20 feet of VTCW. The VCTW exception thresholds are in Table 2-M.

	Severity	Class 1	Class 2	Class 3	Class 4	Class 5
Variable Tank Car Warp	Critical	5 3/8	4 3/4	3 3/4	3 5/16	3 1/8
	Urgent	4 7/8	4 1/4	3 1/2	2 7/8	2 7/8

Table 2-M

2.6.4 Measuring Profile

Track profile is the longitudinal elevation of the running rails. Measure track profile along the top of the running rails as follows:

Use a 62-foot chord (string) to obtain track profile measurements for Class 1-5 track. Use a 31-foot, 62-foot and 124-foot chord to obtain track profile measurements for Class 6 track.

Measure the distance between the mid-ordinate or center of the applicable chord and the top of the rail head to determine deviation from uniform profile as shown in Figure 2-V.

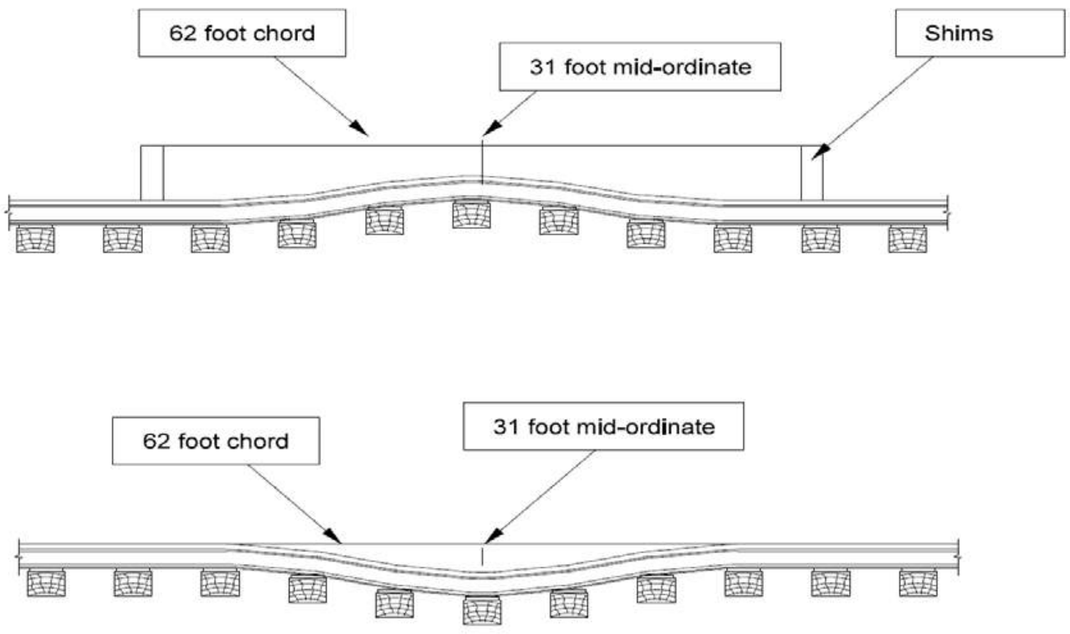


Figure 2-V

If the mid-ordinate of the chord contacts the rail head, place 1-inch or greater shims on top of the rail head at the ends of the applicable chord.

NOTE: If shims are used, subtract the shim thickness from the mid-ordinate measurement to determine the exact reading.

2.6.5 Track Surface Limits

1. Track Surface Limits - Do not allow track surface to deviate from uniform profile and crosslevel more than the following thresholds for the applicable class of track. Measure deviations as prescribed by each category.
   - If maximum crosslevel in a curve is 6” or more and there is a difference in crosslevel between any 2 points less than 62 feet apart of more than 1 ½” the track is not good for any class of track.
   - To control harmonics on Class 2 through 5 in jointed track with staggered joints, the cross-level difference shall not exceed 1-1/4” in all of six consecutive pairs of joints, as created by 7 low joints. Track with joints staggered less than 10 feet shall not be considered as having staggered joints. Joints within the 7 low joints outside of the regular joint spacing shall not be considered as joints for measurement.

Table 2-O shows Urgent Limits.

Track Surface	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6
The maximum crosslevel on the outside rail of a curve may not be more than…	5-3/4"	5-3/4"	5-3/4"	5-3/4"	5-3/4"	5-3/4”
The runoff in any 31 feet of rail at the end of a raise may not be more than…	N/A	N/A	N/A	N/A	N/A	N/A
The deviation from uniform profile on either rail at the mid-ordinate of a 31-foot cord may not be more than...	N/A	N/A	N/A	N/A	N/A	15/16”
The deviation from uniform profile on either rail at the mid-ordinate of a 62-foot cord may not be more than...	2-7/8"	2-5/8"	2-1/8"	1-7/8"	1-3/16"	15/16”
The deviation from uniform profile on either rail at the mid-ordinate of a 124-foot cord may not be more than...	N/A	N/A	N/A	N/A	N/A	1-5/8"
The deviation from zero crosslevel at any point on tangent may not be more than…	2-13/16"	1-15/16"	1-11/16"	1-3/16"	15/16"	15/16”
The difference in crosslevel between any 2 points less than 62 feet apart may not be more than…	2-15/16"	2-3/16"	1-15/16"	1-11/16"	1-7/16"	1-7/16”
The variation of crosslevel on the spiral per 31 feet may not be more than:	1-15/16"	1-11/16"	1-3/16"	15/16"	11/16"	9/16”
The difference in crosslevel between any 2 points in a curve less than 10 feet apart (Short Warp) may not be more than….	NA	NA	NA	NA	NA	1”

Table 2-O

Table 2-P shows Critical Limits.

Track Surface	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6
The maximum crosslevel on the outside rail of a curve may not be more than…	6"	6"	6"	6"	6"	6"
The runoff in any 31 feet of rail at the end of a raise may not be more than…	3-1/2"	3"	2"	1-1/2"	1"	N/A
The deviation from uniform profile on either rail at the mid-ordinate of a 31-foot cord may not be more than...	N/A	N/A	N/A	N/A	N/A	1"
The deviation from uniform profile on either rail at the mid-ordinate of a 62-foot cord may not be more than...	3"	2-3/4"	2-1/4"	2"	1-1/4"	1"
The deviation from uniform profile on either rail at the mid-ordinate of a 124-foot cord may not be more than...	N/A	N/A	N/A	N/A	N/A	1-3/4"
The deviation from zero crosslevel at any point on tangent may not be more than…	3"	2"	1-3/4"	1-1/4"	1"	15/16"
The difference in crosslevel between any 2 points less than 62 feet apart may not be more than…	3"	2-1/4"	2"	1-3/4"	1-1/2"	1-1/2"
The variation of crosslevel on the spiral per 31 feet may not be more than:	2"	1 3/4"	1 1/4"	1"	3/4"	5/8"
The difference in crosslevel between any 2 points in a curve less than 10 feet apart (Short Warp) may not be more than…	N/A	N/A	N/A	N/A	N/A	1-1/4"

Table 2-P

2. **Multiple Track Surface Deviation – Class 6 track only.**
   - Do not allow track surface to deviate from uniformity more than the threshold for **three or more non-overlapping deviations** occurring within a distance equal to five times the specified cord length.

Table 2-R shows Urgent Limits for Class 6.

Track Surface	Track Class
	6
The deviation from uniform profile on either rail at the mid-ordinate of a 31-foot cord may not be more than...	**11/16”**
The deviation from uniform profile on either rail at the mid-ordinate of a 62-foot cord may not be more than...	**11/16"**
The deviation from uniform profile on either rail at the mid-ordinate of a 124-foot cord may not be more than...	**1-3/16"**

Table 2-R

Table 2-S shows Critical Limits for Class 6.

Track Surface	Track Class
	6
The deviation from uniform profile on either rail at the mid-ordinate of a 31-foot cord may not be more than...	**3/4"**
The deviation from uniform profile on either rail at the mid-ordinate of a 62-foot cord may not be more than...	**3/4"**
The deviation from uniform profile on either rail at the mid-ordinate of a 124-foot cord may not be more than...	**1-1/4"**

Table 2-S

2.6.6 Spirals

Spirals designed into curves gradually transition alignment and superelevation from tangents into curves, from curves into tangents, and between curves of varying degrees. Follow these requirements:

1. Curves of 10 minutes (00° 10' 00") or greater require spirals.
2. The maximum rate of change in superelevation must not exceed 1 inch per 44 feet of distance. Limit this rate of change to curves with a maximum speed of less than 50 MPH.
3. Use Table 2-T to determine the distance requirements for each 1-inch change of superelevation.

Distance Between Each Inch Change of Superelevation		
Maximum Speed (1)	**Desired Distance for New and Existing High Speed Tracks (2)**	**Minimum Distance for Canyon and Heavy Grade Territory (3)**
20 MPH	44 feet	44 feet
25 MPH	44 feet	44 feet
30 MPH	44 feet	44 feet
35 MPH	44 feet	44 feet
40 MPH	47 feet	44 feet
45 MPH	53 feet	44 feet
50 MPH	59 feet	49 feet
55 MPH	65 feet	54 feet
60 MPH	70 feet	59 feet
65 MPH	76 feet	64 feet
70 MPH	82 feet	69 feet
75 MPH	88 feet	73 feet
80 MPH	94 feet	78 feet
85 MPH	100 feet	83 feet
90 MPH	106 feet	88 feet
95 MPH	112 feet	93 feet
100 MPH	118 feet	98 feet
105 MPH	124 feet	103 feet
110 MPH	130 feet	108 feet

Table 2-T

4. If the length of the spiral permits, run superelevation off at a uniform rate over the entire length of the spiral, with full superelevation through the body of the curve and no superelevation on tangent track.
5. If no spirals exist, or spirals are too short to meet the required rate of runoff, a maximum of 1 inch of superelevation may be run onto tangent track.
6. When the tangent between two curves is too short to provide the minimum length of runoff for the authorized superelevation:
   - Divide the tangent into two parts in proportion to the degree of curvature of the adjoining curves.
   - If possible, place the longer segment adjacent to the curve of greater degree.
7. Maintain at least 100 feet of level track between reverse curves, regardless of whether tangent track exists or not, to ensure that cars can right themselves between curves.
8. Ensure that compound curves have full superelevation for the higher-degree curve carried through the entire higher-degree portion of the curve and reduced superelevation on the lower-degree portion of the curve within the prescribed runoff rates.

2.6.7 Superelevation

The outer or high rail of curves is the designated reference rail for installing and maintaining superelevation. Maintain superelevation as provided on curve markers and/or designated on the high rail of curves.

- The EFMS curve database that can be accessed through the Engineering Website may be used to determine approved elevations and degree of curvature when there are no field markings on the rail. If the accuracy of the EFMS curve database is in doubt, the Manager of Track Maintenance should contact a surveying field engineer. Changes to the database cannot be made without Chief Engineer Approval.

NOTE: Designated superelevation may not be less than 3/4 inch or greater than 5 inches in any curve.

Install approved superelevation in main tracks when track renewals involve surfacing and lining.

Unless approved by the Chief Engineer the designated superelevation is 1 inch unbalanced.

The Chief Engineer must approve all changes to designated superelevation.

All speeds are rounded down to the nearest 5 MPH.

Use Table 2-U to design new superelevation.

CURVE SPEEDS (Miles Per Hour)																				
Curve		Unbalance Condition	SUPERELEVATION (Inches)																	
Deg	Min		0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00
0	30	0 Inch	45	50	55	65	70	75	80	80	85	90	95	100	100	105	110	110	115	115
		1 Inch	70	75	80	80	85	90	95	100	100	105	110	110	115	115	120	125	125	130
		2 Inch	85	90	95	100	100	105	110	110	115	115	120	125	125	130	130	135	135	140
		3 Inch	100	105	110	110	115	115	120	125	125	130	130	135	135	140	140	145	145	150
1	00	0 Inch	30	35	40	45	50	50	55	55	60	65	65	70	70	75	75	80	80	80
		1 Inch	50	50	55	55	60	65	65	70	70	75	75	80	80	80	85	85	90	90
		2 Inch	60	65	65	70	70	75	75	80	80	80	85	85	90	90	90	95	95	100
		3 Inch	70	75	75	80	80	80	85	85	90	90	90	95	95	100	100	100	105	105
1	30	0 Inch	25	30	30	35	40	40	45	45	50	50	55	55	55	60	60	65	65	65
		1 Inch	40	40	45	45	50	50	55	55	55	60	60	65	65	65	70	70	70	75
		2 Inch	50	50	55	55	55	60	60	65	65	65	70	70	70	75	75	75	80	80
		3 Inch	55	60	60	65	65	65	70	70	70	75	75	75	80	80	80	80	85	85
2	00	0 Inch	20	25	25	30	35	35	40	40	40	45	45	50	50	50	55	55	55	55
		1 Inch	35	35	40	40	40	45	45	50	50	50	55	55	55	55	60	60	60	65
		2 Inch	40	45	45	50	50	50	55	55	55	55	60	60	60	65	65	65	65	70
		3 Inch	50	50	55	55	55	55	60	60	60	65	65	65	65	70	70	70	70	75
2	30	0 Inch	20	20	25	25	30	30	35	35	35	40	40	40	45	45	45	50	50	50
		1 Inch	30	30	35	35	35	40	40	40	45	45	45	50	50	50	50	55	55	55
		2 Inch	35	40	40	40	45	45	45	50	50	50	50	55	55	55	55	60	60	60
		3 Inch	45	45	45	50	50	50	50	55	55	55	55	60	60	60	60	65	65	65
3	00	0 Inch	15	20	20	25	25	30	30	30	35	35	35	40	40	40	40	45	45	45
		1 Inch	25	30	30	30	35	35	35	40	40	40	40	45	45	45	50	50	50	50
		2 Inch	35	35	35	40	40	40	40	45	45	45	50	50	50	50	50	55	55	55
		3 Inch	40	40	40	45	45	45	50	50	50	50	50	55	55	55	55	55	60	60
3	30	0 Inch	15	20	20	20	25	25	30	30	30	30	35	35	35	40	40	40	40	45
		1 Inch	25	25	30	30	30	30	35	35	35	40	40	40	40	45	45	45	45	45
		2 Inch	30	30	35	35	35	40	40	40	40	45	45	45	45	45	50	50	50	50
		3 Inch	35	40	40	40	40	45	45	45	45	45	50	50	50	50	50	55	55	55
4	00	0 Inch	15	15	20	20	25	25	25	25	30	30	30	35	35	35	35	40	40	40
		1 Inch	25	25	25	25	30	30	30	35	35	35	35	40	40	40	40	40	45	45
		2 Inch	30	30	30	35	35	35	35	40	40	40	40	40	45	45	45	45	45	50
		3 Inch	35	35	35	40	40	40	40	40	45	45	45	45	45	50	50	50	50	50
4	30	0 Inch	15	15	15	20	20	25	25	25	25	30	30	30	30	35	35	35	35	35
		1 Inch	20	25	25	25	25	30	30	30	30	35	35	35	35	35	40	40	40	40
		2 Inch	25	30	30	30	30	35	35	35	35	35	40	40	40	40	40	45	45	45
		3 Inch	30	35	35	35	35	35	40	40	40	40	40	45	45	45	45	45	45	50

CURVE SPEEDS (Miles Per Hour)

Curve		Unbalance Condition	SUPERELEVATION (Inches)																	
Deg	Min		0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00
5	00	0 Inch	10	15	15	20	20	20	20	25	25	25	30	30	30	30	30	35	35	35
		1 Inch	20	20	25	25	25	25	30	30	30	30	30	35	35	35	35	35	40	40
		2 Inch	25	25	30	30	30	30	30	35	35	35	35	35	40	40	40	40	40	40
		3 Inch	30	30	30	35	35	35	35	35	40	40	40	40	40	40	45	45	45	45
5	30	0 Inch	10	15	15	15	20	20	20	25	25	25	25	30	30	30	30	30	35	35
		1 Inch	20	20	20	25	25	25	25	30	30	30	30	30	35	35	35	35	35	35
		2 Inch	25	25	25	30	30	30	30	30	35	35	35	35	35	35	40	40	40	40
		3 Inch	30	30	30	30	35	35	35	35	35	35	40	40	40	40	40	40	40	45
6	00	0 Inch	10	15	15	15	20	20	20	20	25	25	25	25	25	30	30	30	30	30
		1 Inch	20	20	20	20	25	25	25	25	25	30	30	30	30	30	35	35	35	35
		2 Inch	25	25	25	25	25	30	30	30	30	30	35	35	35	35	35	35	40	40
		3 Inch	25	30	30	30	30	30	35	35	35	35	35	35	40	40	40	40	40	40
6	30	0 Inch	10	10	15	15	15	20	20	20	20	25	25	25	25	25	30	30	30	30
		1 Inch	15	20	20	20	20	25	25	25	25	25	30	30	30	30	30	30	35	35
		2 Inch	20	25	25	25	25	25	30	30	30	30	30	30	35	35	35	35	35	35
		3 Inch	25	25	30	30	30	30	30	30	35	35	35	35	35	35	35	40	40	40
7	00	0 Inch	10	10	15	15	15	20	20	20	20	20	25	25	25	25	25	30	30	30
		1 Inch	15	20	20	20	20	20	25	25	25	25	25	30	30	30	30	30	30	30
		2 Inch	20	20	25	25	25	25	25	30	30	30	30	30	30	30	35	35	35	35
		3 Inch	25	25	25	30	30	30	30	30	30	30	35	35	35	35	35	35	35	40
7	30	0 Inch	10	10	15	15	15	15	20	20	20	20	20	25	25	25	25	25	30	30
		1 Inch	15	15	20	20	20	20	20	25	25	25	25	25	30	30	30	30	30	30
		2 Inch	20	20	20	25	25	25	25	25	30	30	30	30	30	30	30	35	35	35
		3 Inch	25	25	25	30	30	30	30	30	30	30	35	35	35	35	35	35	35	40
8	00	0 Inch	10	10	10	15	15	15	20	20	20	20	20	25	25	25	25	25	25	25
		1 Inch	15	15	20	20	20	20	20	25	25	25	25	25	25	25	30	30	30	30
		2 Inch	20	20	20	25	25	25	25	25	25	25	30	30	30	30	30	30	30	35
		3 Inch	25	25	25	25	25	25	30	30	30	30	30	30	30	35	35	35	35	35
8	30	0 Inch	10	10	10	15	15	15	15	20	20	20	20	20	25	25	25	25	25	25
		1 Inch	15	15	15	20	20	20	20	20	25	25	25	25	25	25	25	30	30	30
		2 Inch	20	20	20	20	25	25	25	25	25	25	25	30	30	30	30	30	30	30
		3 Inch	25	25	25	25	25	25	25	30	30	30	30	30	30	30	30	35	35	35
9	00	0 Inch	10	10	10	15	15	15	15	15	20	20	20	20	20	25	25	25	25	25
		1 Inch	15	15	15	15	20	20	20	20	20	25	25	25	25	25	25	25	30	30
		2 Inch	20	20	20	20	20	25	25	25	25	25	25	25	30	30	30	30	30	30
		3 Inch	20	25	25	25	25	25	25	25	30	30	30	30	30	30	30	30	35	35
9	30	0 Inch	10	10	10	15	15	15	15	15	20	20	20	20	20	20	25	25	25	25
		1 Inch	15	15	15	15	20	20	20	20	20	20	25	25	25	25	25	25	25	30
		2 Inch	20	20	20	20	20	20	25	25	25	25	25	25	25	30	30	30	30	30
		3 Inch	20	20	25	25	25	25	25	25	25	30	30	30	30	30	30	30	30	30
10	00	0 Inch	10	10	10	10	15	15	15	15	15	20	20	20	20	20	20	25	25	25
		1 Inch	15	15	15	15	15	20	20	20	20	20	20	25	25	25	25	25	25	25
		2 Inch	15	20	20	20	20	20	20	25	25	25	25	25	25	25	25	30	30	30
		3 Inch	20	20	20	25	25	25	25	25	25	25	25	30	30	30	30	30	30	30
10	30	0 Inch	10	10	10	10	15	15	15	15	15	20	20	20	20	20	20	20	25	25
		1 Inch	15	15	15	15	15	20	20	20	20	20	20	20	25	25	25	25	25	25
		2 Inch	15	20	20	20	20	20	20	20	25	25	25	25	25	25	25	25	30	30
		3 Inch	20	20	20	20	25	25	25	25	25	25	25	25	30	30	30	30	30	30
11	00	0 Inch	5	10	10	10	10	15	15	15	15	15	20	20	20	20	20	20	20	25
		1 Inch	15	15	15	15	15	15	20	20	20	20	20	20	20	25	25	25	25	25
		2 Inch	15	15	20	20	20	20	20	20	20	25	25	25	25	25	25	25	25	30
		3 Inch	20	20	20	20	20	25	25	25	25	25	25	25	25	30	30	30	30	30

CURVE SPEEDS (Miles Per Hour)																				
Curve		Unbalance Condition	SUPERELEVATION (Inches)																	
Deg	Min		0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00
11	30	0 Inch	5	10	10	10	10	15	15	15	15	15	20	20	20	20	20	20	20	20
		1 Inch	10	15	15	15	15	15	20	20	20	20	20	20	20	20	25	25	25	25
		2 Inch	15	15	20	20	20	20	20	20	20	20	25	25	25	25	25	25	25	25
		3 Inch	20	20	20	20	20	20	25	25	25	25	25	25	25	25	30	30	30	30
12	00	0 Inch	5	10	10	10	10	15	15	15	15	15	15	20	20	20	20	20	20	20
		1 Inch	10	15	15	15	15	15	15	20	20	20	20	20	20	20	25	25	25	25
		2 Inch	15	15	15	20	20	20	20	20	20	20	25	25	25	25	25	25	25	25
		3 Inch	20	20	20	20	20	20	25	25	25	25	25	25	25	25	25	25	30	30
12	30	0 Inch	5	10	10	10	10	15	15	15	15	15	15	20	20	20	20	20	20	20
		1 Inch	10	15	15	15	15	15	15	20	20	20	20	20	20	20	20	25	25	25
		2 Inch	15	15	15	20	20	20	20	20	20	20	20	25	25	25	25	25	25	25
		3 Inch	20	20	20	20	20	20	20	25	25	25	25	25	25	25	25	25	25	30
13	00	0 Inch	5	10	10	10	10	10	15	15	15	15	15	15	20	20	20	20	20	20
		1 Inch	10	10	15	15	15	15	15	15	20	20	20	20	20	20	20	20	25	25
		2 Inch	15	15	15	15	20	20	20	20	20	20	20	20	25	25	25	25	25	25
		3 Inch	20	20	20	20	20	20	20	20	25	25	25	25	25	25	25	25	25	25
13	30	0 Inch	5	10	10	10	10	10	15	15	15	15	15	15	15	20	20	20	20	20
		1 Inch	10	10	15	15	15	15	15	15	15	20	20	20	20	20	20	20	20	25
		2 Inch	15	15	15	15	15	20	20	20	20	20	20	20	20	25	25	25	25	25
		3 Inch	15	20	20	20	20	20	20	20	20	25	25	25	25	25	25	25	25	25
14	00	0 Inch	5	10	10	10	10	10	15	15	15	15	15	15	15	20	20	20	20	20
		1 Inch	10	10	15	15	15	15	15	15	15	20	20	20	20	20	20	20	20	20
		2 Inch	15	15	15	15	15	20	20	20	20	20	20	20	20	20	25	25	25	25
		3 Inch	15	20	20	20	20	20	20	20	20	20	25	25	25	25	25	25	25	25
14	30	0 Inch	5	5	10	10	10	10	10	15	15	15	15	15	15	15	20	20	20	20
		1 Inch	10	10	10	15	15	15	15	15	15	15	20	20	20	20	20	20	20	20
		2 Inch	15	15	15	15	15	15	20	20	20	20	20	20	20	20	20	25	25	25
		3 Inch	15	15	20	20	20	20	20	20	20	20	20	25	25	25	25	25	25	25
15	00	0 Inch	5	5	10	10	10	10	10	15	15	15	15	15	15	15	20	20	20	20
		1 Inch	10	10	10	15	15	15	15	15	15	15	20	20	20	20	20	20	20	20
		2 Inch	15	15	15	15	15	15	20	20	20	20	20	20	20	20	20	20	25	25
		3 Inch	15	15	20	20	20	20	20	20	20	20	20	20	25	25	25	25	25	25

Table 2-U

2.6.8 Curve Markers

Place and maintain curve markers according to Standard Drawing No. 0015 as follows:

1. Place curve markers in milepost ascending order as identified in Figure 2-W, Figure 2-X, and Figure 2-Y. Refer also to Table 2-V.

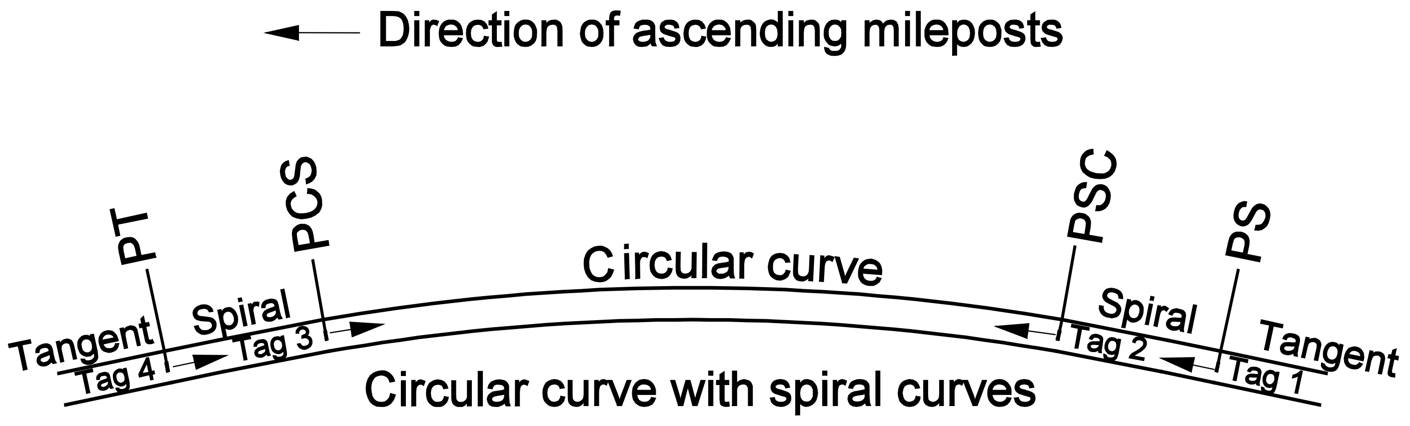


Figure 2-W

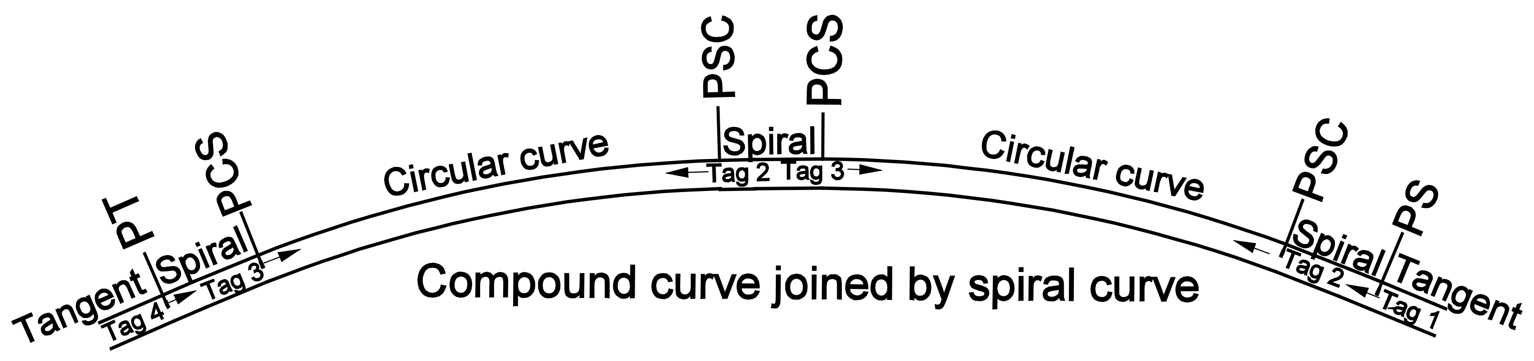


Figure 2-X

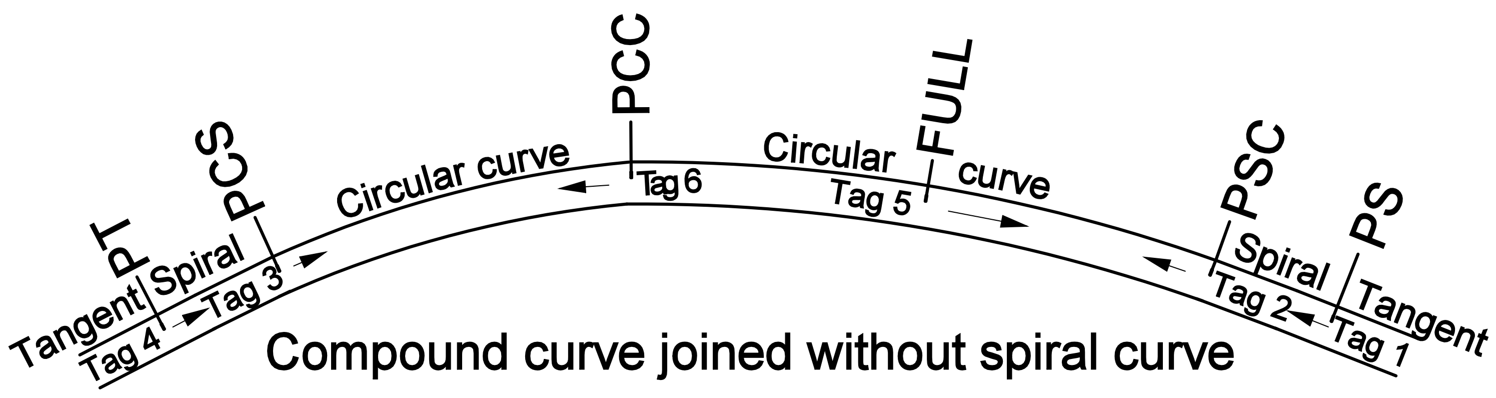


Figure 2-Y

Curve Marker Identification		
Abbreviation	**Full Name**	**Description**
PS	Point of Spiral	Tangent ends and spiral begins
PSC	Point of Spiral to Curve	Spiral ends and full body begins
PCC	Point of Compound Curve	Curve degree changes with no spiral
PCS	Point of Curve to Spiral	Full body ends and spiral begins
PT	Point of Tangent	Spiral ends and tangent begins

Table 2-V

2. Place curve markers on top of ties 6 to 8 inches from the base of the high rail toward the center of the track. Locations for mounting markers to wood and concrete ties are shown in Figure 2-Z and Figure 2-AA.

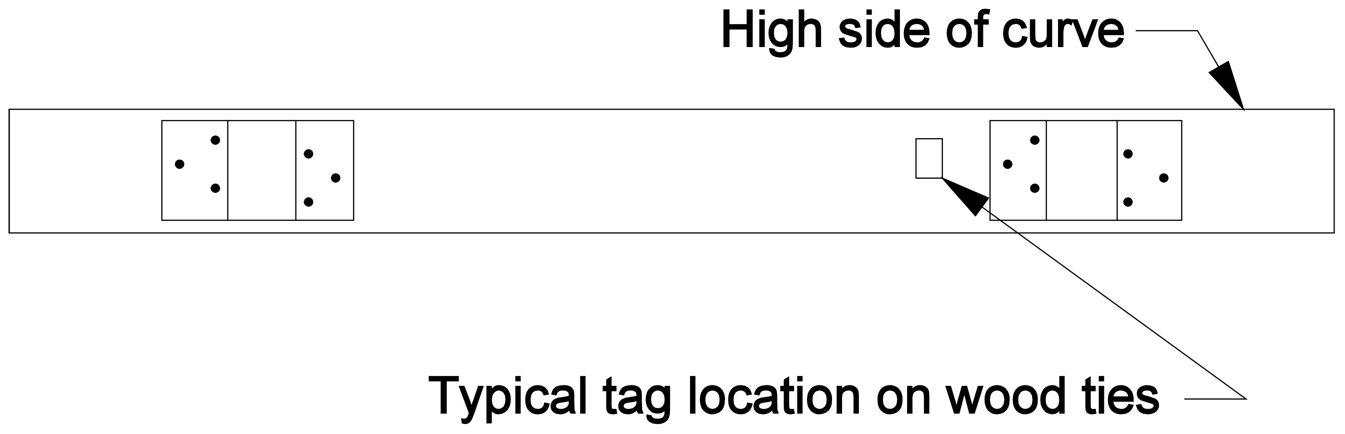


Figure 2-Z

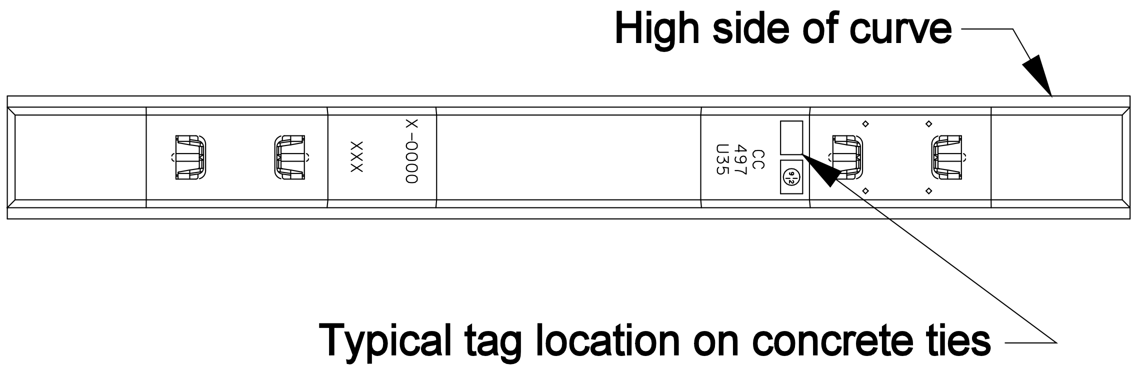


Figure 2-AA

NOTE: LEVEL (LVL) indicates where superelevation begins and FULL indicates where full superelevation is attained.

3. Mark superelevation changes on the high rail through spirals in 1/4-inch increments.
4. Transfer curve information from the old rail to the new rail when the rail is replaced. When ties with curve markers are replaced, transfer curve markers to the new ties.

2.6.9 Restoring Surface

Follow these requirements when restoring surface:

1. Make sure there is enough ballast to restore the ballast section after completing the raise.
2. Restore a “0” crosslevel to tangents and restore designated superelevation in curves when surfacing track.
3. Sight along the ball of the rail to determine surface irregularities.
4. When performing spot surfacing by hand:
   - Correct the designated grade rail in curves before re-establishing the designated superelevation in the high rail.
   - If necessary, raise the opposite rail to obtain the desired crosslevel or superelevation.
5. Make runoffs from track raises gradually—between 1/2 to 3/4 inch per 39 feet.
   - Start runoffs soon enough to blend into the top-of-rail elevation of fixed objects such as open deck bridges, crossing frogs, or other immovable objects.
   - Do not make permanent runoffs in curves or switches.

6. When surfacing switches, do not allow train traffic through the turnout side until it has been tamped.

   Tamp both sides of ties for a distance of 15 inches from each side of the rail base. To prevent center-bound track, avoid tamping wood and concrete tie centers.

7. When out-of-face tamping with automatic tamping machines:
   - Follow manufactures recommended squeeze pressure.
   - Make at least two insertions per cross tie and three insertions per switch tie. (CAT only requires one insertion.).
   - Adjust tamper tools to ensure that the top of the blade is 1/2 inch below the bottom of the tie as shown in Figure 2-BB. Table 2-W-1 shows depth of each tie type.
   - Avoid striking ties with tamper tools when making insertions.

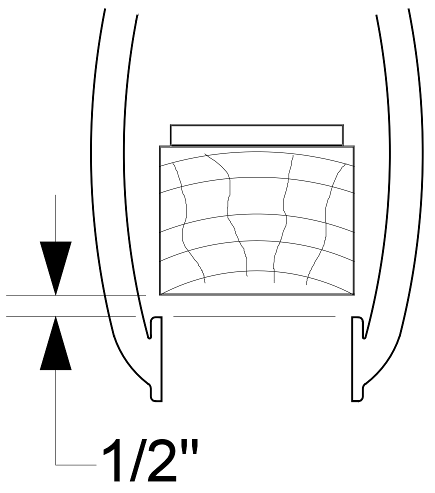


Figure 2-BB

Tie Type	Depth of Tie
Wood	7"
Composite	7"
Concrete	8 3/4"
Steel	4" to 5"

Table 2-W-1

8. When tamping crossovers that have intermixed long ties and butted ties follow these guidelines:

   a. Remove the crossover from service.

   b. From the ties that go under both main tracks remove the rail fasteners on the main track you intend to raise first and on the crossover portion.

   c. Raise the main track crossover switch as you would any turnout except do not tamp the long ties that you have unclipped.

   d. Carefully watch your alignment, as it is important not to throw the turnout beyond smooth lining.

   e. Raise the turnout on the other main track.

   f. Tamp all the long ties on this track.

   g. Carefully ensure that while raising and aligning this track that the plates on the long ties come up under the crossover and other main track.

   h. Clip up the long ties.

   i. Tamp the crossover and long ties on the other main track.

   j. Return crossover back in service.

2.6.10 Surfacing Steel Tie Installations

Steel tie installations require multiple insertions to initially place and compact ballast as follows. Following these steps is critical for long term performance of the ties:

1. Make three insertions in the rail seat area.
2. Make three insertions in the tie center area.
3. Make three or more insertions in the rail seat area to compact the ballast until it is visible at the top of the inspection holes located near the base of the rail.
4. Determine if the ballast is visible at the top of the inspection holes provided.
   - If yes, the tie is properly tamped.
   - If no, fill tie cribs with ballast and repeat steps 1 to 4.

2.6.11 Surfacing at Signal Detectors

Signal detectors are a critical component to the UPRR network. Examples of signal detectors include Hot Box, Dragging Wheel and Wheel Impact Load Detectors. When surfacing operations are performed in the area of detectors the surfacing operation should continue through the detector area whenever possible. Surfacing operations should take extreme care to avoid surfacing up to a detector, skipping the detector and surfacing on the other side as this may create a area of high stress that can damage detectors.

Prior to surfacing or any maintenance activity through a detector location or AEI Site the signal department should be notified a minimum of 24 hours in advance whenever possible. Signal department personnel can assist with removing and adjusting of wires and other damageable equipment. When surfacing through certain detectors it may be required that tamping equipment be placed into switch tamping mode and slow down. Job briefings are critical between the groundman, machine operator and signal personnel to make sure that equipment will not be damaged.

Wheel Impact Load Detectors (WILD) – These special types of detectors utilize strain gauges to pick up wheel impacts. They are intended to find flat or damaged wheels. Due to the configuration of these detectors it is critical that they are surfaced during normal surfacing operations and a minimum of **ONCE ANNUALLY.** Proper surfacing will allow these detectors to operate properly.

2.6.12 Track Shims and Planks

Install track shims and/or planks in wood tie track with frozen ballast conditions to restore surface and cross level irregularities. Shims /planks should be used as the last viable option to correct irregularities and removed when possible. Use shims/planks as follows:

1. Place shims that are at least the same size as tie plates on top of wood ties with level surfaces. Place shims directly under the tie plate.
2. Use the minimum number of shims that will add up to the desired thickness required.
3. Fasten shims and/or planks to ties using spikes that penetrate the wood tie at least 4 inches.
4. When necessary to shim track over 1 inch:
   - Do not allow train speed to exceed 30 MPH.
   - Remove rail anchors from shimmed ties and brace the rail on both sides with tie plates on every third tie for the full length of the shimmed track.
   - Fill all holes in tie plates when spiking rail back down to wood ties as shown in Figure 2-CC.

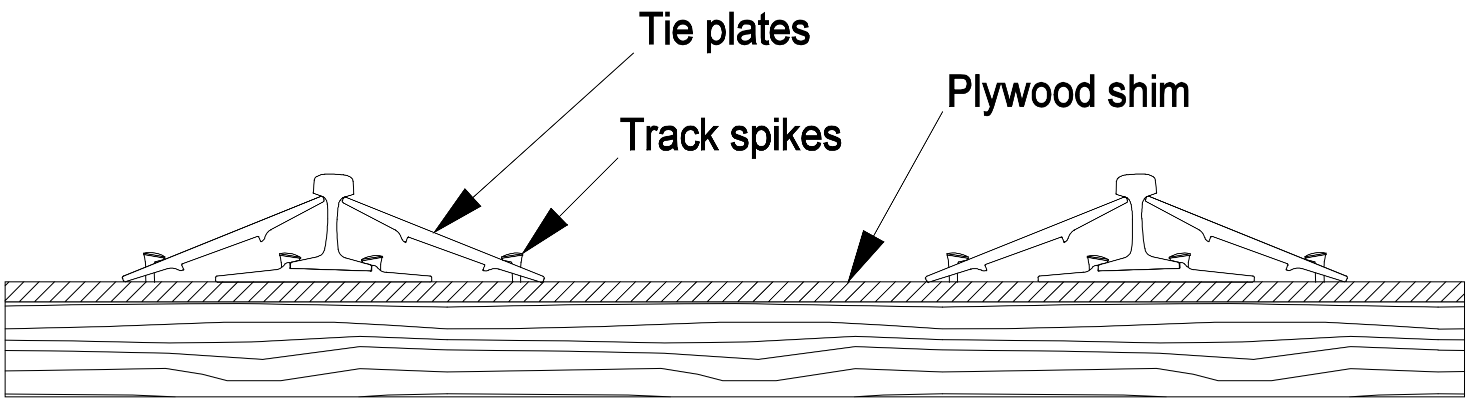


Figure 2-CC

5. When necessary to shim wood tie track over 2 inches:
   - Use a 2-inch plank in combination with shims placed on top of the plank. The plank must be at least 3 feet long, as wide as the tie plate, and spiked flush with the end of the tie.
   - Drill 5/8-inch holes through the plank at all locations where spikes will penetrate the plank.
6. In track with wood ties, when track shims and/or planks are placed to correct surface irregularities in frozen ballast:
   - Remove the track shims and/or planks and surface the track immediately after thawing occurs.
   - Replace rail anchors removed during the shimming procedure.

2.7 Vehicle Track Interaction (VTI)

Vehicle Track Interaction (VTI) is a technology that evaluates how the vehicle interacts with the track. The tool is used to: detect vehicle and track interaction deviations, provide a proactive approach to reducing damage to vehicles and track, improve the track inspection process, quantify and prioritize the exceptions, prevent costly service and equipment failures, and provide quality assurance through evaluation of maintenance quality and results.

VTI is a real time system that continuously evaluates the track for exceptions. When exceptions are found they are labeled with milepost, GPS coordinates, speed, date and time.

Current FRA measurements are based on static measurements and do not take into account how the moving vehicle interacts with the track. The VTI exceptions are more of a performance based exception. An example of this would be a derailment where the track measurements are within the FRA thresholds and the cars measurements do not exceed acceptable levels.

Note: Not all VTI exceptions will correlate to FRA exceptions.

2.7.1 Hardware Used for VTI System

The system is mounted primarily on locomotives and some rail cars. The main components of the on board VTI system are: accelerometers, a central processor, communication system, and DGPS for location information. The system uses accelerometers for sensors to measure accelerations. There is one accelerometer that is mounted above the suspension in the center pivot point of the front truck that measures carbody laterals and carbody verticals. There is one accelerometer that is mounted on the truck that measures truck laterals. There are two accelerometers that measure axle verticals that are mounted on both sides of the front axle.

The VTI unit uploads the exception through wireless communication to a central server. When an exception is found and processed, the information that is being furnished is real time. The exception to this is when the unit is out of cellular range. The system will keep trying to send the exception, until it is successful.

Once the exception data is processed at the central server it is sent to U. P. Engineering Systems, where the information is processed internally.

2.7.2 VTI Thresholds

VTI Thresholds have been established to prioritize the exceptions. Thresholds have been set for carbody vertical accelerations, carbody lateral accelerations, truck lateral accelerations, axle vertical force, carbody roll, 10’ Mid Chord Offset and Combo Clusters. The seven exceptions have two priority levels: High and Medium. Table 2-W-2 contains these exceptions.

VTI Exceptions and Thresholds 1-19-15				
Class	Speed	Exception	High Priority	Medium Priority
		CB Vertical	> 1.25 G	>1.1 G < 1.25 G
		CB Lateral	> .8 G	> .71 G < .8 G
		Truck Lateral	>.45 G	> .41 G < .45 G
		Axle Vertical	> 140 kips	> 120 kips < 140 kips
		CBR	> 3. Deg	> 2.5 Deg < 3. Deg
		CCL (Cluster)	>.18	No Threshold
Wood Tie Track MCO Thresholds				
			"High" Threshold (inches)	"Medium" Threshold (inches)
Class 1	0 - 10 mph		No MCO below 10 mph.	No MCO below 10 mph.
Class 2	11 - 25 mph	MCO	> 2.75"	> 2.20" < 2.75"
Class 3	26 - 40 mph	MCO	> 2.25"	> 1.80" < 2.25"
Class 4	41 - 60 mph	MCO	> 2.00"	> 1.60" < 2.00"
Class 5	61+ mph	MCO	> 1.25 "	> 1.00" < 1.25"
Concrete Tie Track MCO Thresholds				
			"High" Threshold (inches)	"Medium" Threshold (inches)
Class 1	0 - 10 mph		No MCO below 10 mph.	No MCO below 10 mph.
Class 2	11 - 25 mph	MCO	> 1.10"	> 0.90" < 1.10"
Class 3	26 - 40 mph	MCO	> 0.90"	> 0.65" < 0.90"
Class 4	41 - 60 mph	MCO	> 0.65"	> 0.50" < 0.65"
Class 5	61+ mph	MCO	> 0.65"	> 0.50" < 0.65"

Table 2-W-2

Axle verticals are being measured as a force. Kips are being used for this measurement. 1 kip is equal to 1000 lbs.

Carbody vertical, carbody lateral and truck lateral exceptions are measured as accelerations. The units of measures for acceleration are G’s. The value of G is a constant measured as 32.2 ft/s2. The acceleration that the VTI measures is above the normal conditions.

Carbody Verticals (CB Vertical)

Carbody vertical spots are profiles spots. This is when the car or locomotive goes up and down. Most carbody verticals are very apparent, but some are more difficult to see. If the spot is difficult to see, watch a train across the track.

Multiple carbody vertical spots can set up the condition for buckling cars.

Some of the locations where carbody vertical exceptions are found are in road crossings, bridge approaches and mud spots.

Carbody Laterals (CB Lateral)

This is when the car or locomotive rock from side to side. These are very rare on the locomotives, so when you have an exception like this you need to take a look at it. Generally cross level or twist cause this exception.

Truck Lateral

Truck lateral exceptions are rare on locomotives, but an alignment spot or problem with the locomotive truck can cause this exception.

Axle Vertical

An axle vertical exception is measured when the wheel hits a spot in the rail. These are measured impacts, which can be used to eliminate potential service failures or prioritize the maintenance. The gap size or deflection will drive the level of the force. Speed also has an impact on the level of the force.

Some of the conditions that generate axle verticals are rail diamonds, mismatched joints, crushed heads, joints with cracked angle bars, broken rails, frogs, broken bolts in frogs and wheel flanges hitting the top of the angle bar. Rail diamonds generate higher forces: the wider the gap, the higher the force generated.

Crushed heads generate some of the higher exceptions. Axle Vertical exceptions should be used to prioritize the removal of crushed head rails.

Frogs generate axle vertical exceptions. As the condition of a frog deteriorates, the exception will grow. Typically, RBM frogs produce twice the level of exceptions as spring rail frogs.

A wheel flange hitting the top of the angle bar generates higher axle vertical exceptions.

Carbody Roll (CBR)

A Carbody roll angle peak to peak exception is measured over 1 sec and used to provide early warning of rock off hazards. The CBR is only measured on the two VTI coal cars.

10' Mid Chord Offset

The axle vertical accelerations are being used to derive space curves and calculate 10' Mid Chord exceptions. The 10' Mid Chord Offset (MCO) was implemented to find short chord length locations not otherwise found using a 62' or a 31' chord. These short chord locations identified with one of the following conditions can cause rail and joint failures.

Missing spikes, missing plate/severe cutting, cracked joint bars, switch support, mud holes, crowned welds, bridge transitions, crossing transitions, bad tie and bad tie clusters. MCN1 and 2 = Mid Chord Negative and, MCP1 and 2 = Mid Chord Positive.

Combo Cluster (CCL)

A Combo Cluster is a combination of axle, carbody and/or MCO exceptions. The exceptions used in the algorithm to identify localized clusters can be made up of High, Medium or Low threshold values. A High is a combination of new and high growth as well as those exceptions that continue to get worse over time.

2.7.3 Handling of VTI Exceptions

VTI High Priority exception Alerts are routed to Maintenance of Way Operations Control (MWOC), the Director Track Maintenance and Manager Track Maintenance. The MWOC desk will put out all VTI High Priority Alert Slow Orders.

- Electronic messages will be sent to Manager Track Maintenance & Track Inspector office telephones and cell telephones.
- High Priority exceptions need to be slow ordered to 25 MPH and inspected within 24 hours.
- All repeat VTI high exceptions need to be slow ordered to 10 MPH and inspected within 24 hours. If no visual cause can be identified, then a train must be watched over the location before the slow order can be removed. After watching a train over the location at the slow ordered speed and a visual cause is still not identified, then you must contact the dispatcher and remove the slow order and watch a train over the location at track speed before closing the exception using code M998 No Defect Found.
- All bridge VTI high exceptions that are within 500' of a bridge need to be slow ordered to 10 MPH and inspected immediately. The inspection must be completed by a 213.7 qualified employee. If no visual cause can be identified, then a train must be watched over the location before the slow order can be removed. After watching a train over the location at the slow ordered speed and a visual cause is still not identified, then you must contact the dispatcher and remove the slow order and watch a train over the location at track speed before closing the exception using code M998 No Defect Found. If the VTI exception is located on the bridge and is not a confirmed rail or track tie issue, contact a qualified bridge inspector to discuss appropriate handling.
    - Qualified Bridge Inspector

      An employee holding the job title of Manager Bridge Maintenance, Director Bridge Maintenance, Bridge Inspector*, Bridge Supervisor (Inspection)*, Manager Bridge Inspection, Manager Structures Projects, Manager Bridge Construction or Director Bridge Construction and those individuals designated as Railroad Bridge Engineers.

      *A designated Railroad Bridge Inspector per UPRR's Bridge Management Program

NOTE: Updates to the contact list and telephone numbers should be administered through the Track Maintenance Planner (TMP).

Medium Priority will go to the track maintenance planner.

- Medium Priority exceptions require inspection within 7 days.

2.8 Performance Based Track Geometry (PBTG)

Performance-based Track Geometry (PBTG) is a technology for track evaluation. It is a technology that has been added to the track evaluations cars. This technology uses the real time track geometry data and models rail cars across the track, which relates the track geometry to vehicle performance.

PBTG currently defines vehicle performance in terms of derailment potential. It identifies locations where the interaction of the vehicle and the track geometry are likely to produce a flange climb or wheel lift derailment. The vehicle/track combination, under the right conditions can produce an undesirable response. These are evident in the one wheel type derailments, where the track and car measurements are within standard.

PBTG is intended to help prioritize track geometry maintenance by: reducing track geometry caused derailment incidents and reducing vehicle/track dynamics related performance issues. The PBTG technology is integrated into the track evaluation car and generates PBTG exceptions on the cars exception report.

For locations that have been identified with PBTG exceptions, the technology generates recommended track maintenance actions that can be taken to eliminate the condition. This tool can be used to help prioritize these track geometry related maintenance conditions.

2.8.1 PBTG System

The PBTG is operating on a real-time basis on the track evaluation car. It receives track geometry data and freight speed from the track geometry operating system. The application processes the data and analyzes the results. The system outputs the dynamic wheel/rail forces, vehicle response exception and recommended maintenance actions.

2.8.2 PBTG Exception Criteria

PBTG exceptions have been established to identify and prioritize the poor performance locations. By determining the maximum lateral to vertical wheel load ratio and maximum lateral wheel load exception criteria, flange climb derailments can be prevented. Understanding the minimum vertical wheel load, wheel lift derailments can be prevented. The criteria that is being used for PBTG vehicle exceptions are:

- L/V Max (Lateral to vertical wheel load ratio) > 1.0.
- V Min (Vertical wheel load) < 10% of static (kip).
- L Max (Lateral wheel load) > static weight (kip).

2.8.3 Track Evaluation Car PBTG Exception Report

The PBTG exceptions have been integrated into the track geometry exceptions reports on the cars. The exception report will be provided on the track evaluation car.

2.8.4 Track Evaluation Car PBTG Recommended Action Report

The PBTG recommended maintenance actions have also been integrated into the track geometry exceptions reports on the cars. This report is provided for use in identifying maintenance actions to eliminate PBTG exceptions. The maintenance report identifies the parameter or parameters that require maintenance and must be inspected within 7 days.

3.0 TIES AND FASTENINGS

3.0 TIES AND FASTENINGS

3.1 Ties

A tie is a support to which rails are fastened and held to gauge. Ties are designed to distribute wheel loads to the roadbed and to interlock with ballast to prevent lateral, longitudinal and vertical movement of the track structure.

3.1.1 Types and Applications

Determine the tie requirements for various track applications according to subsections A. Wood Ties, B. Concrete Ties, C. Steel Ties, D. Composite and E. Borate Ties.

A. Wood Ties

Follow these requirements when using wood ties:

1. Install wood ties of the designated length and size as determined by annual traffic density on the main track. Use Table 3-A to determine tie length and size.

Wood Tie Types and Applications			
Track Type	**ML Traffic Density**	**Tie Size**	**Tie Length**
Main	Greater than 10 MGT	7” x 9”	8’6”
Main	Less than 10 MGT	7" x 9"	8 feet or 8' 6"
Sidings	50 MGT or more	7" x 9"	8’6”
Sidings	Less than 50 MGT	7" x 9"	8 feet or 8' 6"
Industry and Yards	All locations	6" x 8" or 7" x 9"	8 feet or 8' 6"

Table 3-A

Note: For assistance with Tie Type Designation See UPRR System Tie Map: MyUP > Reference > Bulletin Board > Maps > Tie Usage Map. Also, Capital Project Management page under the Project Ident tab.

DO NOT INTERMIX WOOD TIES WITH CONCRETE TIES TO MAKE PERMANENT REPAIRS.

2. Install 10 foot wood ties and concrete crossing panels for 10 foot ties if the daily traffic count exceeds 1500 vehicles/day.
3. Install 9 foot wood ties and concrete crossing panels for 9 foot ties if the daily traffic count is 500-1500 vehicles/day.
4. Install 9 foot wood ties and wood prefab crossing panels if the daily traffic count is less than 500 vehicles/day.
   a. For daily traffic count use: http://home.www.uprr.com/emp/engineering/apps/efms/afi_reports/facility_reports.cfm > Road Crossings
5. Reconditioned and industrial grade ties may be utilized on Industrial Leads and Yard Tracks as approved by the Chief Engineer. Capital wood tie projects may utilize reconditioned and industrial grade ties if intermixed with new wood ties but not to exceed 50% reconditioned and industrial grade ties.

B. Concrete Ties

Follow these requirements when installing ties in concrete tie track:

1. Clean and drain the ballast section.
2. Ensure that the ballast section has a minimum depth of 12 inches below the bottom of the tie and a minimum shoulder width of 12 inches.
3. Install concrete guard rail ties in concrete tie track where guard rail installation is required as outlined in Standard Drawing Nos. 4000 through 4016.

NOTE: Use only the coach screws and washers in Standard Drawing No. 0420 to lag steel plates to ties specified in Standard Drawing No. 0202.

4. Install 10 foot concrete ties and concrete crossing panels for 10 foot ties if the daily traffic count exceeds 200 vehicles/day.
5. Install 8-6 foot concrete ties and concrete crossing panels for 8-6 foot ties if the daily traffic count is less than 200 vehicles/day.
6. Use Item Number 540-1930 for crossing pads that will be installed on the UP11 and UP15 (Rail.One) tie. Refer to Standard Drawing No. 0216 for tie details.

C. Steel Ties

Follow these requirements when using steel ties:

1. Do not use steel ties on any mainline track.
2. In yard tracks, steel ties should be used in place of gauge rods to provide additional gauge restraint.
3. Install steel ties at locations in which corrosive materials may be present (i.e.

locomotive facilities, rip tracks).

4. Install steel turnout ties according to Standard Drawing No. 0243 for additional gauge restraint in other than main track turnouts.
5. When tamping steel ties use the inspection hole to determine that the inside of the tie is full of ballast showing that the tie is fully tamped.
6. When installing used steel ties make thorough inspection of hook-in shoulder holes looking for elongation or cracks.

Steel tie installations require multiple insertions to initially place and compact ballast as follows:

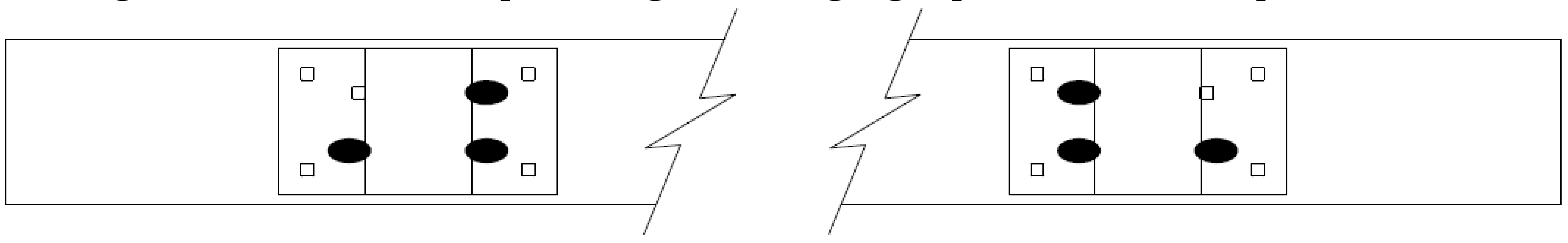
1. Make three insertions in the rail seat area.
2. Make three insertions in the tie center area.
3. Make three or more insertions in the rail seat area to compact the ballast until it is visible at the top of the inspection holes located near the base of the rail.
4. Determine if the ballast is visible at the top of the inspection holes provided.
   - *If yes, the tie is properly tamped.*
   - *If no, fill tie cribs with ballast and repeat steps 1 to 4.*

D. Composite Ties

Composite ties are utilized in specialty applications only as approved by the Chief Engineer.

1. Composite ties may be used in the following areas where wood tie life is shortened due to environmental conditions.
   - High decay areas (Louisiana, Arkansas and East Texas: See map located at: Engineering>Engineering Bulletin Board>Maps)
   - Soda ash territory
2. Do not use composite ties in any road crossings or any location where inside guard rails are required.
3. Composite ties can be handled and installed with wood tie equipment. Tie Bed Scarifiers equipped with digger head extensions must be used to scarify the tie bed to a depth that will allow approximately 1" clearance between top of newly installed tie and bottom of rail base. This will prevent unnecessary bending of the composite tie during insertion.
4. Composite ties do not require predrilling for cut spike installations but predrilling is required for lag screw installations.
5. Composite ties can be recycled and should not be placed in a landfill or incinerated.
6. Composite tie spiking standards are shown below. When using 8 hole plates, do not use a spike in the hold down holes.
7. Due to material properties of composite ties, they are able to retain initial holding power more effectively than wood ties. Because of the material properties the use of plugging compound is not necessary when re-spiking composite ties. If composite ties need to be re-gauged the only option is to replace the composite tie.

On tangent track and curves up to 1 degree use 2 gauge spikes and 1 field spike.



On all curves of 1 degree and over, use 2 gauge and 2 field rail spikes.

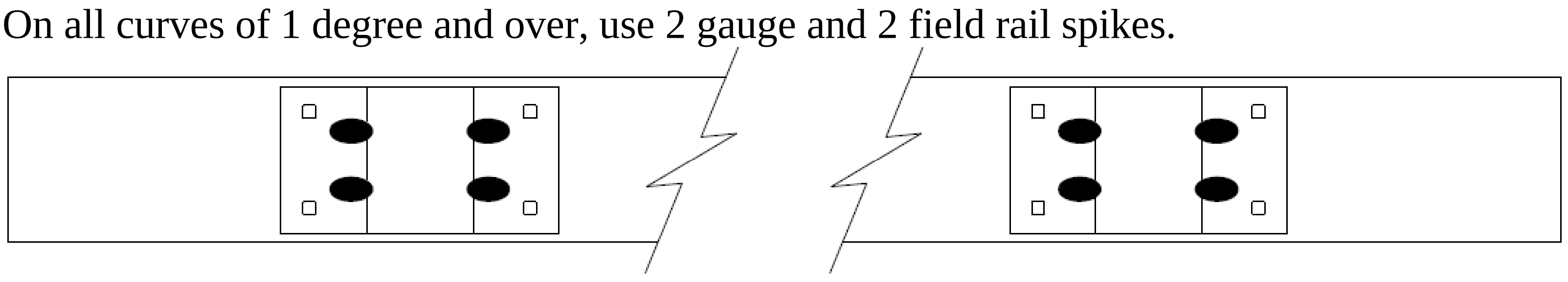


Figure 3-A

On all 6 hole plates, use spiking patterns as shown in 3.5.3 Spike Pattern.

E. Borate Ties

Borate acts as a preservative enhancer for our creosote treated wood ties.

Follow the following requirements when using Borate treated wood ties:

1. Borate ties are to be used in areas where non-treated wood tie life is shortened due to environmental conditions.
   - High decay areas (See map located at: MyUP>Reference> Bulletin Board>Maps>Tie Usage Map)

3.1.2 Installation and Spacing

Unless otherwise approved by the AVP Engineering – Track Programs or Chief Engineer Maintenance, follow these requirements when installing and spacing ties:

1. Do not replace more than three consecutive cross or switch ties at one time.
2. Do not replace more than two consecutive cross or switch ties at one time if the rail

temperature is at, above, or forecasted to be above, the "Rail Temperature Required for Speed Restriction Behind Track Work" for the Subdivision.

3. Do not replace more than 50 percent of the cross or switch ties in any rail length at one time. If you must replace more than the limit of consecutive ties at one time:
   a. Ensure that all the ties installed in the first pass have been:
      - Fully spiked and anchored.
      - Refer to section 2.3.3 Measuring Gauge for base gauge.
      - Installed with enough ballast to maintain proper surface and alignment.
   b. Make an additional pass to install ties if required.
4. Tie replacement requirements 1 – 3 do not apply when installing ties in:
   - Road crossings.
   - Station platforms.
   - Confined track areas.
   - Sledding, plowing, or undercutting operations.
5. Install ties at a right angle to the track's running rails (except No. 20 and No. 30 concrete switch ties per Standard Drawings Nos. 5060 and 5070).
6. Mark the inner rail of curves with appropriate tie spacing.
7. Where tracks come together behind turnouts:
   - Do not interlace ties.
   - Maintain at least 3 inches between the ends of ties.
8. Install ties with "sap side" kerf marks (1/8-inch grooves cut into the top of the tie) facing up. This places the ties' harder heartwood down on the ballast as shown in Figure 3-B.

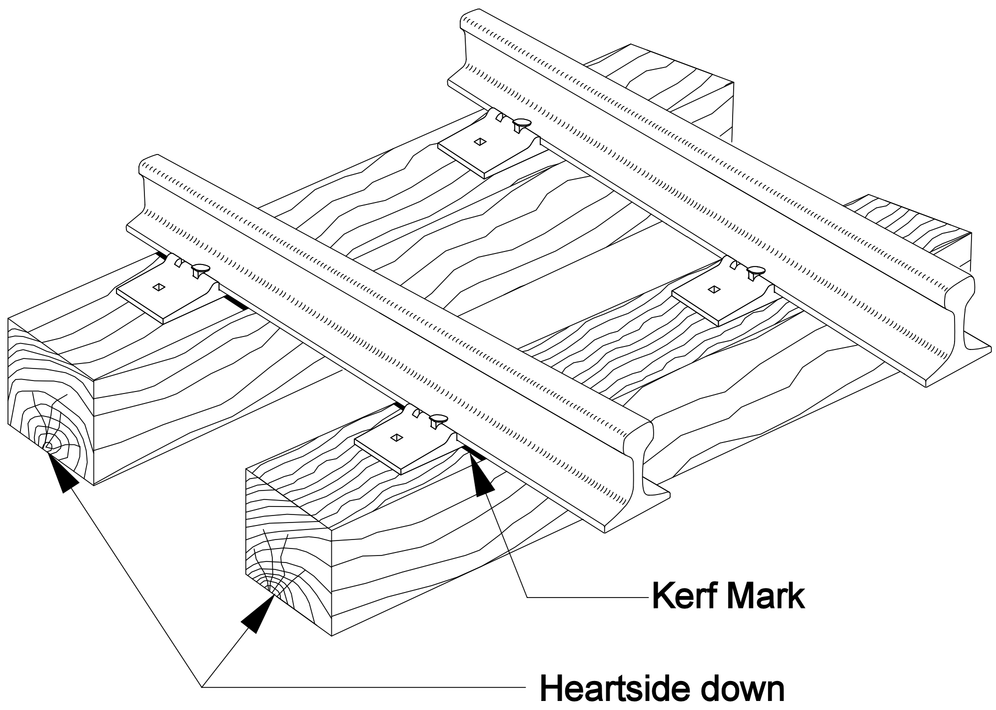


Figure 3-B

9. Align kerf mark in ties with the rail base of the designated line rail. Install non-marked wood ties with the tie ends extending from the outside rail base of the line rail as shown in Table 3-B.

Distance from Outside Rail Base to End of Wood Tie on Line Rail		
Tie Application	**Tie Length**	**Outside Line Rail Base to End of Tie Distance**
Cross Tie	8 feet	15 inches
Cross Tie	8 feet 6 inches	18 inches
Cross Tie	9 feet	21 inches
Cross Tie	10 feet	27 inches
Switch Tie	10 to 17 feet	*27 inches
Switch Tie	18 feet	*21 to 27 inches
Switch Tie in Crossover	23 to 27 feet	*21 to 27 inches with ties centered under the 2 tracks

Table 3-B

**NOTE: See Section 3.1.3 Switch Ties for additional information.*

10. When wood ties are re-spiked, plug the spike holes. Do not plug spike holes in composite ties when re-spiking.
11. When trains must operate through tie renewal areas during working hours, adhere to the minimum requirements outlined in Table 3-C.

Track Type	Maximum Number of Consecutive Ties Left Unspiked	Maximum Allowable Train Speed
Tangent	3	25
Curve	2	25

Table 3-C

12. Maintain a minimum number of ties at the designated spacing in each 39 feet of track as determined by the tie and track type. Tie spacing for 8'6" ties and 9' ties are the same. Use Table 3-D to determine the quantities.

Tie Quantities Per 39 Feet of Track and Required Spacing		
Tie Type	**Main Track**	**Sidings and Yards**
7" x 9" Wood/ Composite	24 ties @ 19-1/2 inches	20 ties @ 24 inches
6" x 8" Wood/ Composite	Do not use	22 ties @ 21-1/4 inches
Concrete	20 ties @ 24 inches	20 ties @ 24 inches
5 ½" x 8'6" Steel	Do not use	20 ties @ 24 inches

Table 3-D

13. Install and space ties under rail joints with the centerline of the tie measuring between 9 and 18 inches from the rail end. Ensure that tie spacing will allow for field welding of joints to avoid re-spacing ties.

3.1.3 Switch Ties

The standards that apply to cross ties also apply to switch ties. Follow these general switch tie requirements:

1. Maintain a standard set of switch ties in every turnout according to the applicable Standard Drawing.
   - Do not install cross ties in turnouts in place of switch ties to make a permanent repair.
   - Do not cut switch ties to make shorter lengths.
2. When ordering replacement concrete or steel ties, specify the turnout size, hand, individual tie number, tie generation, HST present, tie spacing and frog type.

NOTE: Each concrete or steel switch tie in a turnout is unique. The ties are individually numbered for identification. Concrete turnout ties span multiple generations and tie spacings; for assistance with ordering contact Methods and Research at 402-544-5447.

A. Installing Switch Ties at Turnouts

Follow these requirements when installing switch ties:

1. Install 10-foot switch ties ahead of the switch points in main track and siding switches according to Standard Drawing No. 0220. In yard track switches, install eight 9-foot switch ties ahead of the switch points.
2. Install 10-foot switch ties under the full length of the switch points. You may use 9-foot ties in yard track switches where the track configuration does not give enough clearance between tie ends of adjacent track.
3. Ensure that wood switch ties extend 27 inches from the outside base of the designated line rail on the straight side of a switch.
4. Change switch tie lengths to the next longer tie where the amount of tie that extends from the outer rail base on the turnout side becomes less than 21 inches while maintaining the prescribed 27-inch distance on the straight side of the switch.
5. Reduce the amount of tie that extends from the base of the designated line rail on the straight side of a switch to 21 inches on the last few 18-foot switch ties. See Figure 3-C-1.
   - Do this where the amount of 18-foot tie that extends on the turnout side becomes less than 21 inches while maintaining the 27 inches on the straight side.
   - Install the remaining 18-foot ties in this manner to where at least 45 inches exist between the outside rail bases of the turnout and straight side rails.

NOTE: For new installations refer to latest turnout Standard Drawings No. 5000 to 5099.

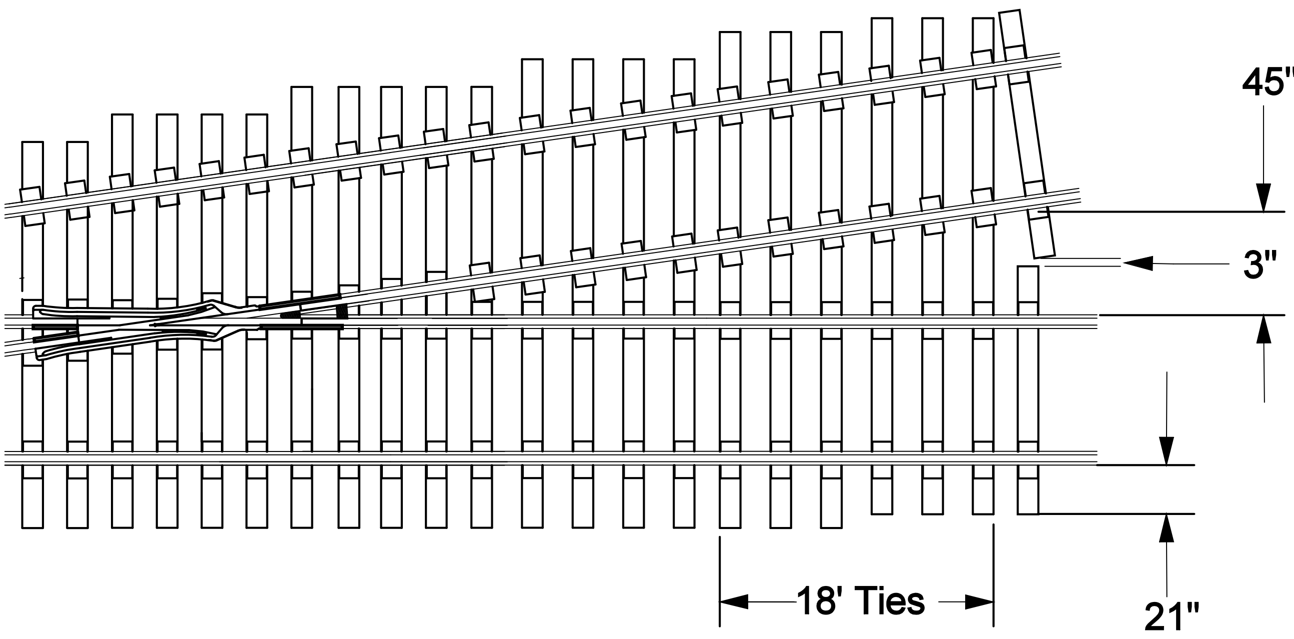


Figure 3-C-1

B. Installing Switch Ties at New Turnout Locations

Follow these requirements to install switch ties at new turnout locations in main track or sidings:

1. Before installing switch ties, unload enough ballast to:
   - Support all switch ties throughout their entire length.
   - Fill all cribs.
   - Provide enough shoulder ballast throughout the limits of the new switch location to maintain proper surface and alignment.
2. Install switch ties in at least two passes as follows:
   - Replace no more than one-half of the ties in the first pass.
   - Install no more than two ties in a row in one pass.
   - Fully spike and anchor all ties.

C. Installing Switch Ties in Crossover Switches

Follow these requirements when installing switch ties in crossover switches:

1. Measure track centers in wood tie track to determine the length of long switch ties required in crossover switches where ties extend under both tracks. See Table 3-E.

Long Switch Tie Lengths for Crossover Switches	
Existing Track Center	**Long Switch Tie Length**
13 feet to 13 feet 11 inches	23 feet
14 feet to 14 feet 11 inches	24 feet
15 feet to 15 feet 11 inches	25 feet
16 feet to 16 feet 11 inches	26 feet
17 feet to 17 feet 11 inches	27 feet
18 feet or greater	Not required

Table 3-E

NOTE: In crossover switches, long switch ties extending under both tracks replace shorter length switch ties used in standard turnouts where track centers are less than 18 feet.

2. At crossover switches where the track centers do not measure in even feet, center the long switch ties under both tracks, with 21 to 27 inches extending from the outer rail base of the designated line rails.
3. Where the first and last long switch ties are installed, make sure at least 45 inches exist between the rail base of the outside turnout rail and the rail base of the inside adjacent track.

   This distance will provide 3 inches of clearance between the tie ends of shorter length switch and cross ties installed next to the outer long switch ties as shown in Figure 3-C-2.

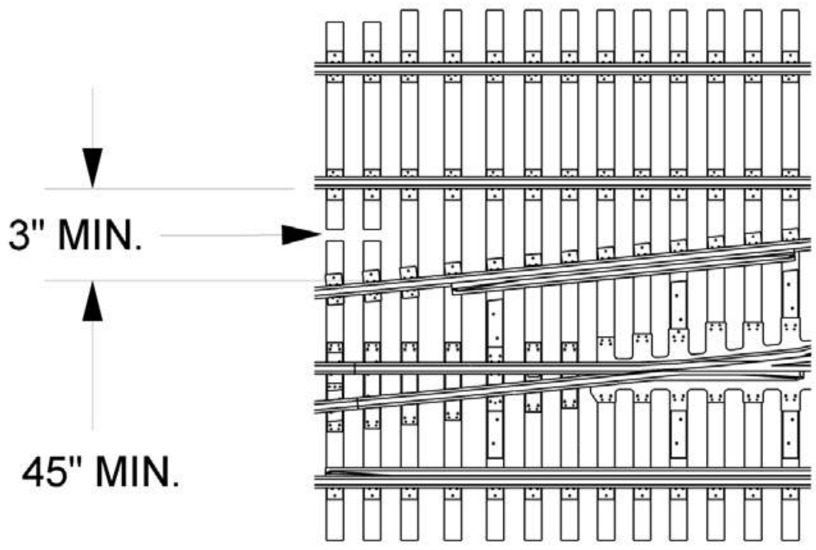


Figure 3-C-2

4. Use the Table 3-F below to determine the shorter length switch ties replaced by long switch ties in crossover switches.

Switch Ties Replaced by Long Switch Ties in Crossover Switches	
Existing Track Center	**Long Switch Ties Replace These Shorter Length Ties**
13 feet to 13 feet 11 inches	14 feet and longer
14 feet to 14 feet 11 inches	15 feet and longer
15 feet to 15 feet 11 inches	16 feet and longer
16 feet to 16 feet 11 inches	17 feet and longer
17 feet to 17 feet 11 inches	18 feet and longer
18 feet or greater	Not applicable

Table 3-F

3.1.4 Head Block and Switch Machine Ties

Follow these requirements to install head block and switch machine ties:

1. In hand-operated switches, determine the length of wood switch ties to use as head block ties by determining the length of the connecting rod. See Table 3-G.

NOTE: When using table 3-G, round the actual length of the connecting rod to the nearest foot.

Head Block Tie Length for Hand-Operated Switches	
Connecting Rod Length	**Head Block Tie Length**
3 feet	13 feet
4 feet	14 feet
5 feet	15 feet
6 feet	16 feet
7 feet	17 feet

Table 3-G

2. Install dapped/tapered switch machine ties in power-operated switches where there are dapped gauge plates.
   - Make sure helper rod assemblies on switches mount to specific length switch ties to provide adequate clearance for automatic tamping machines to surface through the switch point area.
   - Use Table 3-H to determine the proper combination of switch tie lengths.

Dapped/Tapered Switch Machine Tie Lengths			
Turnout Size	**Helper Rod Design**	**Switch Machine Tie Length**	**Supporting Switch Tie Length**
7 to 15	Not applicable	14 feet 6 inches	Not applicable
20	Single	14 feet 6 inches	11 feet
20	Double	15 feet 6 inches	12 feet

Table 3-H

3. Use the diagram in Figure 3-D to determine the installation location for helper rod supporting switch ties.

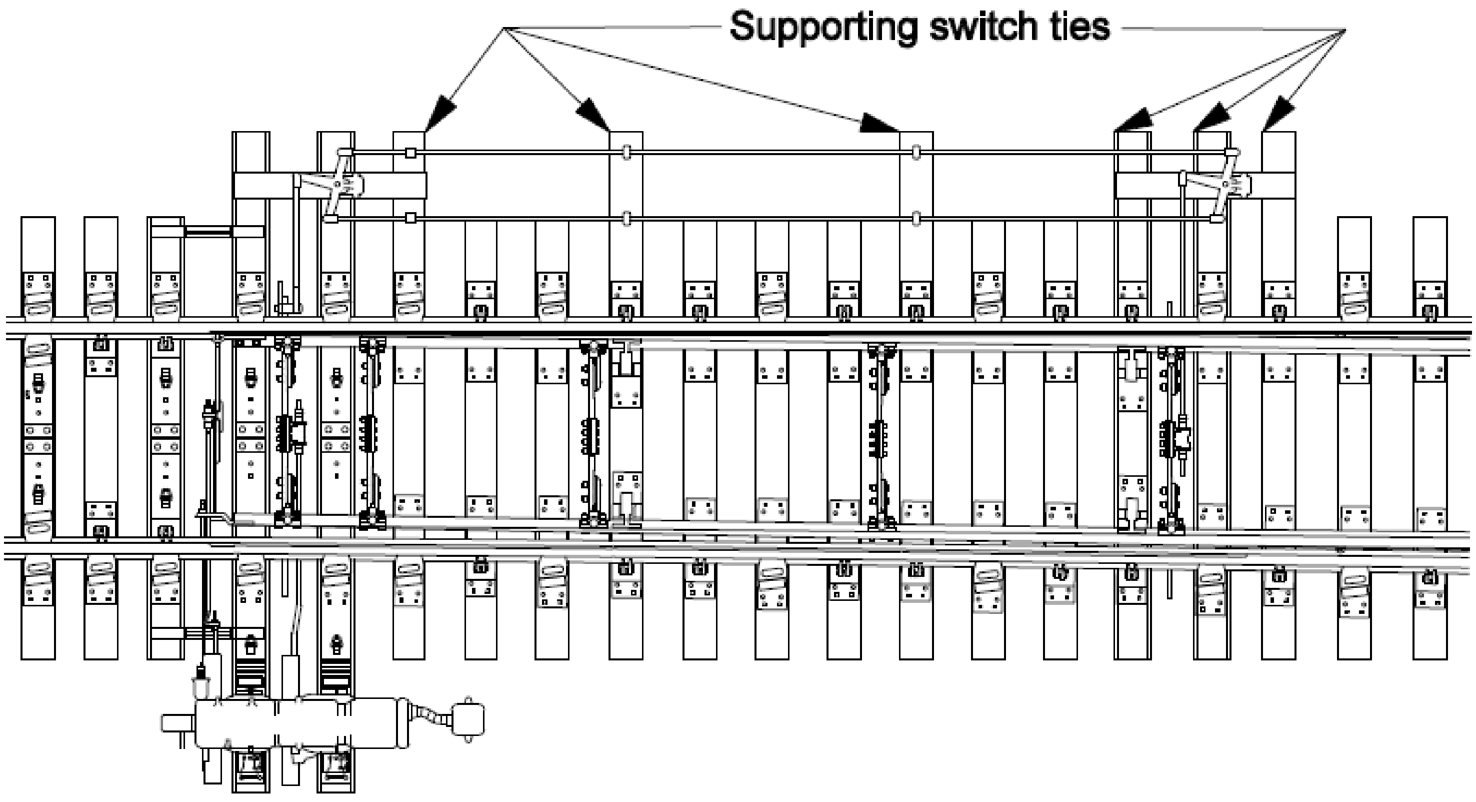


Figure 3-D

3.1.5 Transition Zones

Follow the requirements in Standard Drawing 0220 for transition zones:

1. Install wood ties of specific lengths with elastic fasteners to transition to wood turnouts as shown in Table 3-I.

Elastically Fastened Wood Tie Requirements for Turnout Transitions		
When transitioning from...	**And maximum train speed is...**	**Then install...**
Wood Ties to Turnouts	More than 40 MPH on Mainline Side	24, 10-foot ties ahead of the switch points and 24, 9-foot ties behind the last long switch tie on the mainline side
Wood Ties to Turnouts	More than 40 MPH on Mainline Side and More than 35 MPH on Turnout Side Track	24, 10-foot ties ahead of the switch points and 24, 9-foot ties behind the last long switch tie on both mainline and turnout sides

Table 3-I

2. Install transition zone ties on the approaches of open deck bridges as show in Table 3-J.

Open Deck Bridge	
Wood Ties	10 ea. 10' Ties
Concrete Ties	10 ea Ties with varied spacing between 17" and 24". Per Standard Drawing 0220.

Table 3-J

3. Install wood ties of specific lengths with elastic fasteners to provide transition from wood tie track to concrete ties in Table 3-K.

Elastically Fastened Wood Tie Requirements for Concrete Tie Transitions			
When transitioning from...	**And maximum train speed is...**	**Then install this quantity of 9-foot ties …**	**And install this quantity of 10-foot ties …**
Concrete to Wood or Composite Ties	Less than 30 MPH	10	None
Concrete to Wood or Composite Ties	30 to 50 MPH	10	10
Concrete to Wood or Composite Ties	More than 50 MPH	10	20

Table 3-K

NOTE: Install 10-foot ties next to the concrete ties when using multiple tie lengths in the transition zone.

NOTE: Composite ties are considered the same as wood ties.

4. When transitioning from concrete to wood tie track, do not install transition zones in curves or through road crossings. Instead, extend the concrete beyond these conditions.

3.1.6 Tie Drilling

Drill pilot holes as follows:

1. Drill the proper diameter pilot holes into wood ties before installing screw type fasteners. Use drill bit sizes according to the wood type in Table 3-L.

Drill Bit Size Required by Wood Type				
Fastener Size and Type	**Softwood**	**Hardwood**	**Composite**	**Azobe**
15/16- x 6 1/2-inch Coach Screw	11/16 inch	3/4 inch	3/4 inch	13/16 inch
3/4-inch Dome Head Road Crossing Screw	1/2 inch	9/16 inch	1/2 inch	11/16 inch
5/8-inch Torx Head Road Crossing Screw	*Not required	*Not required	Not Required	9/16 inch

Table 3-L

**NOTE: Torx head screw spikes are self-tapping.*

2. Drill ties 1/2 inch below the lowest point where the screw fastener will penetrate the tie. Ensure that pilot holes do not extend through the bottom of the ties.

3.1.7 Defective Wood or Composite Ties

Ties are defective if:

- Broken through or hollow.
- Split or otherwise impaired to the extent that ballast works through.
- Unable to hold spikes or other rail fasteners.
- Deteriorated to the extent that the tie plate or base of the rail can move laterally 1/2 inch (3/8 inch in Class 6 track) or more in relation to the tie.
- Plate cut more than 40% of the tie thickness.
- Cut by wheel flanges or dragging equipment, or damaged by fire or other sources to a depth of more than 2 inches within an area closer than 12 inches to the base of the rail, frog, or other load-bearing component.

3.1.8 Non-Defective Tie Distribution

Each 39-foot segment of track must have enough non-defective ties distributed to maintain alignment, surface, and gauge. Determine effective distribution of non-defective ties according to the track alignment and class of track in Table 3-M.

Minimum Number of Non-Defective Ties per 39-foot Segment		
Class of Track	**Tangent Track and Curves up to 2 Degrees**	**Turnouts and Curved Track Greater Than 2 Degrees**
1	5	6
2	8	9
3	8	10
4 and 5	12	14
6	14	16

Table 3-M

3.1.9 Joint Tie Support

A minimum number of non-defective ties must support each rail joint. Their centerlines must be within prescribed distances from the centerline of the rail joint for the class of track as shown in Table 3-N.

Non-Defective Tie Placement to Support Rail Joints		
Class of Track	**Centerline of 1 Non-Defective Tie Must Exist Within...**	**OR Centerlines of 2 Non-Defective Ties Must Exist With 1 on Each Side of a Rail Joint Between...**
1 and 2	24 inches of the rail joint center line	Not applicable
3 to 6	18 inches of the rail joint center line	18 and 24 inches of the rail joint center line

Table 3-N

Refer to Figures 3-F through 3-H for specific details concerning locations of these non-defective ties.

A. Class 1 and 2 Tracks

Class 1 and 2 tracks must have one non-defective tie whose centerline is within the 48-inch measurement as shown in Figure 3-E-1.

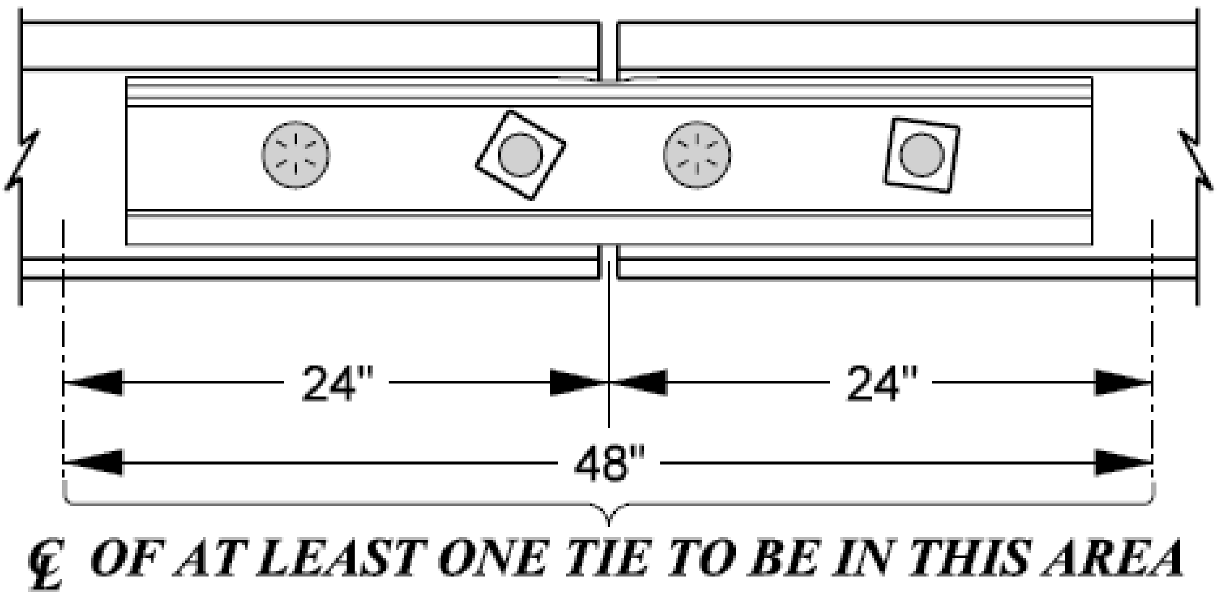


Figure 3-E-1

B. Class 3, 4, 5 and 6 Tracks

Class 3, 4, 5 and 6 tracks must have one of the following:

1. One non-defective tie whose centerline is within the 36-inch measurement as shown in Figure 3-E-2.

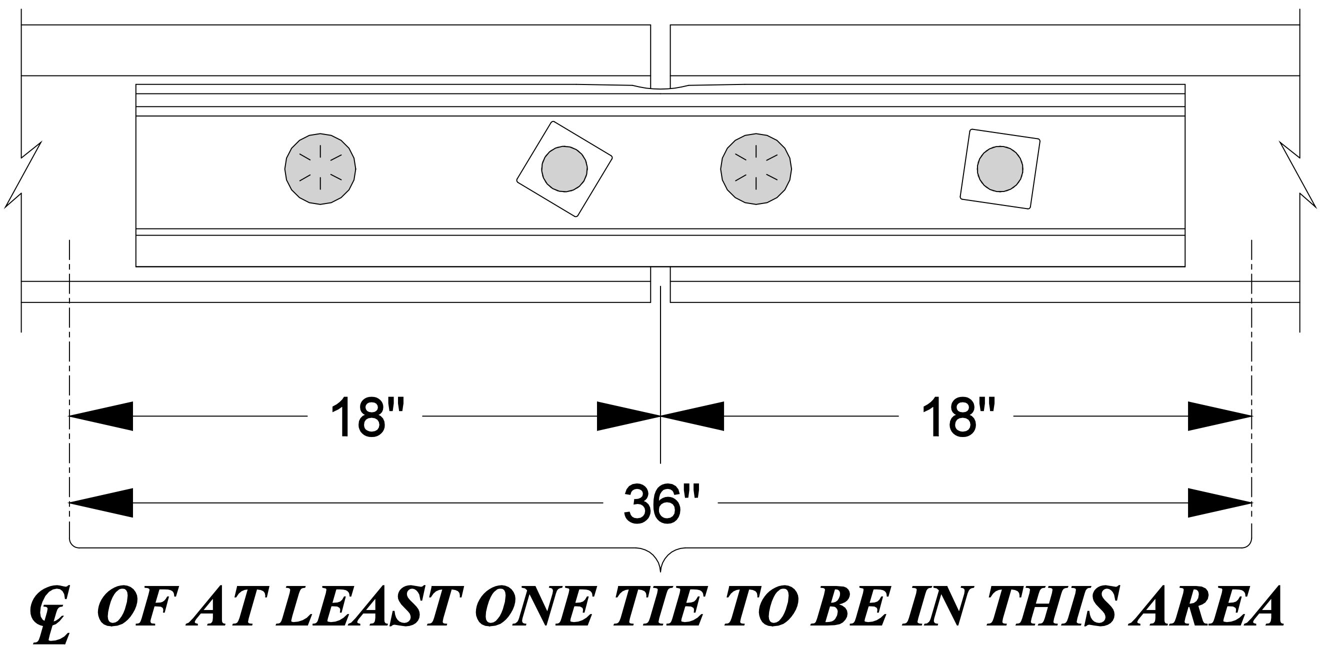


Figure 3-E-2

OR

2. Two non-defective ties, one on each side of the joint, whose centerlines are within 24 inches of the rail joint shown in Figure 3-E-3.

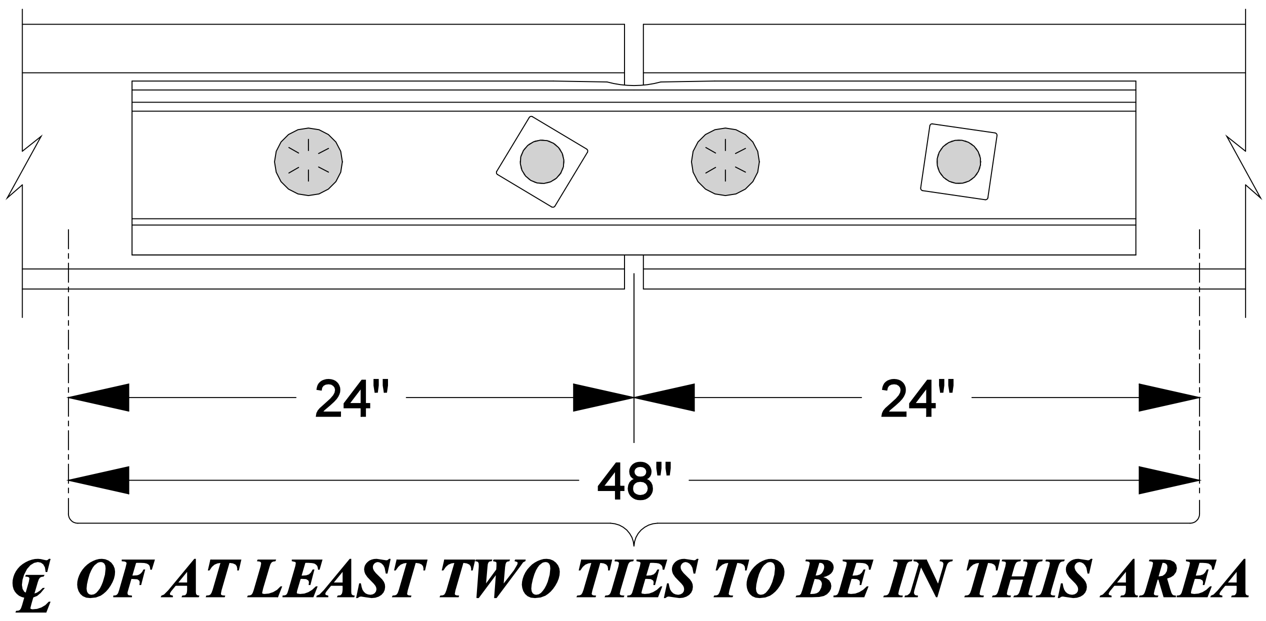


Figure 3-E-3

3.1.10 Program Maintenance for Wood Ties

Follow these tie program maintenance requirements:

1. Track Assessment tie raters will mark defective switch ties for replacement by system tie gangs.
   - Mark switch ties by placing paint marks on the field side of the rail on the straight rail of the switch.
   - Mark tie lengths on the field-side web of the same rail for identification purposes.
2. Track Assessment tie raters will rate each individual cross tie per the criteria in Table 3-O.
   - Program logic (tonnage, speed, curvature, routes etc.) along with individual tie ratings will determine future tie programs.
   - The individual cross tie ratings will be depicted in charts called bingo sheets, which number and rate each tie.
3. Track Programs tie markers will mark defective ties on open-deck bridge approaches, across ballast deck bridges, through road crossings, and in turnouts.
   - Track Programs will also replace defective ties on open-deck bridge approaches, across ballast deck bridges, through road crossings, and in turnouts.
4. Adze wood ties during out-of-face rail relays or gauging operations that remove tie plates from ties.
5. Adze wood ties during curve relays when new or second-hand rail is laid with a different size tie plate.
6. Adze wood ties during curve relays or transpositions when gauging is required or differential plate cutting exists. Refer to Section 2.3.6 Restoring Standard Gauge.
7. When replacing rail on curves with elastic fasteners on one rail and the opposite rail has already been relayed with elastic fastener plates, all gauging must be done rail base to rail base.
8. Do not use power-operated equipment to adze bridge ties on open deck bridges.

9. Do not adze ties when laying rail on track that does not show signs of plate cutting.
10. Remove the curve marker from the old tie removed and reattach it to the new tie.
11. Before returning the track to normal service:
    - Fully plate, spike and anchor wood ties.
    - Make sure all rail clips are in place.
12. Do not leave ties out of the track overnight when tracks will be returned to service.
13. When replacing ties with lag screw fasteners, new lag screws must be used. Do not reuse existing lag screws in new ties.

Tie Rating:	**Terms:** • **Break**-Damage from load or impact cross wise to the grain of the wood. • **Split**-Damage from load or impact parallel with the grain of the wood. • **Deteriorated**-Crushed or breakdown in grain structure. • **Plate Cut**-Damage from load and plate movement on tie. • **Wheel Cut**-Any cut like damage from equipment moving across the grain of the wood. • **Rot or Hollow**-Void in tie area may be due to weather or insects.

Tie Rating System:

	Tie Class			
Condition	**#1 Excellent**	**#2 Good**	**#3 Fair**	**#4 Bad**
Broken	No breaks.	Slight separation starting.	Fairly deep separation.	Broken through
Spilt or Otherwise Impaired	Slight weather splits but integrity not compromised	Tie holds spikes, some splits deep enough to allow water into tie. If necessary, tie can plugged and re-spiked	Will not hold spikes or rail fasteners. *Tie must be plugged and re-spiked.*	To the extent the cross tie will allow ballast to work through, or will not hold spikes or rail fasteners
Lateral Plate Movement	No plate movement	Less than 1/4 inch of combine lateral plate movement, can be repaired by foam plugging	More than 1/4 inch less then 3/4 inch, can be repaired by foam plugging	Greater then ¾ inch of lateral Plate or rail Movement
Plate Cut Straight	No plate cutting	Less than 1/2 inch in depth	Greater than 1/2 inch but less than 2 inches in depth	Greater than 2 inches in depth
Plate Cut Differential	None	Less than ¼ inch	Greater then1/4 inch and less than 3/4 inches in depth	Greater than 3/4 inch
Wheel Cut	No structural damage to tie	0 inch to 2 inches deep not broken through the tie	Greater than 2 inches deep, with in 12 inches of the tie plate, not broken through the tie	Tie Broken through or crushed tie end
Rotten or Hollow	None	None	Some amount of wood decayed or missing, can be repaired by foam plugging	Hollow under Plate area, that tamping will break tie

Table 3-O

Note: Ties under IJ's and permanent joints, using the above criteria, when a tie is rated as a No. 2 (good) or No.3 (fair), lower the rating by a factor of 1(No. 2 will be rated a No. 3 and No. 3 will be rated a No. 4).

3.1.11 Defective Concrete Ties

NOTE: INFORMATION AND REQUIREMENTS CONTAINED IN THIS SECTION ARE FRA MANDATES AND MUST NOT BE REVISED.

Concrete ties are defective if:

1. Deteriorated or broken in the vicinity of the shoulder or insert so that the fastener assembly can either pull out or move laterally more than 3/8 inch relative to the tie.
2. Deteriorated such that the base of either rail is moving laterally more than:
   - $^3/_8$ inch relative to the cross tie on curves of 2 degrees or greater.
   - ½ inch relative to the cross tie on tangent track and curves less than 2 degrees.
3. Deteriorated or abraded at any point under the rail seat to a depth of ½ inch or more.
4. Deteriorated or broken in center section of the tie between rails and steel tendons are exposed.
5. Broken through or deteriorated to the extent that pre-stressing material is visible.
6. Configured with less than two fasteners on the same rail, except for where fastener placement impedes insulated joints from performing as intended, the fastener may be modified or removed provided that the crosstie supports the rail.
7. Deteriorated such that the crosstie's fastening or anchoring system is unable to maintain longitudinal rail restraint, or maintain rail hold down, or maintain gauge due to insufficient fastener toe load:
   - If rail anchors are applied to concrete track, the combination of the crosstie fastening and rail anchor shall provide effective longitudinal restraint.
   - Where fastener placement impedes insulated joints from performing as intended, the fastener may be modified or removed, providing that the cross ties supports the rail.

3.1.12 Minimum Number of Non-Defective Concrete Ties

NOTE: INFORMATION AND REQUIREMENTS CONTAINED IN THIS SECTION ARE FRA MANDATES AND MUST NOT BE REVISED.

Each 39-foot segment of track must have enough non-defective concrete ties distributed to maintain alignment, surface, and gauge. Determine minimum number of non-defective concrete ties according to class of track in Table 3-P-1. If the number of non-defective concrete ties per 39-foot segment of track does not meet the posted timetable track speed apply appropriate slow order (apply slow order code T-38) per Table 3-P-1 until repairs are performed.

Minimum Number of Non-Defective Concrete Ties per 39-foot Segment		
Class of Track	**Tangent Track and Curves up to 2 Degrees**	**Turnouts and Curved Track Greater Than 2 Degrees**
1	5	6
2	8	9
3		10
4 & 5	12	14
6	14	16

Table 3-P-1

When ordering replacement concrete tie(s) to remediate a tie defect(s) utilize the following instructions:

NOTE: RAIL SEAT CANT VARIES WITH CONCRETE TIE DESIGNS

1. Identify the fastening system installed on the concrete tie(s):
   a. Safelok III Clip – Refer to Standard Drawing No. 0401 for drawing of clip.
   b. Safelok I Clip – Refer to Standard Drawing No. 132000 for drawing of clip.
   c. E-Clip – Refer to Standard Drawing No. 132500 for drawing for clip.
2. Based on the fastening system installed determine which type of concrete cross tie is required:
   a. If Safelok III clip – order item number 503-1720 (clips & pads included with tie).
   b. If Safelok I clip – order item number 503-1730 (clips & pads included with tie).
   c. If e-clip – order item number 503-1730 (clips & pads included with tie).

   NOTE: Concrete cross ties with e-clips are no longer available, replacement tie to have Safelok I clips.
3. If a concrete tie(s) is deemed defective per Section 3.1.12 Defective Concrete Ties and top surface or end surface cracks are present the tie may qualify for warranty replacement.

NOTE: TOP SURFACE CRACKS(S) BETWEEN RAILS MAY NOT QUALIFY FOR WARRANTY REPLACEMENT PROGRAM.

Figure 3-F

In order to qualify for the warranty replacement program the following information must be provided to the Engineering Methods and Research Department:

a. Subdivision
b. Track Number(s)
c. Mile post range
d. Quantity of defective ties
e. Fastener type (Safelok I or Safelok III)
f. Manufacturer date

Once subject information has been received and reviewed Methods and Research personnel will order the required concrete ties for field personnel.

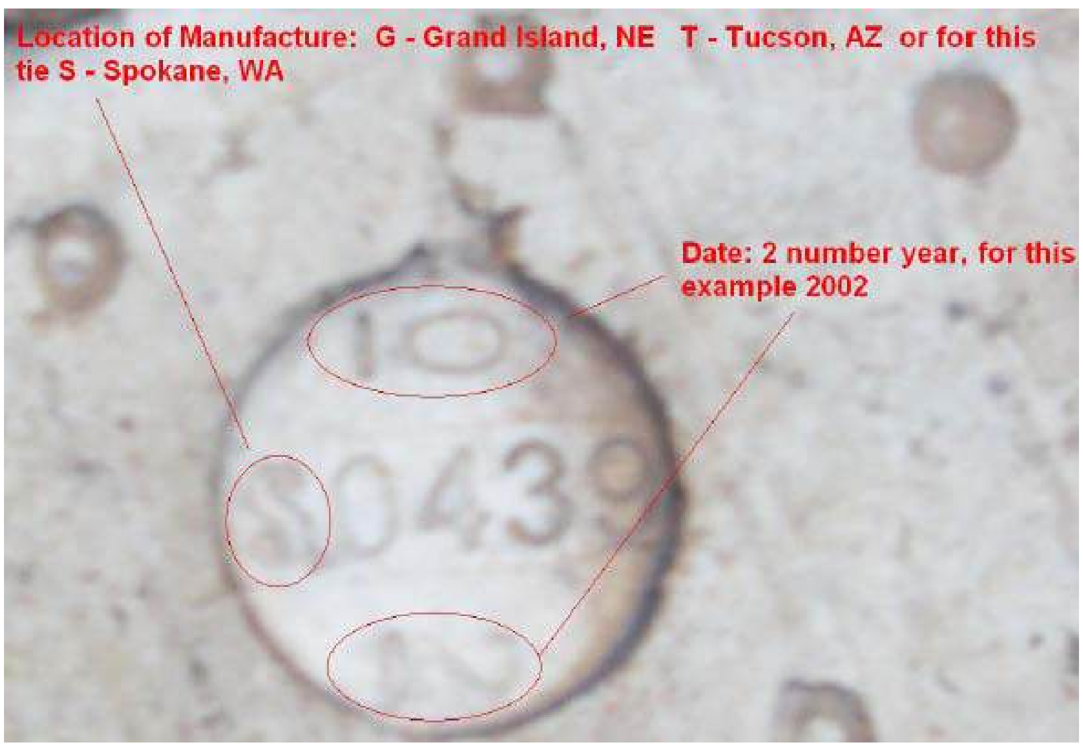


Figure 3-G-1

3.1.13 Maximum Number of Consecutive Non-Supportive Concrete Ties

NOTE: THE REQUIREMENT FOR MAXIMUM NUMBER OF CONSECUTIVE NON-SUPPORTIVE TIES IS A UPRR REQUIREMENT AND IS NOT CALLED OUT IN THE FRA CONCRETE TIE REGULATIONS .

For concrete tie track the maximum number of consecutive non-supportive concrete ties is seen in Table 3-P-2. These are ties that are completely missing or have the rail seat missing and do not provide vertical or lateral support to the track structure. These ties would be rated a #5.

Ties that are still holding surface and gauge are not to be counted as non-supportive ties for the purpose of this slow order. Figure 3-G-2 is an example of a non-supportive tie. This tie is rated a #5.

Maximum Number of Consecutive Non-supportive Concrete Ties		
Class of Track	Tangent Track and Curves up to 2 Degrees	Curved Track Greater Than 2 Degrees
1	5	4
2	4	3
3	3	2
4-5	2	1
6	1	1

Table 3-P-2

NOTE: THIS REQUIREMENT DOES NOT TAKE THE PLACE OF STANDARD TRACK GEOMETRY AND GAUGE REQUIREMENTS.

Figure 3-G-2

3.1.14 UPRR Concrete Tie Rating Scale

RATING	DESCRIPTION OF RATING CLASS
#1	Tie is solid with no visible cracking; tie has no signs of rail seat abrasion and no center binding. Tie is in excellent condition.
#2	Tie has been damaged to the point of being defective as defined by 3.1.11. Tie was damaged by UPRR equipment or a derailment and does not qualify for warranty replacement. Tie is center bound cracked in multiple locations that are easily visible.
#3	Tie has small cracking that is within 4 to 5 inches of the end of the tie. Cracking can be either on the top surface at the end or on the side of the tie following a wire row. Cracks are relatively narrow and do not spread across the surface of the tie.
#4	Tie has cracking that is easily visible. Cracking is either straight or "spider webs". Cracks run greater than 5" from the end of the tie on either the top surface or the side. Cracks are large enough to allow water to penetrate. Tie is still holding gauge or surface, may have pieces of concrete broken off.
#5	Tie is completely failed and no longer supports the rail vertically in the rail seat. Tie is not supporting gauge restraint as a shoulder is fractured off. Tie is not supporting surface and is fractured in multiple locations.

3.2 Concrete Tie Maintenance

Follow these requirements to maintain concrete ties:

1. To reduce the chances of center binding concrete ties, surfacing must be performed once the track accumulates 50 MGT after the initial installation or an undercutting operation. Thereafter, concrete track must be scheduled for surfacing operations on a 100 to 200 MGT cycle.
2. Concrete ties do not perform well in track that retains water.
   - Every effort must be used to promote excellent drainage.
   - When mud spots develop, it is important to remove fouled ballast to a minimum of 12 inches below the bottom of the tie and replace with clean ballast.
   - In areas where mud or fouled ballast re-appears, inspect the location for the root cause. A potential source of the problem is poor drainage in the area. It may be necessary to dig in trench drains or lateral pipes to allow trapped water to exit the track bed. See Figure 3-H-1 for an example of trench drains.

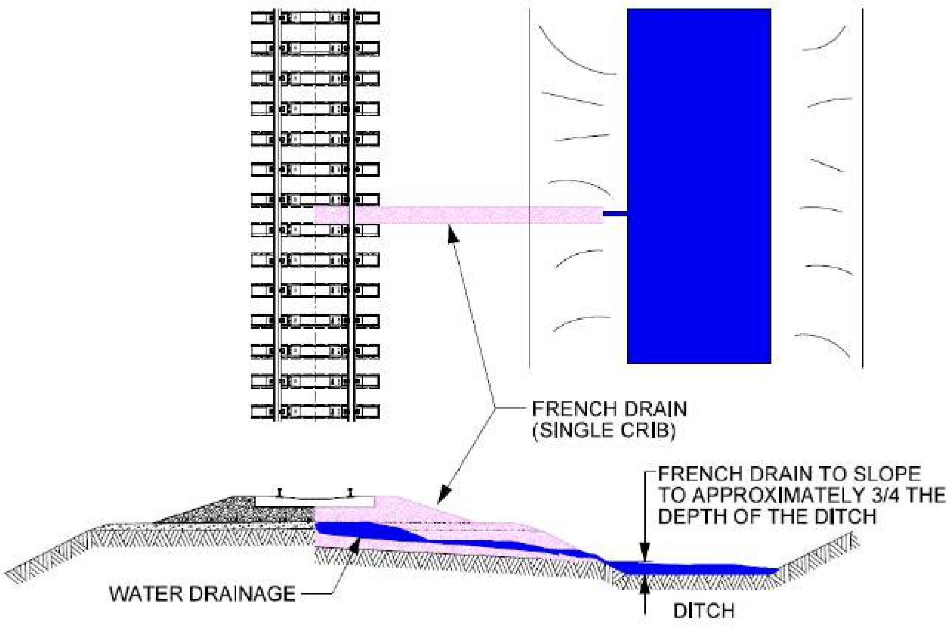


Figure 3-H-1

Refer to Chapter 1 for complete details on drainage procedures.

   - It is advisable to install trench drains or lateral pipes on both ends of road crossings and any other area that would have a tendency to hold water.
3. Concrete ties do not perform well under high impacts.
   - Eliminate all joints as soon as possible, not to exceed 90 days.

- Preventive Gradual Maintenance Rail Grinding is required in concrete tie track.
- Eliminate high and medium level axle vertical VTI exceptions in concrete tie track.

4. Every effort should be made to replace pads that are displaying high amounts of wear in track. Black or Rubber pads do not hold up due to the heavy axle loading and should be watched for signs of wear. Some of the maintenance issues caused by the pad wear and deterioration are:
   - Reduced toe load of the elastic fasteners on the base of the rail, which allows rail movement.
   - Accelerated rail seat abrasion, generated by direct contact of the base of the rail onto the top of the concrete tie and the effect of longitudinal and lateral movement of the rail on the rail seat.
5. Controlling neutral temperature is critical in concrete tie track and to prevent longitudinal rail movement. Use Standard Drawing 0460 to determine when to install anchors on concrete ties.
   - When an anchor is to be used on a concrete tie, use the specially designed nylon isolator (Item Number 550-1653) over the anchor to prevent damage to the tie.
   - The isolator is designed to work only with the Unit 5 bar stock anchor. (Item number for anchor w/isolator 550-1652) Refer to Figure 3-H-2.

Figure 3-H-2

   - Use shaved anchors to box anchor from the switch point through the heel block. (Item number for shaved anchor 550-1880). See Section 4.17 Rail Anchors for all installation instructions.
6. To reduce center cracking of concrete ties on ballast deck structures, inspect for a minimum of 12 inches of ballast between bottom of the concrete tie and the top of the structure.
   - Add ballast to any location that does not have the minimum amount of ballast and surface track.
   - Do not install single ties with rubber bottom pads due to the change in track modulus.
7. To prevent center binding of concrete ties, ensure that a minimum of 12 inches of ballast is installed during new construction and track renewal projects.

3.2.1 Rail Seat Abrasion

1. Rail seat abrasion is the mechanical wearing of the concrete tie surface under the pad assemblies. Rail seat abrasion can be a minimum of 1/16”. Once it starts, rail seat abrasion causes rapid deterioration of the rail seat. As the concrete tie rail seat further deteriorates, the aggregate in the concrete becomes more exposed. Reasons for rail seat abrasion are:
   - Rail movement on top of pad assembly both longitudinally and laterally.
   - Moisture between the tie seat and pad assembly, can cause abrasive slurry to develop between the tie seat and the pad.
   - Deteriorated or incorrect pad assembly.
   - High lateral/vertical forces generated from train operation or super-elevation issues.
2. Inspection for rail seat abrasion on concrete ties is critical. If possible, take advantage of rail program replacements for the most efficient visual inspection of rail seat abrasion. Evidence of rail seat abrasion to inspect for include:
   - Rail cant.
   - Pads that have squeezed-out from under the rail seat, are torn on the ends, or have shown signs of bleeding on the concrete ties.
   - Longitudinal rail movement through the clips.
   - Insufficient toe loads generated from the clips.
   - Crushed or missing insulators.
3. The pad arrangement in both tangent and curved track must be at least a two part pad assembly:
   - The bottom plate must be smooth and strong. Smooth so it is not abrasive to the top of the tie and tough enough that it does not break, tear or deteriorate.
   - The top pad provides attenuation to the tie to reduce the impacts that are generated through the rail from rolling stock.
   - This pad must be able to withstand the loads and impacts generated from continuous wheel loadings and soft enough to absorb as much of this load as possible.
   - Another part of the assembly is the foam gasket. The gasket is installed directly on

the tie surface. The only benefit of this gasket is to seal the concrete surface to help reduce any moisture from getting into the concrete. The use of epoxy is actually serving this purpose and it also gives the rail seat area a harder surface than what concrete provides.

4. The following are some examples of rail seat abrasion:
   - Figure 3-H-3 shows light abrasion. The root cause of this abrasion was the incorrect pad. This is typical of tangent track rail seat abrasion. If this rail seat is covered with epoxy and all the voids are filled to the original elevation of the tie, the abrasion will be stopped.

Figure 3-H-3

   - The abrasion in Figure 3-H-4 is beyond what is expected to be repaired. This is the type of abrasion that can be found in curves. Ties with this depth of abrasion need to be replaced.

Figure 3-H-4

5. There are various ways to detect rail seat abrasion:
   a. In tangent track where the pad is deteriorating it may be possible to see that the pad is being cut by the base of the rail as in Figure 3-H-5. As you see the rail is sitting on the tie and is unacceptable.

Figure 3-H-5

   b.In curved track, review and evaluate the cant measured by geometry cars.
      - Nominal cant for a Safelok III fastener on a concrete tie is 1.42 degrees positive for a nominal rail seat cant of 1:40.
      - Nominal cant for a Safelok I fastener on a concrete tie is 1.90 degrees positive for a nominal rail seat cant of 1:30.

   c. If the cant measurement is zero degrees, the centerline of the rail is straight up and we have 1.42 degrees of rotation to the field side; which means there is at least 1/4 inch of abrasion on the field side of the rail seat.

   d. If the measured cant is a negative 1 degree there is over 3/8” abrasion on the field side of the rail seat. This negative (or reverse) cant does several things to concrete ties.
      - Negative cant of 1 degree makes the gauge 5/16 inch wide.
      - The field side fastening system has lost toe load on the base of the rail. In addition, the fastening system loses at least one-half of the longitudinal strength.
      - With each movement of the passing wheel, the interaction of the rail and the tie generates additional rail seat abrasion.

- Replacement of the field insulator will not correct any gauge deviations. The base of the rail will work up under the insulator forcing it off the shoulder.
- The base of the rail, working up and down, will wear the front face of the shoulder off. This makes the fastening system ineffective even after the rail seat has been repaired.

e. Every degree of rail rotation impacts the gauge measurement by 1/8".

f. Negative cant correlates to wide gauge and positive cant beyond nominal correlates to tight gauge.

The following thresholds are for negative (reverse) cant on concrete ties:
Urgent limit is negative 1.50 degree
Critical limit is negative 2.0 degree

g. The other way to check for abrasion is to remove the clips, raise the rail with a track jack and remove the tie pad. At the shoulder lay a straightedge over the rail seat, it must be long enough to go beyond the shoulders. At a perpendicular angle measure the depth of abrasion from the straight edge to the tie.

6. Use the following guidelines for determining whether to repair or replace concrete ties:
   - Abrasion less than 1/2 inch should be repaired with epoxy.
   - Abrasion greater than or equal to 1/2 inch and less than 1inch requires the use of a cast plate epoxied to the tie.
   - Abrasion greater than or equal to 1 inch requires tie replacement.

3.2.2 Concrete Tie Pads

1. Concrete ties come from the tie plant with a three part pad assembly.
   - A foam gasket on top of the tie to seal the tie from moisture.
   - The middle plate (steel or nylon) to keep the surface of the tie separated from the pad, to provide protection from rail seat abrasion.
   - The pad absorbs impacts generated by dynamic rail loading from the rail to the tie.
2. After epoxy is applied to the rail seat, the foam gasket is no longer required. When replacing pads behind epoxy repairs use a two part pad assembly.

Note: Using a three part pad during epoxy repairs will prohibit future quality rail seat abrasion repairs.

3. Use new pads when performing program work on concrete ties.
   - When performing maintenance, replace defective and worn pads.

3.2.3 Concrete Tie Abrasion Repairs

1. Any time rail is changed on concrete ties with rail and curve gangs, epoxy repairs must be performed on rail seats. Special equipment is available to dispense the epoxy on the ties in a rail gang consist. Figure 3-I-1, shows epoxy being dispensed on rail seat. This must be followed up immediately with some form of leveling, such as a wide putty knife, to ensure all voids are filled and tie surface has been restored.

Figure 3-I-1

2. To achieve the desired results from the epoxy, the tanks on the machine should be preheated to between 100 degrees F and 110 degrees F prior to application.
   - Test the product prior to starting repairs.
   - Product should come out in a solid color.
   - Any streaking in the epoxy will result in an inferior product.
   - Adjustments must be made prior to placing epoxy on ties.
3. Epoxy must be allowed to firm up before placing the pad and rail.
   - If the epoxy is mixed correctly in the machine it should not take more than 20 minutes at an ambient temperature of 75 degree F for this to happen.
   - If it takes longer the machine is out of adjustment.
4. When performing small rail seat maintenance repairs, utilize the epoxy that is available in double caulking gun type tubes. Use the same hand dispenser that is used to apply the wood tie plugging compound.
5. The item numbers to be used for the epoxy products are:
   - Curve gang operations use item number 503-8880.

- Rail Change Out (RCO) machine use item number 503-8879.
- Epoxy in a tube for maintenance use item number 503-8881.
- Dispensing hand gun use item number 410-2225.
- UV activated epoxy may be ordered by contacting Methods and Research.

6. If abrasion is greater than or equal to 1/2 inch and less than 1inch the use of a cast plate is required in order to make repairs. Figure 3-I-2, shows the cast plate that fits in the rail seat area. When using this plate you must apply a liberal amount of epoxy to fill any voids on the tie. To keep the plate from moving there must be full contact between the tie and the plate. This plate can be ordered by using item number 503-6151.

Figure 3-I-2

3.2.4 Concrete Tie Insulators

1. Insulators are used for two purposes. They insulate the shoulders from shunting the track and they function as a wear component between the rail base and shoulder. Without this wear component, the shoulder could not withstand the abrasion and lateral forces generated by the rail.
2. Proper insulator maintenance is critical in maintaining concrete tie track, especially in curves. A worn field side insulator on one rail can generate 1/4 inch wide gauge. When the insulator is worn out, the rail base comes in contact with the shoulder. The rail base will then start cutting into the shoulder. Not only does this destroy the shoulder, but at the same time causes rail seat abrasion. Figure 3-J shows a heavy-duty insulator in track that has failed. If this is evident in a curve, insulator replacement is required.

Figure 3-J

3. Heavy-duty insulators have a metal plate molded into the plastic, which keeps the insulator from getting squeezed out from between the shoulder and rail. Heavy-duty insulators are required for use on the field side of both the high rail and low rail in all curves greater than or equal to 1 degree 30 minutes.
4. Wide post heavy-duty insulators are available for correcting wide gauge in concrete tie track. The use of a wide post insulator on one rail will give 1/8 inch gauge correction. Both rails will give 1/4 inch. When using wide post insulators it is best to use the old insulators that are worn down on the gauge side of the rail or use a narrow post insulator. This allows the added thickness of the field side insulator to fit in the allotted space. Table 3-Q shows the different types of insulators available.

	Concrete Tie Insulators					
	Classification	Field/Gage Side of Rail	Color	Post Width	Concrete Tie Application	Item Number
Safelok 1	Standard	Gage	White/ Natural	7 MM	Use in tangent track and curves less than 1 deg. 30 min.	503-5250
Safelok 1	Narrow	Gage	Blue	4 MM	Use in curved track to correct wide gage. Requires installation of narrow post insulator 503-6178 on field side.	503-6246
Safelok 1	Heavy Duty	Field	White/ Natural	7 MM	Use in curved track greater than 1 deg. 30 min.	503-6173
Safelok 1	Heavy Duty	Field	Gray	10 MM	Use in curved track to correct wide gage. Requires installation of narrow post insulator 503-6246 on gage side.	503-6178
Safelok 1	Heavy Duty	Field	Bronze	8.5 MM	Use on curves greater than 8 degrees.	503-5980
Safelock III	Standard	Both	White/ Natural	7 MM	All applications	503-6162
E-Clip	Standard	Field	White/ Natural	7 MM	Use in tangents and curves less than 1 deg. 30 min.	503-6260
E-Clip	Standard	Gage	Blue	4 MM	Use in curved track to correct wide gage. Requires installation of narrow post insulator 503-6462 on field side.	503-6245
E-Clip	Heavy Duty	Field	White/ Natural	7 MM	Use in curved track greater than 1 deg. 30 min.	503-6250
E-Clip	Heavy Duty	Field	Gray	10 MM	Use in curved track to correct wide gage. Requires installation of narrow post insulator 503-6245 on gage side.	503-6462

Table 3-Q

5. Replace insulators when performing program work on concrete ties.

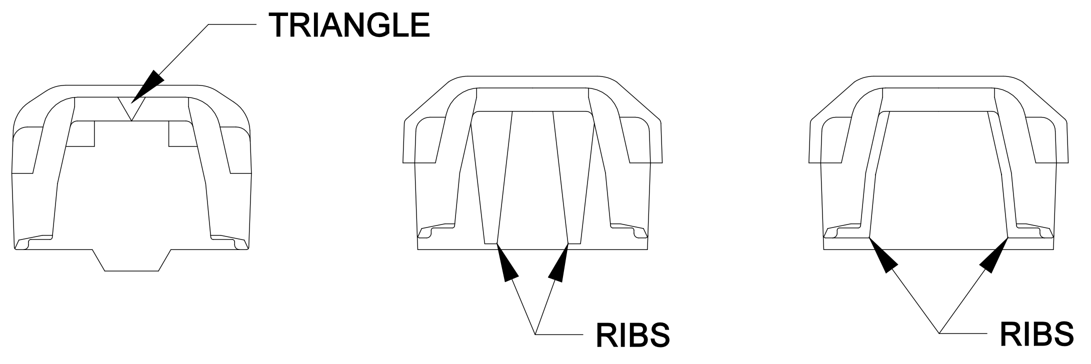
3.2.5 Concrete Tie Spring Rail Clips

Refer to Section 3.3.1 Spring Clips for guidelines on various clip designs and applications.

3.2.6 Concrete Tie Shoulder Replacement

If the shoulder, on concrete ties, fails for one reason or another; it is possible to core out the old shoulder and replace it with a new shoulder. If more than one shoulder on a cross tie or two on a switch tie needs repaired, replace the tie.

1. Replace concrete tie shoulders damaged from derailments or other causes, when they do not effectively hold the rail clip and insulator in place.
2. Replace shoulders with like-kind shoulders and do not substitute one style for another.
3. Identify the proper shoulder design for replacements from Figure 3-K-1, and then use Table 3-R for the item number.



(a) ***(b)*** ***(c)***

Figure 3-K-1

<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>1</td><td>Identify type of tie and shoulder damaged.
<table>
<tr><th>IF tie type is...</th><th>AND shoulder type is...</th><th>THEN....</th></tr>
<tr><td>Cross or Switch</td><td>Pandrol e-clip</td><td>Use Item No. 503-6340</td></tr>
<tr><td>Cross</td><td>Safelok III</td><td>Use Item No. 503-6167</td></tr>
<tr><td>Cross or Switch</td><td>Safelok</td><td>Go to Step 2.</td></tr>
</table>
</td></tr>
<tr><td>2</td><td>Determine existing Safelok shoulder design.
<table>
<tr><th>IF shoulder looks like...</th><th>THEN...</th></tr>
<tr><td>Figure 3-Q (a)</td><td>Use Item No. 503-5075</td></tr>
<tr><td>Figure 3-Q (b)</td><td rowspan="2">Use Item No. 503-6002.</td></tr>
<tr><td>Figure 3-Q (c)</td></tr>
</table>
</td></tr>
</table>

Table 3-R

4. When coring out damaged shoulders:
   - Use only equipment designed for this purpose. Figure 3-K-2 shows a core drilling rig used for this purpose.

Figure 3-K-2

   - Do not drill any deeper than the bottom of the shoulder leg.
   - Use approved concrete grout to affix new shoulders into ties.
   - When temperatures are above 40 deg. F use item number 503-8874.
   - If temperature is between 20 and 40 deg. F use item number 503-8875.
   - If temperature is below 20 degree F. do not grout shoulders in tie.
   - Allow grout sufficient time to cure before inserting insulators and applying spring clips. Allow at least 24 hours before trying first clip to ensure the shoulder is securely set in the tie.

3.2.7 Concrete Switch Tie Lag Inspection

During monthly switch inspections use a two pound hammer to check for broken lags. If broken lags are found be governed by the following:

1. If black lags are found to be defective, replace all lags between the switch points and heel of the switch point.
2. If gold or silver lags are found to be defective, replace all 4 lags in that switch plate.
3. In all cases where lag has been broken off inside the insert the insert must also be replaced.

3.2.8 Concrete Switch Tie Lag Repair

Concrete tie lag screws can fail and fracture inside of the plastic dowel insert. When the lag screws break off they are difficult to remove utilizing common tools. When removing lag screws from the tie with the repair kit (Item Number 503-8889) the follow practice is recommended:

1. Utilize a screw driver to remove all foreign material from and around the lag hole including within the hole itself until the top portion of defective lag is visible, refer to Figure 3-L-1.

Figure 3-L-1

2. Insert carbide drill bit into lag hole until contact is made with top portion of defective lag.
3. Operate drill while applying pressure until top portion of lag has been cleaned (appears silver) per Figure 3-L-2.

   CAUTION: A properly cleaned lag is critical to the repair process.

Figure 3-L-2

4. Using the propane torch and air compressor, remove debris from the hole and dry the hole and area surrounding the hole to remove moisture.

   CAUTION: The area must be free of water, grease or other contaminates. Failure to remove all moisture could result in a violent reaction and a less than desired weld.
5. Utilize the propane torch, dry the mold.
6. Place the six (6) inch metal pipe section into the bolt hole, per Figure 3-L-3.

Figure 3-L-3

7. Utilize the hammer to tap the pipe down onto the defective lag while keeping the pipe as vertical as possible.
8. Secure the mold handle to the mold using two screws attached to mold handle.
9. Place the mold onto the pipe and close the mold handle such that the bottom of the crucible of the mold is in contact with top of the pipe, per Figure 3-L-4.

Figure 3-L-4

10. Install the weld material cup (Item Number 503-8888) into the mold such that the metal strip is located in the slot provided in the top of the mold, per Figure 3-L-5.

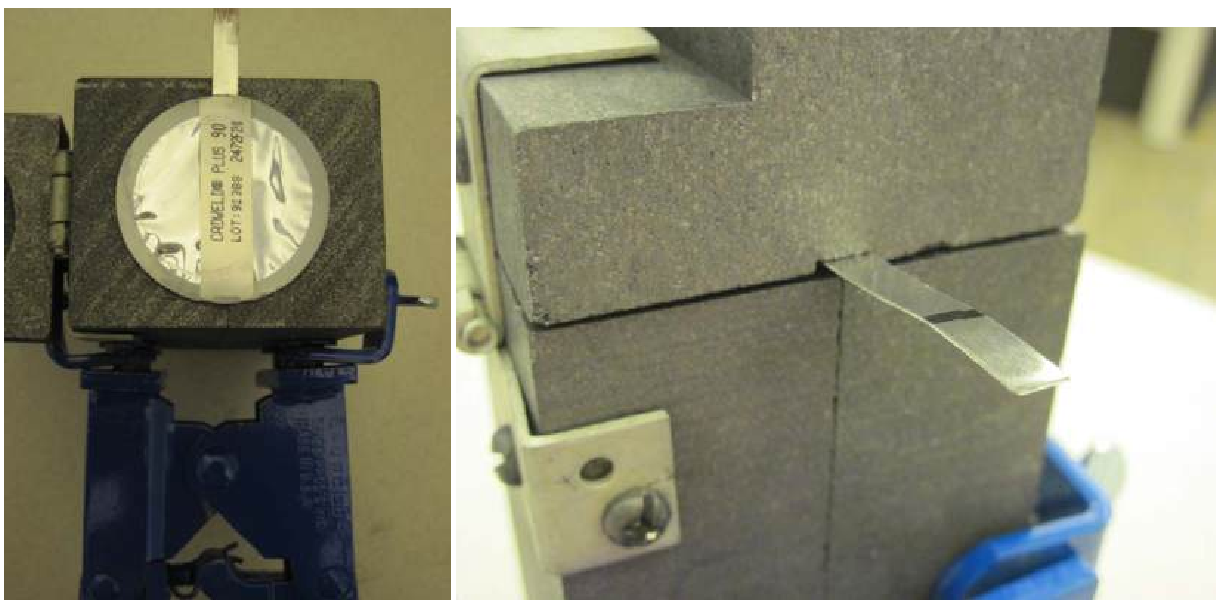


Figure 3-L-5

11. Close the mold cover.
12. Attach the igniter lead to the metal strip extending from the weld material cup, refer to Figure 4 above.
13. Move away from the mold to the fullest extent allowed by the igniter lead on the up wind side.
14. Advise any personnel in the area you are going to weld and to stand clear on the up wind side.
15. Press and hold down the button on the igniter. The green light will flash during the charge cycle. Once charged, the unit will automatically cause an ignition as long as the charge cycle is not interrupted. To interrupt the cycle, release the button.
16. After the reaction takes place wait two (2) minutes.
17. Remove the mold by releasing the clamp/handle and pulling the mold away from the pipe.

    CAUTION: The mold and pipe may be hot due to the reaction.
18. Using the brush, clean the mold of slag and residue from the reaction.
19. Allow the weld to cool for an additional five (5) minutes.
20. Install the pipe wrench or vice grips on the portion of the pipe extending from the lag hole, refer to Figure 3-L-6.

Figure 3-L-6

21. Turn the pipe wrench or vice grips back and forth for short distances ten (10) times to loosen lag.

    NOTE: If the pipe section breaks from the defective lag remove the pipe section and repeat entire procedure.
22. Turn the pipe using the pipe wrench or vice grips counter clockwise until the broken section of the bolt is free from the hole, per Figure 3-L-7.

Figure 3-L-7

23. Install new lag and helical washer.
24. If damaged beyond repair, order new replacement ties with the pop-up shoulders.

3.2.9 Damaged Concrete Tie Temporary Shoulder Repair

Follow these instructions when temporarily repairing concrete tie shoulders that have been damaged in a derailment in order to get the track back in service. The Concrete Rail Securing Device (CRSD) repair can only be applied to railseats with one damaged Safelok I or Safelok III shoulder or tower. (Item number for the CRSD is 410-2136)

Note: In order to place the track back in service, the CRSD must be installed on a minimum of every 4th tie in tangent track up to 2 degrees and every other tie in curves over 2 degrees for a 25 MPH slow order. In cases where the damage to the tie exceeds the clip and the cast housing and damages the concrete under the rail seat a 10 mph and temporary use of gauge rods may be required.

1. The CRSD system is a three piece system composed of two bars and one plate. See Figure 3-M-1.

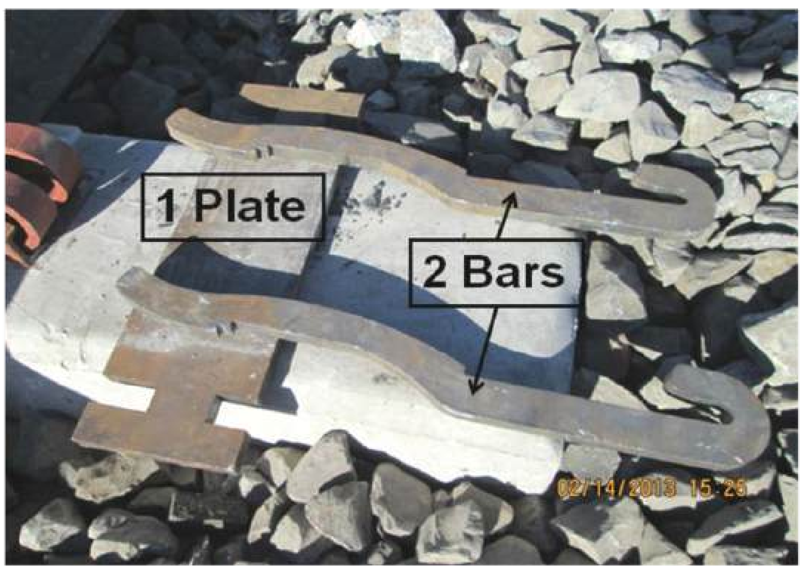


Figure 3-M-1

2. To install, place the bars under the rail as you would an anchor. See Figure 3-M-2.

Figure 3-M-2

3. Then hammer the plate from the field side until it is in contact with the remaining intact shoulder. The bars should then fall into place and be securely hooked into the slots of the plate. See Figure 3-M-3.
   - For Safelok I applications install the short slot in the plate to the field side.
   - For Safelok III applications install the long slot in the plate to the field side.
   - If the system is loose, it is installed incorrectly and the plate needs to be turned around.

Figure 3-M-3

3.2.10 Insulated Joints in Concrete Tie Track

1. Insulated joints in concrete tie track must not be allowed to remain in track if the joint has slipped and insulation is broken down between the bars and the rail. Refer to Section 8.6.15 Insulated Joint Bar Inspections for guidelines.
2. Insulated joints in concrete tie track must be properly supported.

3.3 Elastic Fasteners

3.3.1 Spring Clips

In elastically fastened track, spring rail clips provide enough toe load to prevent rail roll-over and restrain the rail from moving longitudinally. This is a critical component of the fastening system and must be maintained.

1. Replace clips that have been sprung, bent, broken or cracked.
2. Clips can and will lose the designed toe load, when this occurs, longitudinal movement may take place.
3. Replace all rail clips when performing program work on elastic fastener ties.

4. Install galvanized spring clips in road crossings, tunnels or other corrosive environments.
5. Ensure spring clips match the fastening system design of the tie and use the components for the various applications in signalized or circuited track as shown in Table 3-S.

Spring Clip Applications				
Tie Type	**Fastening System**	**Standard Tie**	**Insulated Joint**	**Standard Joint**
Concrete	Safelok 1	Spring clip and insulator	Insulated joint spring clip, insulated joint insulator.	Spring joint clip and cast joint spacer
Concrete	Pandrol e-clip	e-clip and insulator	Modified e-clip and insulated joint insulator	Modified e-clip
Concrete	Safelok III	Spring clip and insulator	Modified spring clip, cast insulated joint spacer and insulated joint insulator	Modified spring clip and cast joint spacer
Steel	Pandrol e-clip	e-clip and insulator	Modified e-clip and insulated joint insulator	Modified e-clip
Wood	Safelok 1	Spring clip	Insulated joint clip and insulated joint insulator.	Spring joint clip
Wood	Pandrol e-clip	e-clip	Modified e-clip	Modified e-clip

Table 3-S

NOTE: Joints in concrete tie track directly across from one another cannot be insulated.

Table 3-T below summarizes the most common spring clips.

Common Spring Clip Types		
Spring Clip Color	**Fastening System**	**Application**
Red, Gray, Black or Brown	Safelok 1 or 3	Standard, for use in general applications
Silver	Safelok 1 or 3	Galvanized, for use in grade crossings and other wet or corrosive environments
Black, Red	Safelok 1	Long reach for use with 10 mm wide post insulators on curves > 1 degree 30 minutes
Yellow	Safelok 1 or 3	Modified fingers, for use on both standard and insulated joints
Blue	Safelok 1	Modified fingers, for use with standard joints

Table 3-T

3.3.2 Safelok I Clips

Figure 3-N-1

1. Inspect SAFELOK I Clips to make sure that they are not sprung.
   - The top of the inside of the prong should be even with the bottom of the outside of the rail clip. Refer to Figure 3-N-2.
   - The distance between the bottom of clip and the bottom of the prong should be a minimum of 1/8" and a maximum of 3/8".
   - Used on both concrete and wood ties.

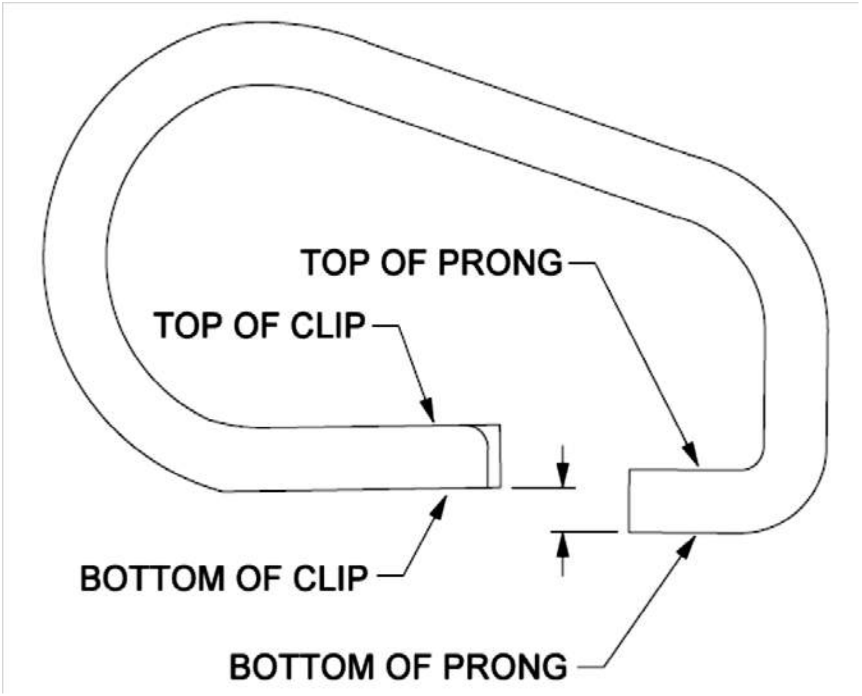


Figure 3-N-2

2. Do not overdrive Safelok I spring clips. If clips are applied properly:
   - The prongs will extend beyond the gauge face of the shoulder by 1/8 to 3/16 inch.
   - The base will be in full contact with the shoulder as shown in Figure 3-N-3.

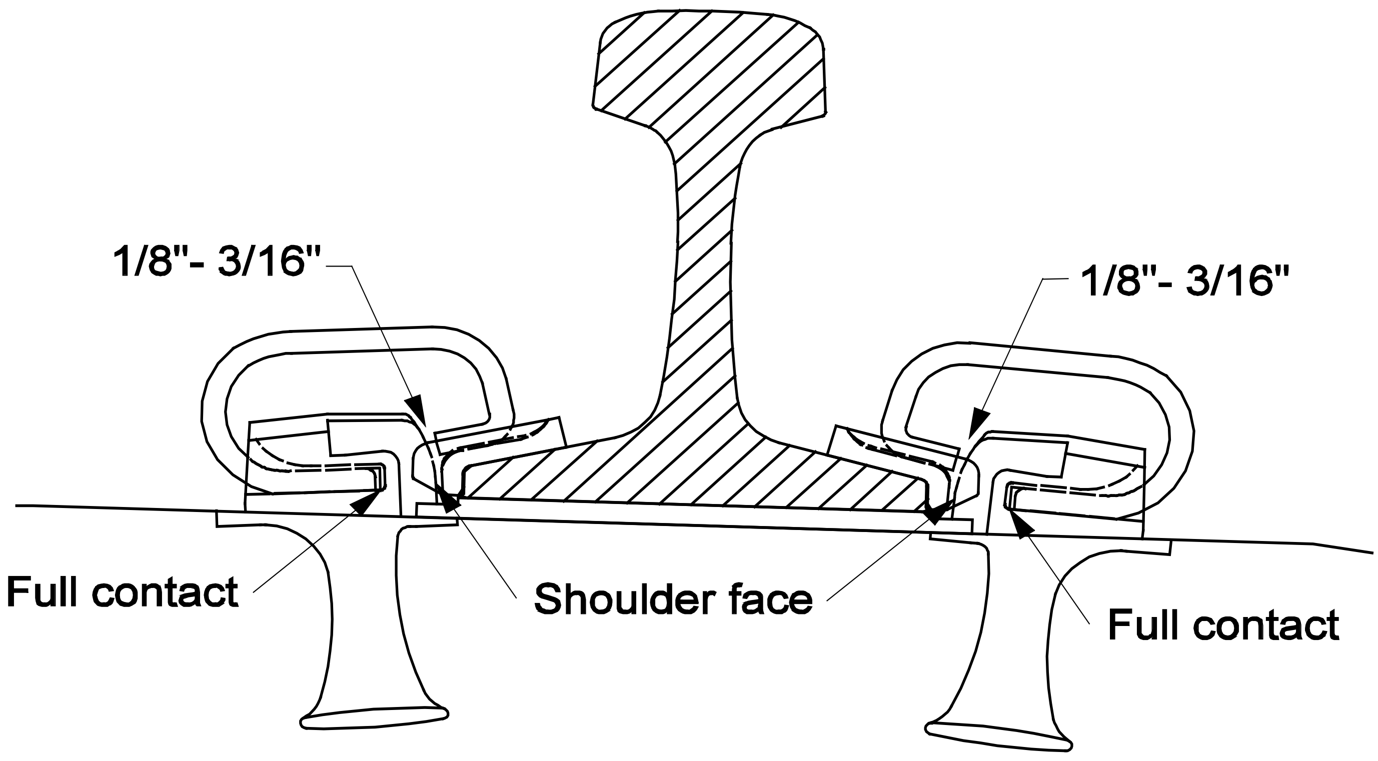


Figure 3-N-3

3.3.3 Safelok III Clips

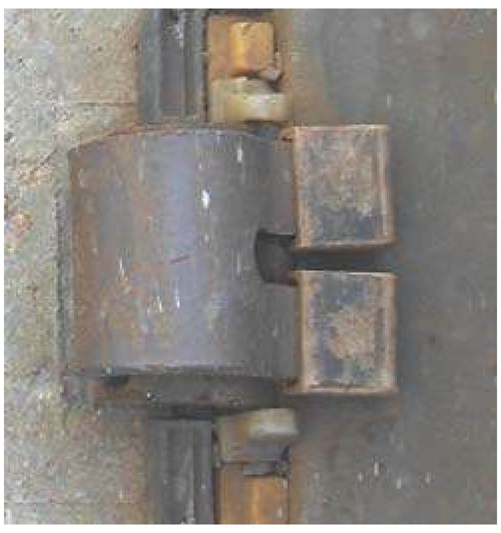


Figure 3-O-1

1. Do not overdrive Safelok III spring clips. If clips are installed properly:
   - The toe insulator will extend onto the base of the rail 5/16 inch.
   - The base of the clip will be in full contact with the shoulder as shown in Figure 3-O-2.
2. Safelok III spring clips are currently only utilized in concrete tie applications.

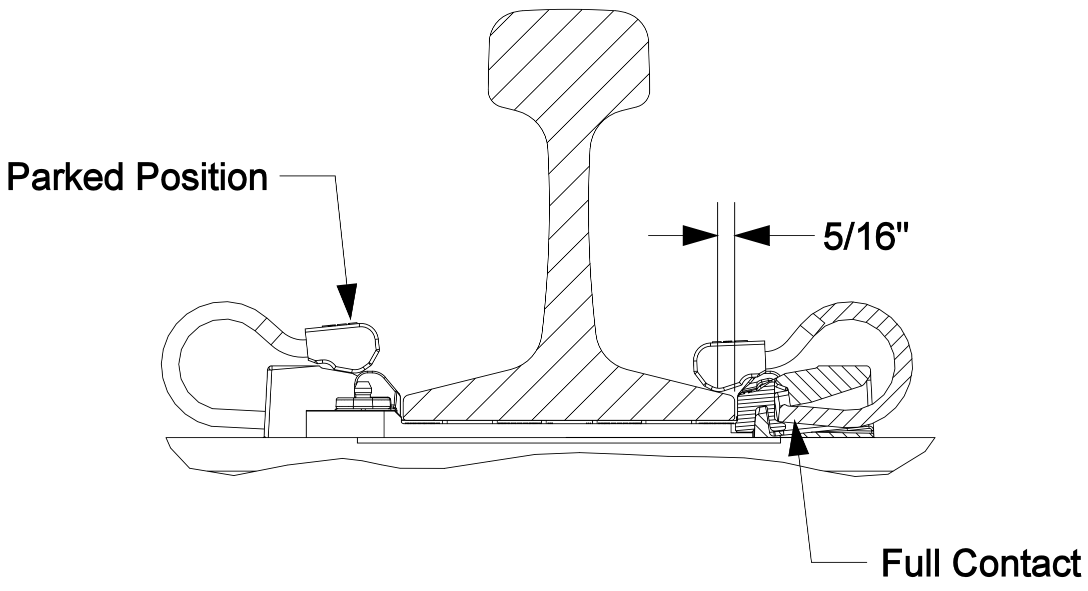


Figure 3-O-2

3.3.4 E-Clips

Figure 3-P-1

1. Do not overdrive e-clips. If installed correctly there will be a 3/8" clearance between bend in clip and clip housing. See Figure 3-P-2. Over driving the clip can cause clip breakage over time.
2. Can be used on concrete or wood ties.

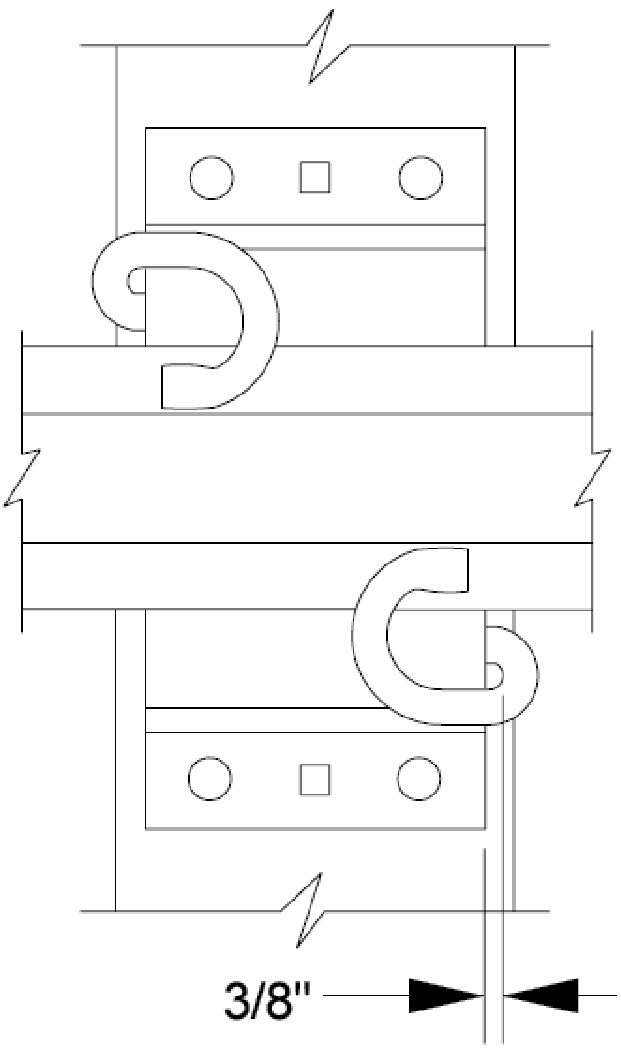


Figure 3-P-2

3.3.5 Vossloh Fastening System

The W30HH Vossloh Fastening System is a type of concrete tie elastic fastening system that is used with Vossloh concrete ties.

A. Vossloh Fastening System Parts

Vossloh fastening system parts list for one tie. See Standard Drawing Nos. 0465 and 0466:

	ITEM	ITEM NUMBER	QUANTITY PER TIE
1	Lag Screw	503-8651	4
2	Fastener	503-8650	4
3	Insulator (Gauge Side)	503-8652	2
4	Insulator (Field Side)	503-8653	2
5	Rail Pad	503-8654	2
6	Wear Plate	503-8655	2
7	Insert	503-8640	4

Table 3-U

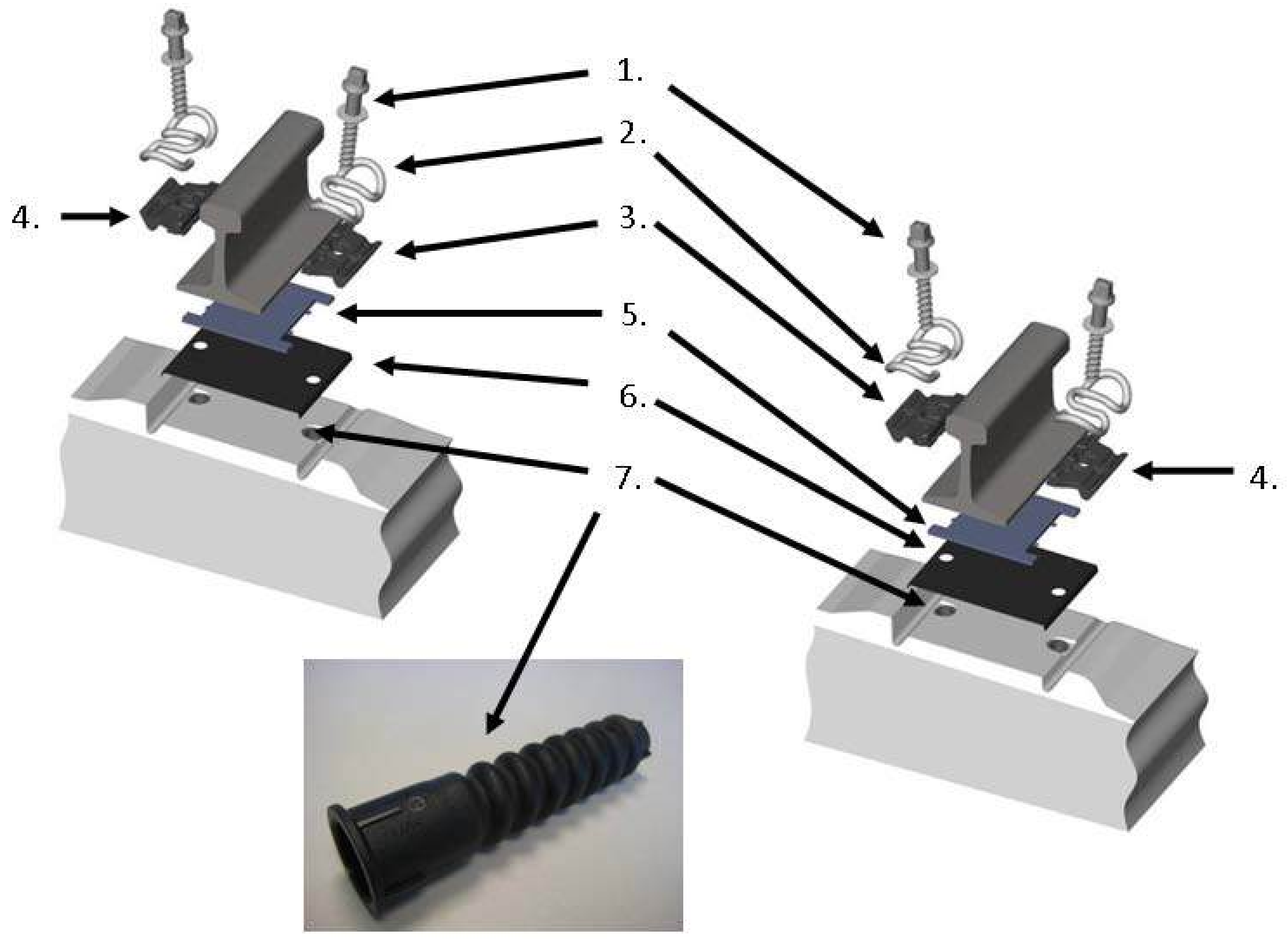


Figure 3-**Q**

B. Fastener Installation

Follow these requirements when installing the Vossloh fastening system:

1. The ties come to the site pre-assembled with the fasteners (Item Number 503-8650) in the parked position as shown in Figure 3-R.

Figure 3-R

2. Place the rail in the correct position on the tie seat between the insulators (Item Number 503-8652 or 503-8653) and on top of the rail pads (Item Number 503-8654) and wear plate (Item Number 503-8655).
3. Loosen lag screws (Item Number 503-8651) with a 7/8" socket approximately 1 to 1-1/2 counter clockwise direction turns.
4. Move the fastener (Item Number 503-8650) from the parked position to the full contact position. The fastener (Item Number 503-8650) has to rest on the top of the rail as shown in Figure 3-S.

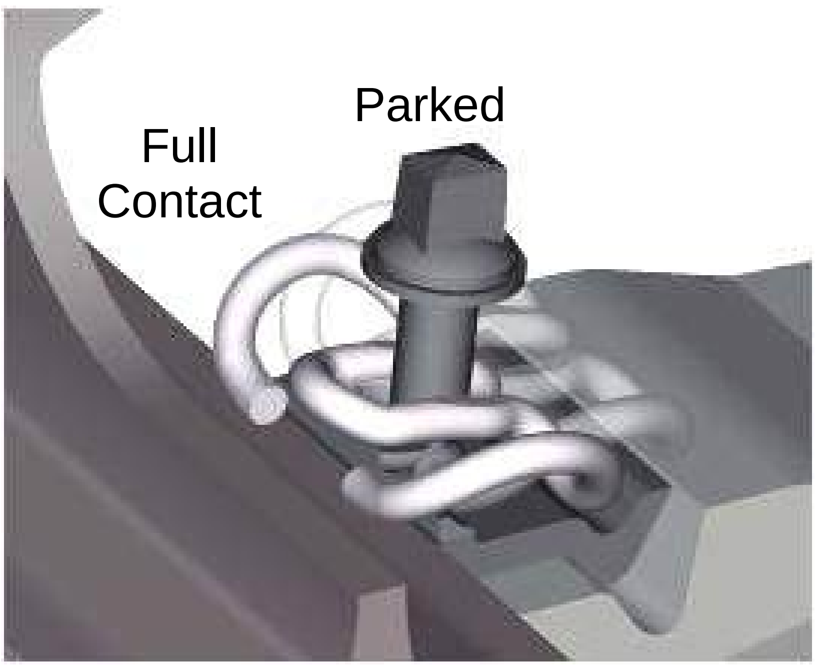


Figure 3-**S**

5. Tighten the lag screw (Item Number 503-8651) with a 7/8" socket until the middle bend of the fastener (Item Number 503-8650) is in contact with the insulator (Item Number 503-8652 or 503-8653).
6. Verify that the fastener (Item Number 503-8650) is in contact with the insulator (Figure 3-T, Item Number 503-8652 or 503-8653) but with a gap between the middle bend and the rail (Figure 3T).

3.0 TIES & FASTENINGS

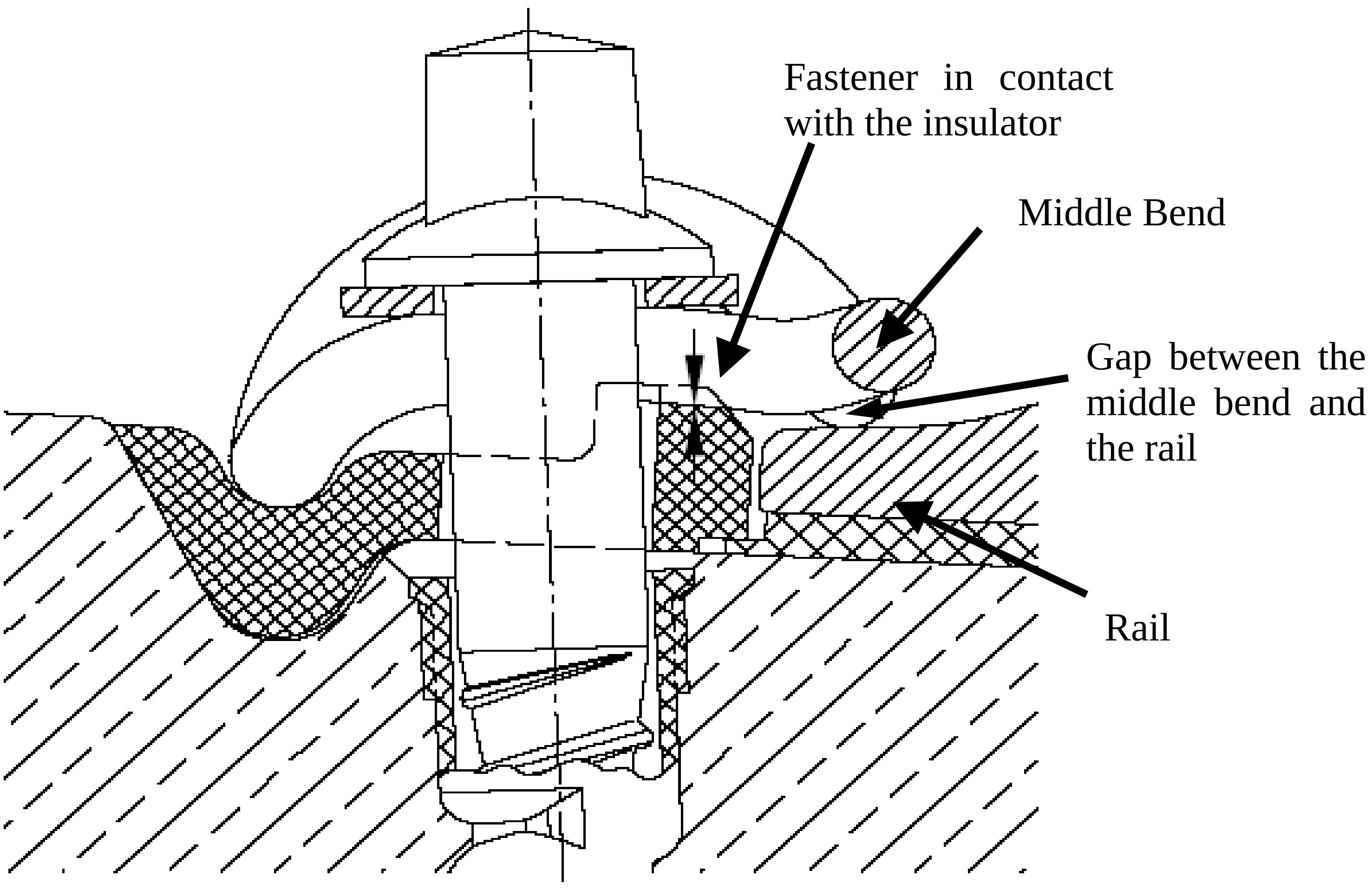


*Figure 3-*T

Correctly Installed:

Middle bend contacting the insulator

Note there is a gap between the middle bend and the rail by design

*Figure 3-*U

Incorrectly Installed:

Notice the large gap between the middle bend and the insulator

Figure 3-V

C. Broken Lag Removal

Follow these requirements when removing a broken lag screw from the Vossloh fastening system:

1. Remove the insulator (Item Number 503-8652 or 503-8653) from the side of the rail with the broken lag screw.
2. Clean out the hole of the broken lag screw to remove any debris that may get in the way of the removal process.
3. Insert the broken lag screw removal tool (Figure 3-W, Item Number 410-0962) into the lag hole.

*Figure 3-*W

4. Using an impact wrench or a ratchet as shown in Figure 3-X, turn the broken lag screw removal tool (Figure 3-W, Item Number 410-0962) counterclockwise until the broken lag screw is loose enough to be screwed out by hand.

***Figure 3-*X**

D. Insert Replacement

Follow these requirements when replacing an insert from the Vossloh fastening system:

1. To remove the previous insert (Figure 3-Q, Item Number 503-8640), drive the insert replacement tool (Figure 3-Y, Item Number 410-0963) with a 2-4 lb hammer into the insert (Figure 3-Z, Item Number 503-8640) until the bottom ring (Figure 3-Z) on the tool is in contact with the surface of the concrete tie or the top of the insert (Item Number 503-8640).

***Figure 3-*Y**

Bottom Ring

***Figure 3-*Z**

2. Using an impact wrench or a ratchet with a 7/8” socket, unscrew the complete insert (Item Number 503-8640) counter clockwise out of the tie.
3. Take out the insert (Item Number 503-8640) with the insert replacement tool (Item Number 410-0963).
4. Use a 2-4 lb hammer and a bar or a screwdriver to hammer the insert replacement tool (Item Number 410-0963) out of the insert (Item Number 503-8640).
5. Screw the replacement insert (Item Number 503-8640) into the tie as far as possible by hand.
6. Drive the insert replacement tool (Item Number 410-0963) with a 2-4 lb hammer into the insert until the bottom ring on the tool (Figure 3-Z) is in contact with the surface of the concrete tie or the top of the insert (Item Number 503-8640).
7. Advance the insert (Item Number 503-8640) with the screwing device by rotating clockwise.
8. Using an impact wrench or a ratchet with a 7/8” socket, screw the complete insert (Item Number 503-8640) in clockwise.

E. Vossloh Joint Fastenings

Follow these requirements when installing the Vossloh fastening system on a standard non-insulated joint:

- Use the standard insulators (Item Number 503-8652 or 503-8653) with the joint fastener (Item Number 503-8656) as shown in Figure 3-AA.

Figure 3-**AA**

Follow these requirements when installing the Vossloh fastening system on an insulated joint:

1. Place the insulated joint insulator (Figure 3-BB, Item Number 503-8657) on the rail base.

Figure 3-**BB**

2. Place the joint fastener (Figure 3-CC, Item Number 503-8656) on the standard insulator (Item Number 503-8652 or 503-8653) and the insulated joint insulator (Item Number 503-8657) as shown in Figure 3-CC. See Standard Drawing No. 0468

Figure 3-**CC**

3. Tighten the lag screw (Item Number 503-8651) with a 7/8" socket until the middle bend of the joint fastener contacts the standard insulator (Item Number 503-8652 or 503-8653) as shown in Figure 3-T.

F. Rail Relay on Ties with the Vossloh Fastening System

Follow these requirements when installing rail on ties with the Vossloh fastening system:

1. Remove lag screw (Item Number 503-8651), fastener (Item Number 503-8650) and insulator (Item Number 503-8652 or 503-8653).
2. Place tape or insert caps (Figure 3-DD, Item Number 503-8641) over the insert hole to prevent debris from getting in the insert.

Figure 3-**DD**

3. Remove the rail and change the rail pad (Item Number 503-8654) and the wear plate (Item Number 503-8655).
4. Place the new rail pad (Item Number 503-8654) and wear plate (Item Number 503-8655) on the rail seat.
5. Place the insulator (Item Number 503-8652 or 503-8653), lag screw (Item Number 503-8651) and fastener (Item Number 503-8650) on the rail seat.
6. Tighten the lag screw (Item Number 503-8651) in the parked position as shown in Figure 3-S and then place the new rail on the rail seat.
7. Move the fastener (Item Number 503-8650) onto the rail base and tighten the lag screw (Item Number 503-8651) until the middle bend of the fastener (Item Number 503-8650) is in contact to the insulator (Item Number 503-8652 or 503-8653) as shown in Figure 3-T.

3.3.6 Insulated Joint Fastenings

Install insulated joint bar insulators between special spring insulated joint clips and the rail base of bonded insulated joints on concrete, steel, or wood ties that use the Safelok system. See Standard Drawing No. 0427 or 0432 depending on clip type. For an insulated joint e-clip see Standard Drawing No. 132600.

3.3.7 Weld-On Shoulders

Safelok weld-on shoulders are insulated or non-insulated and differ by height. The insulated shoulder is approximately 5/16 inch higher than the non-insulated as shown in Table 3-V.

Weld-On Shoulder Types and Dimensions	
Shoulder Type	**Approximate Height**
Non-Insulated	1-1/8 inch
Insulated	1-7/16 inch

Table 3-V

Safelok weld-on shoulder applications include:

- Special plate work fastened to concrete, wood or steel ties in turnouts.
- Plate work directly applied to steel turnout ties at the frog base.

A. Installing Non-Insulated Weld-on Shoulders

Install non-insulated weld-on shoulders:

- To plate work where spring clips fasten the rail base.
- Directly to steel turnout ties to fasten the rail base of other than self-guarded frogs.

B. Installing Insulated Weld-on Shoulders

Install insulated weld-on shoulders:

- To plate work under insulated or standard joints.
- To frog plates where spring clips fasten to the thicker base of self-guarded frogs in wood turnouts.
- Directly to steel turnout ties to fasten to the thicker rail base of self-guarded frogs.

C. Replacing Weld-on Shoulders

Replace weld-on shoulders damaged from derailments or other causes when they do not effectively hold the rail clip in place.

Replace damaged weld-on shoulders with similar shoulders.

D. Welding Weld-on Shoulders

Weld weld-on shoulders to special plate work or steel turnout ties with a 3/8-inch fillet weld using an E7018 welding rod.

E. Installing Weld-on Shoulders in Various Applications

Follow these requirements:

1. When installing non-insulated weld-on shoulders in the following applications, maintain a 1/16-inch gap between the rail base and the front face of the shoulder. See Figure 3-EE.
   - Plate work under standard joints that uses cast joint spacers and spring joint clips.
   - Plate work where spring clips fasten to the rail base or the base of frogs.
   - Steel turnout ties where spring clips fasten to the rail base of frogs.

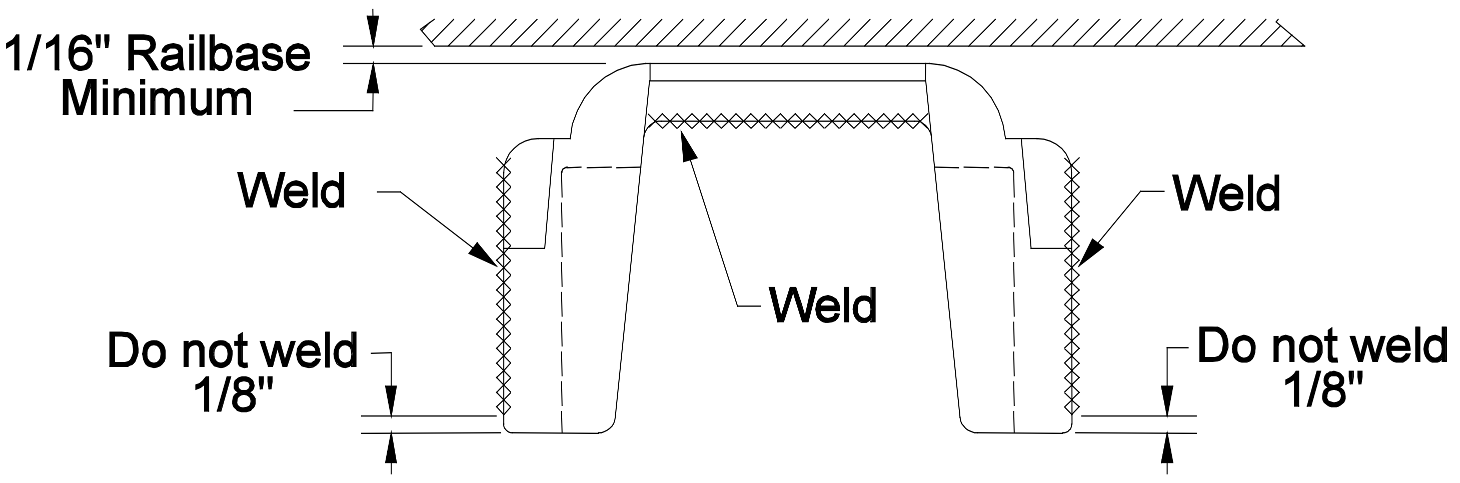


Figure 3-EE

2. When installing insulated weld-on shoulders in the following applications, maintain a 5/16-inch gap between the rail base and the front face of the shoulder to allow for the installation of insulators or cast spacers (see Figure 3-FF).
    - Plate work under insulated joints that uses insulated joint insulators, cast pins, and insulated joint spring clips.
    - Plate work fastened to steel turnout ties in a signalized or circuited application that uses plastic insulators.
    - Base plates of guard rails that use cast spacers.

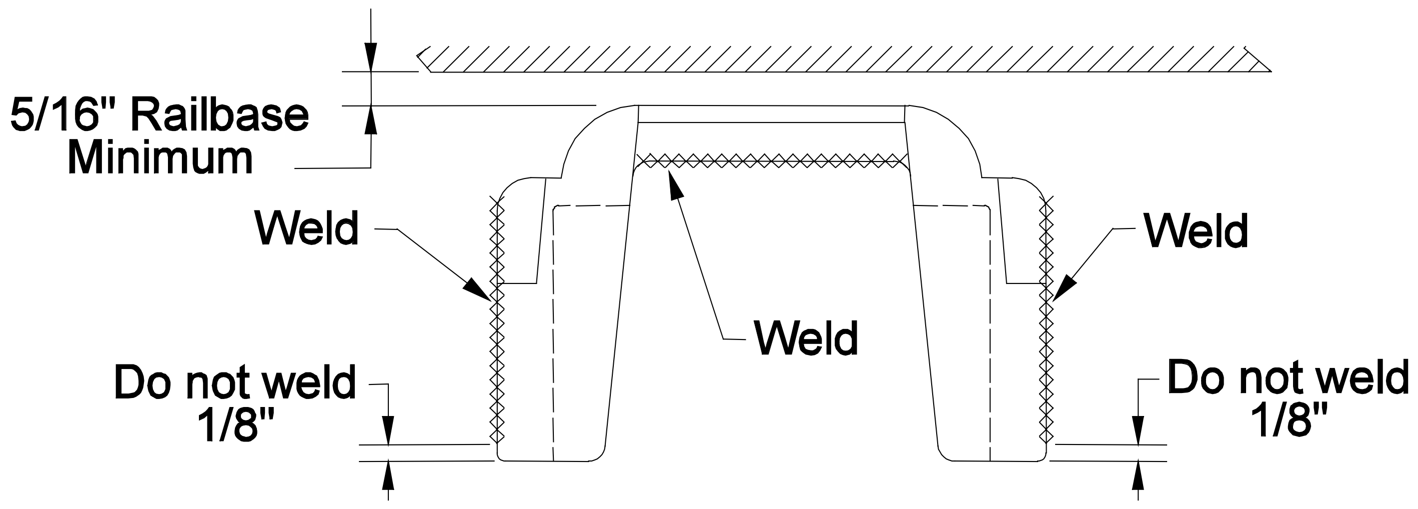


Figure 3-FF

3.3.8 Hook-In Shoulders

Steel cross and switch ties use hook-in shoulders to apply spring clips. The hook-in shoulder must match the steel tie thickness.

1. Identify the proper hook-in shoulder from Table 3-W.

Hook-In Shoulder Types and Steel Tie Dimensions		
Shoulder Type	**Steel Tie Type**	**Tie Thickness**
12 millimeter	Existing Tunnel or Mainline Ties	12 millimeter
10 millimeter	Yard Track Tie	10 millimeter
10 millimeter	Turnout Tie	10 millimeter

Table 3-W

2. Replace hook-in shoulders damaged from derailments or other causes when they do not effectively hold the rail clip in place.

3.4 Tie Plates

3.4.1 Double Shoulder Tie Plates

A double-shoulder tie plate (See Figure 3-GG) is designed to:

- Protect the wood crosstie from damage by distributing vertical and lateral wheel loads over a wider area.
- Establish and maintain track gauge accurately and securely.
- Provide inward rail cant for proper positioning of the wheel on the rail head.
- Resist tie skewing through interaction between the rail base and the plate shoulders.

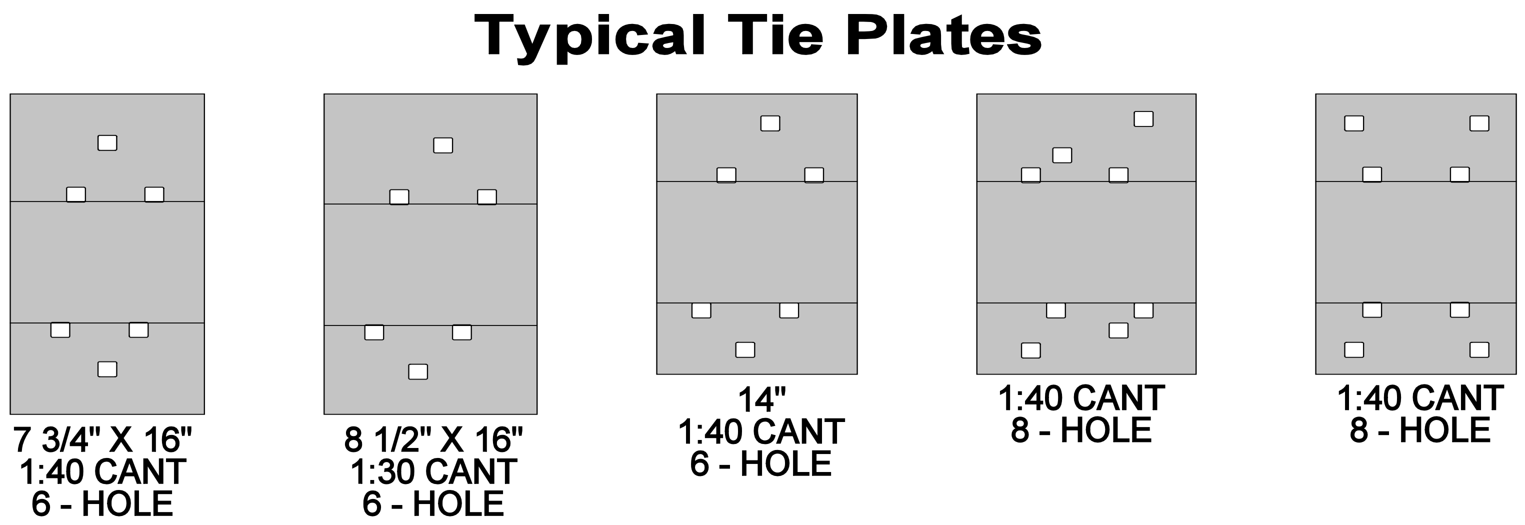


Figure 3-GG

3.4.2 Tie Plate Requirements

Follow these requirements when installing tie plates:

1. Apply tie plates to all wood and composite ties.
2. Do not intermix plates of different sizes and cant along the same rail.
3. Install tie plates so that:
   - Plates have full even bearing on the ties.
   - Field-side plate shoulder is square against the field-side base of the rail.
   - Plate is centered on the tie.
   - Proper cant is provided to the rail when the wide side of the plate is on the field side. See Figure 3-HH.
   - Do not reuse broken, bent, worn, or corroded tie plates.

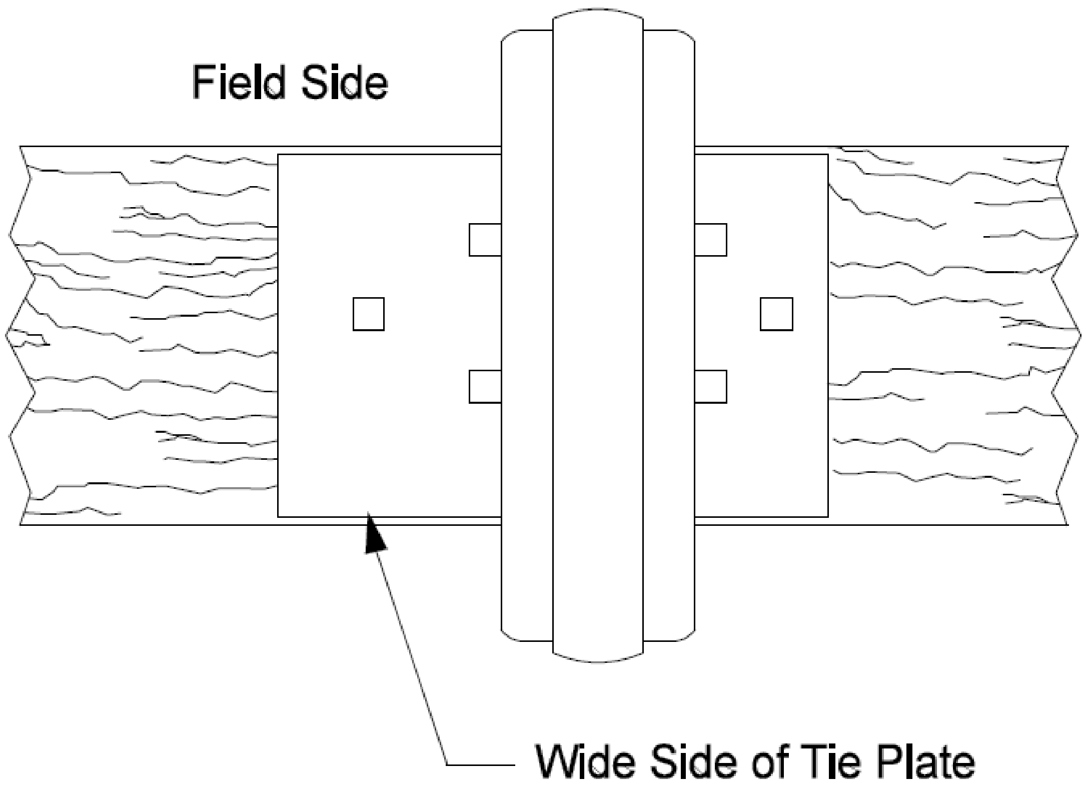


Figure 3-HH

See Table 3-X for types of tie plates.

Size and Type	Road	Cant
DBL Single shoulder 5-1/2" and 6" base rail	SP	1:40
DBL shoulder 8" x 14" for 6" base rail	UP/SP/ CNW	1:40
DBL shoulder 5-1/2" base rail	UP/ MP/CNW	1:40
DBL shoulder 8-1/2" x 16" for 6" base rail	UP	1:30
Cast Plate for Safelok fastening 16" prior to year 2003	UP	1:30
Cast Plate for Safelok fastening 18"	UP	1:40
Cast Plate for Safelok fastening 16” after year 2003	UP	1:40
DBL shoulder 7-3/4" x 16" for 6" base rail	UP	1:40
Rolled e-clip plate 7-3/4” x 16” for 6” base rail	UP/CNW/SP	1:40

Table 3-X

3.4.3 Curve Blocks

Install tie plates with curve blocks in main track curves of 3 degrees or higher, or at other locations designated by the Chief Engineer. See Figure 3-KK for tie plate requirements.

Install tie plates with curve blocks on every fourth tie as shown in Figure 3-II.

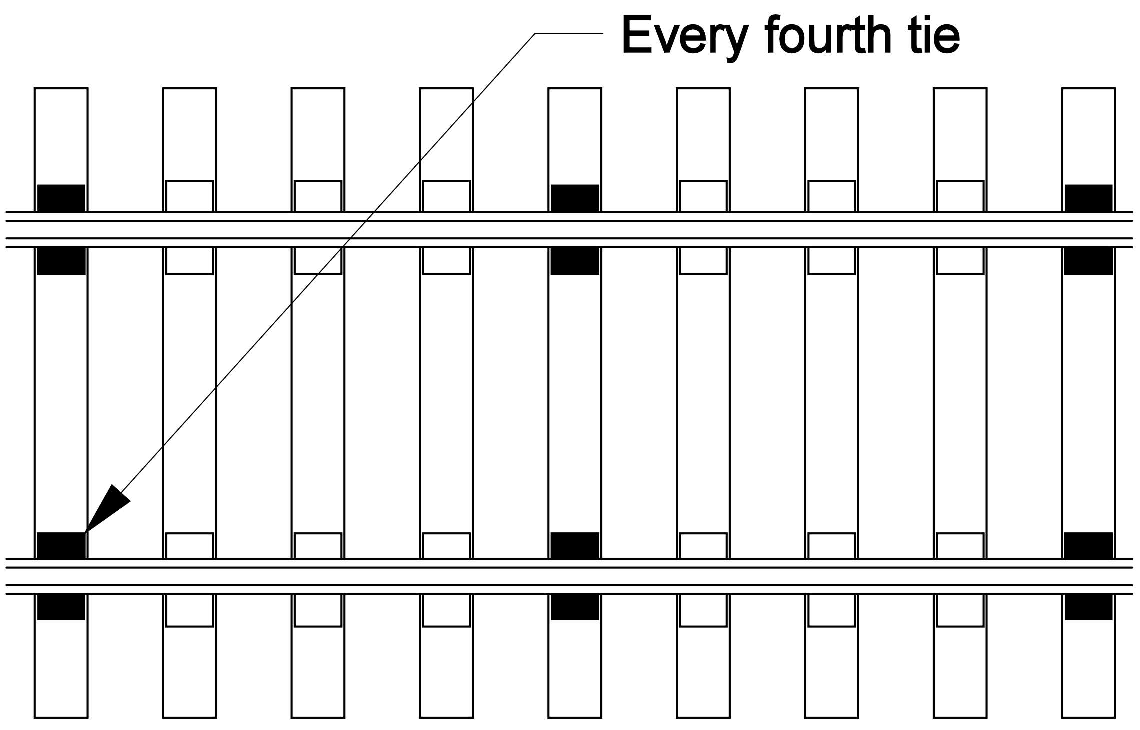


Figure 3-II

3.4.4 Elastic Fastener Plates

Elastic fastener plates are used in specific locations to assist in holding gauge, and areas of special track work. Victor plates are the standard elastic fastener plates for high degree curves. (Figure 3-KK)

1. Curves less than 3 degrees will use 16” double shoulder cut spike plates
2. Curves 3 degrees and greater will utilize curve block plates on both high and low sides on subdivisions with less than 20 MGT.
3. Subdivisions with 20 MGT or more will utilize 16” Victor plates with cut spikes on curves 3 degrees and greater, and less than 6 degrees on high and low side.
4. Subdivisions with 20 MGT or more will utilize 18” Victor plates with cut spikes on curves 6 degrees and greater on high and low side.

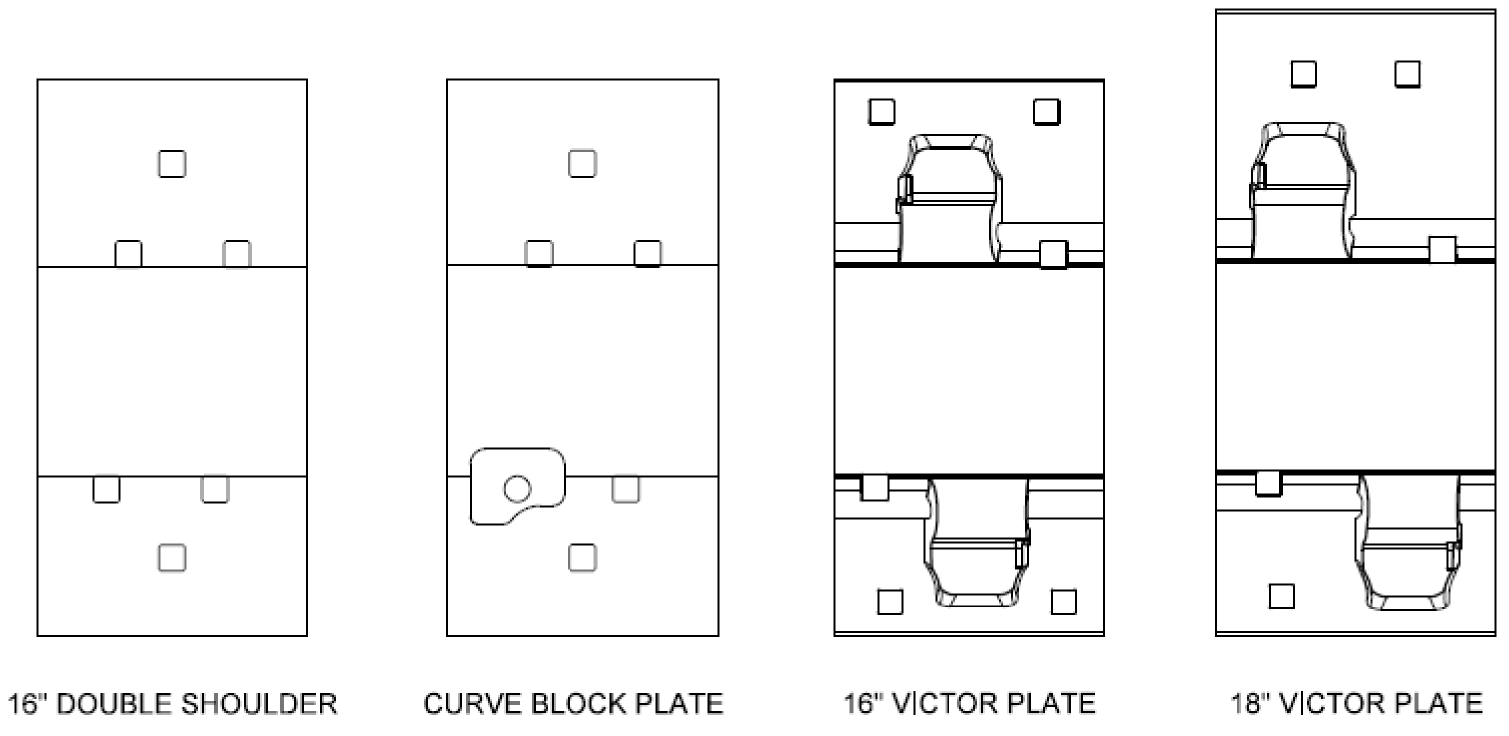
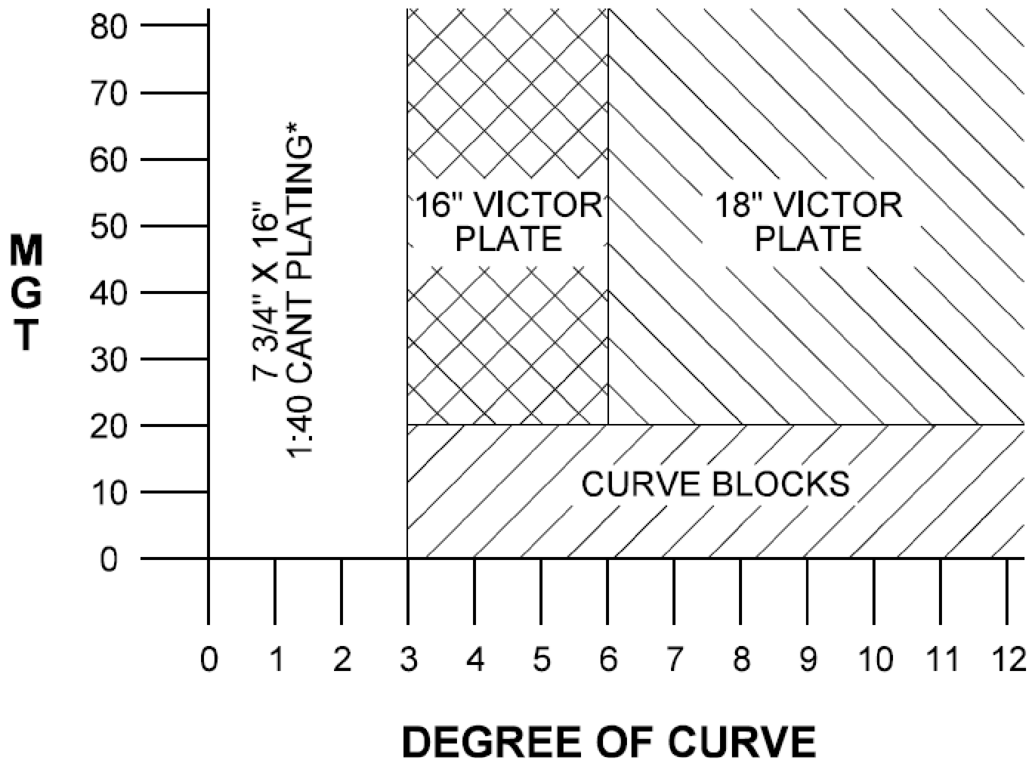


Figure 3-JJ



ALL SOFTWOOD TIES REQUIRE 16" PLATES.
ALL TRACK CARRYING MORE THAN 50 MGT REQUIRES 16" TIE PLATES.

EXISTING 16" TIE PLATES MAY BE USED IF WEAR DOES NOT EXCEED 1/8" AND IS NOT A CAST PLATE.

AREAS WHERE GRADE EXCEEDS 2% AVERAGE WILL UTILIZE ELASTIC FASTENERS ON CURVES > 6 DEGREES.

Figure 3-KK

3.5 Spikes and Screws

3.5.1 Spikes

Spikes fasten rail, tie plates, switch stands and other devices to wood and composite ties. Follow these requirements:

1. Spike each tie with a minimum of two rail spikes per plate.
2. Before driving spikes, properly align ties and center tie plates.
3. Maintain uniform standard track gauge within permissible limits when spiking.
4. Use new spikes for rail spikes and good second-hand spikes for hold-down spikes when available.
5. Drive spikes vertically with the face in contact with the base edge of the rail.
6. Drive spikes just until they contact the rail. Over driving spikes may damage the base of the rail.

3.5.2 Joint Spikes

Follow these requirements when spiking joints:

1. When spiking insulated joints, turn spike heads away from the rail.
2. Do not drive spikes into the slots or holes of skirted joint bars. Do not drive rail spikes within 2 inches of the end of skirted joint bars.
3. When driving rail spikes within 2 inches of the ends of non-skirted joint bars, leave the spikes up approximately 2 inches to allow the joint bar to bypass the spike head if rail movement occurs.

3.5.3 Spike Pattern

Standard spiking patterns are required during tie renewal, rail relay and new construction, unless the Chief Engineer Maintenance has approved an exception.

During rail and tie renewals, additional spikes may be required to bring track into compliance with the standard pattern. Track ties not being replaced also may require additional spiking.

Use Table 3-Y, Table 3-Z, Table 3-AA, and Figure 3-LL to determine proper spiking patterns.

Note: Locations with permanent speed restrictions must have spike patterns based on a subs predominant class of track. For example, if a mile long section of track is permanently slow ordered to Class 3, but the sub's predominant class of track is Class 5 then the mile long section requires Class 5 spike patterns.

Main Track and CTC Sidings Less Than 40 MPH	
Application	**Pattern**
Tangents and curves less than 1° 30'	1
Curves at least 1° 30' but less than 4°	3
Curves at least 4° but less than 8°	4
Curves 8° or more and Turnouts	5

Table 3-Y

Main Track and CTC Sidings 40 MPH or More	
Application	**Pattern**
Tangents and curves less than 30'	2
Curves at least 30’ but less than 1^{o} 30”	3
Curves at least 1° 30' but less than 4°	4
Curves 4° or more and Turnouts	5

Table 3-Z

Yard and Industry Tracks	
Application	**Pattern**
Tangents and curves less than 4°	1
Curves at least 4° but less than 8°	3
Curves 8° or more	4
Turnouts	5

Table 3-AA

**For Composite tie spiking patterns on eight hole plates refer to Figure 3-A

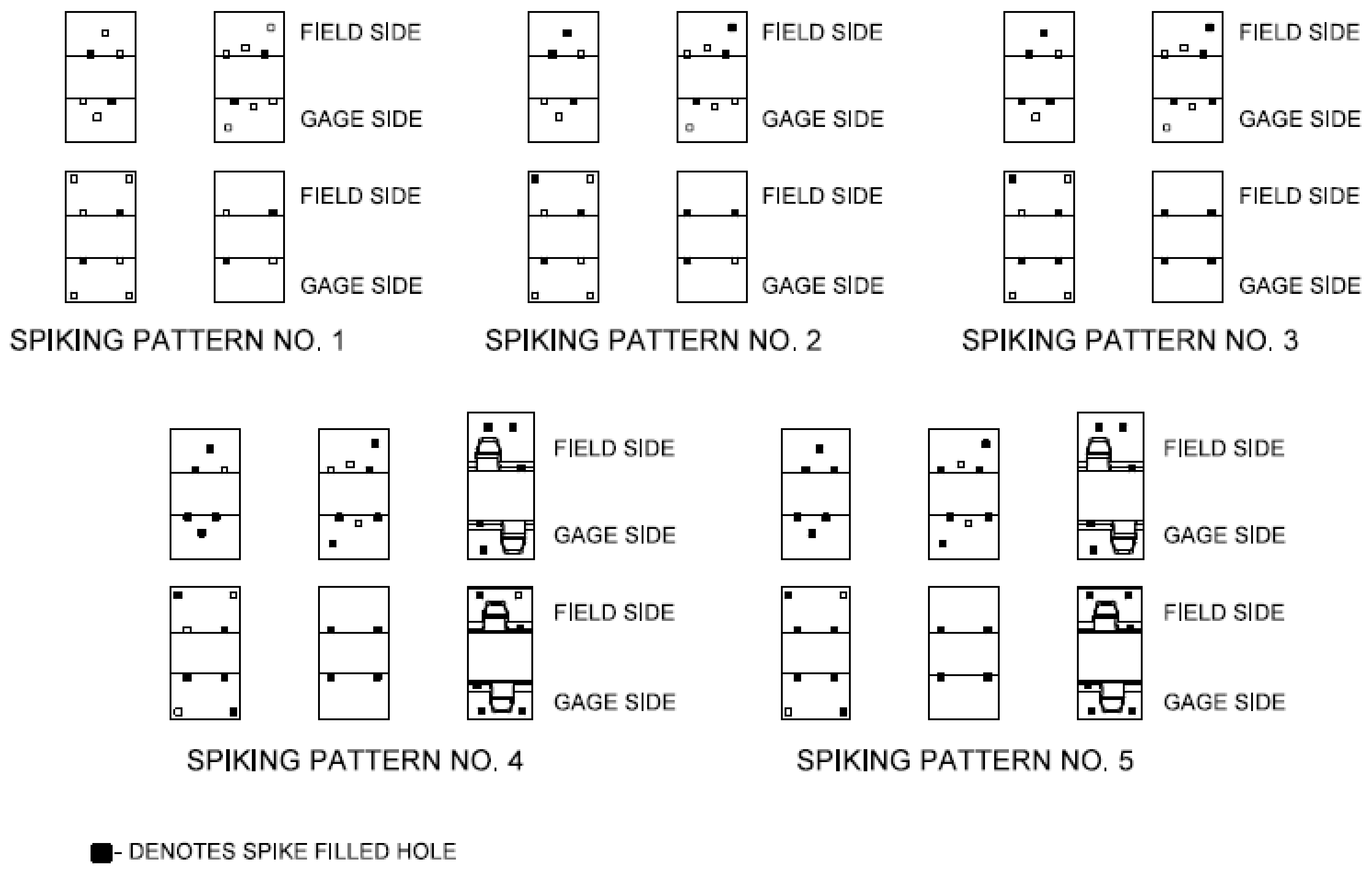


Figure 3-LL

Where only one outer rail spike is required, and tie plates with offset spike holes are used, drive the outer rail spikes in the spike hole punched nearest to the center of the tie plate. See Figure 3-MM.

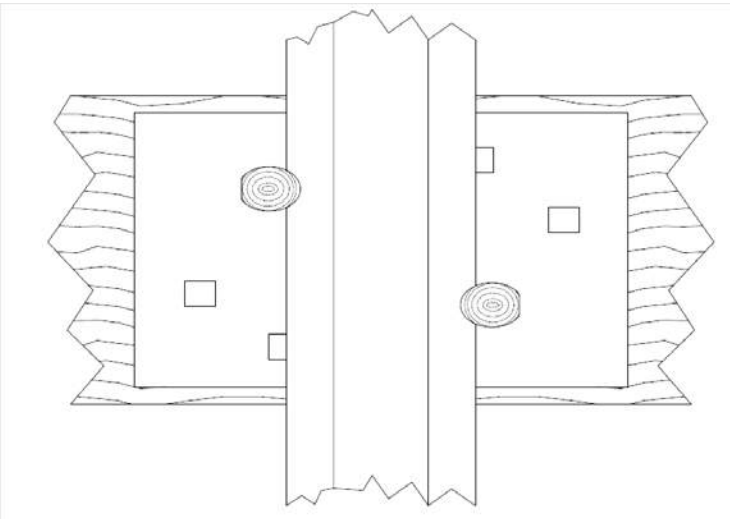


Figure 3-MM

A. Spiking Turnouts

When spiking turnouts, use spike pattern number 5 in Figure 3-LL on:

- All switch ties.
- 24 ties ahead of switch points.
- 24 ties behind the last long switch tie on the mainline side of the switch.
- Diverging side of the turnout from the last long switch tie through the reverse curve and for 24 ties onto tangent track.
- Fully spike all switch, frog, and guard rail plates in wood turnouts. Refer to Chapter 5 for more details.

B. Spiking Road Crossings

When the design of the road crossing material will not allow for installation of the standard spike pattern, spike ties directly under the crossing material as shown in Figure 3-NN to ensure that the crossing panel will set flat on the ties.

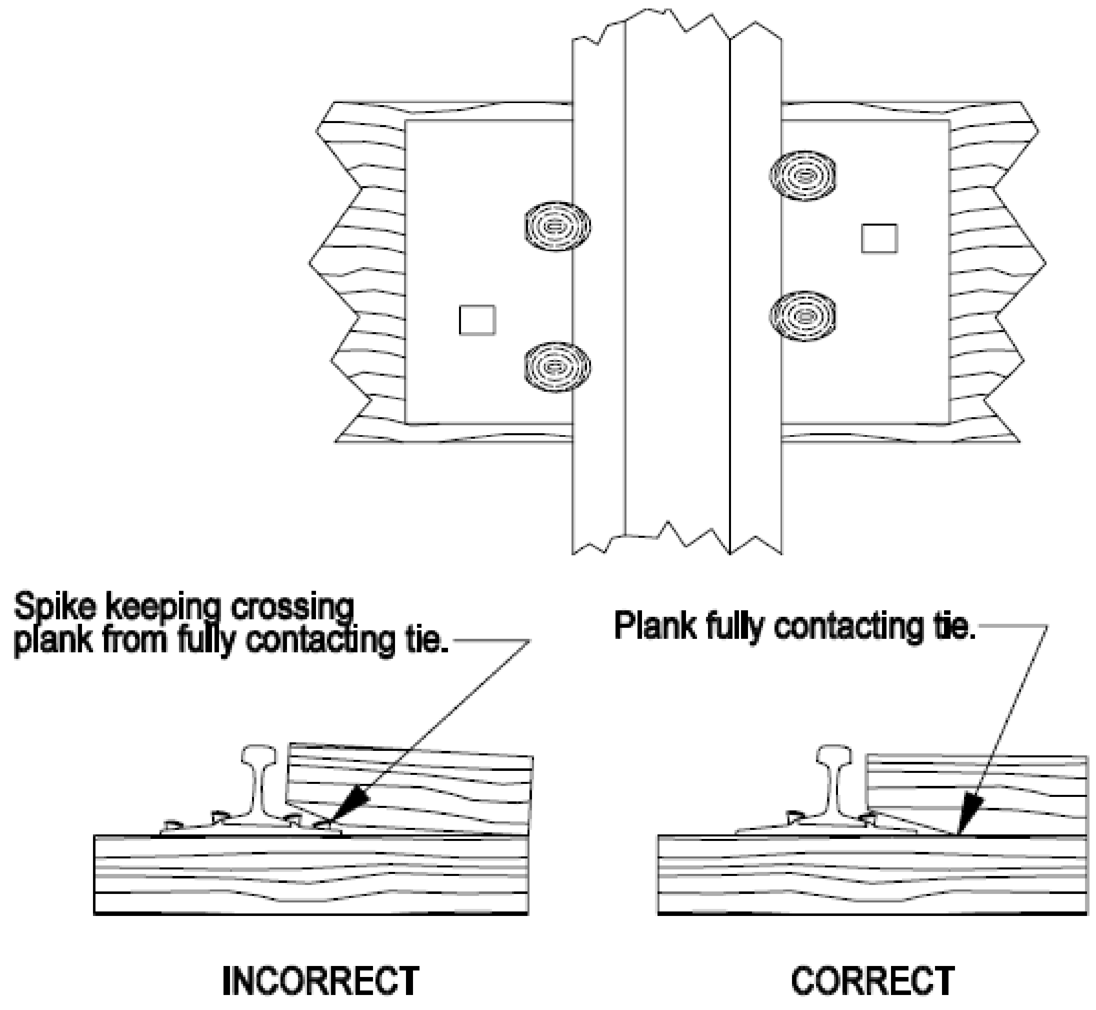


Figure 3-NN

3.5.4 Lag Screw Application

Lag screws are used in specific applications in curves, crossings, turnouts and crossovers to secure frogs, gauge plates, guardrails and elastic fastener plates to ties. See Standard Drawing No. 0454.

Follow these requirements:

1. Ensure screws are inserted to a depth, where the bottom of the head of the lag screw is touching the top of the plate and securely fastens the plate to the tie.
2. Do not over tighten the lag screws.
3. Do not drive lag screws into the tie.
4. Use the proper size drill bit for the type of tie when drilling holes for lag screws as referred to in Table 3-BB.
5. Drill holes to a depth of 6 inches.
6. Do not drill through the bottom of the tie.
7. Do not place track spikes in round screw holes.

Hole diameters for 15/16-inch X 6 1/2-inch lag screws are as follows:	
Douglas Fir or other softwood	11/16 inches
Oak , hardwood or composite	3/4 inches
Azobe or other exotic hardwoods	13/16 inches

Table 3-BB

3.5.5 Evergrip Lag Screw

Evergrip lag screws in Figure 3-OO are used in specific applications in curves, crossings, turnouts and crossovers to secure frogs, gauge plates, guardrails and elastic fastener plates to ties. Evergrip lag screws require fewer revolutions to fully tighten and have a higher holding power than the standard lag screw. See Standard Drawing No. 0454.

Follow the requirements in Section 3.5.4 Lag Screw Applications.

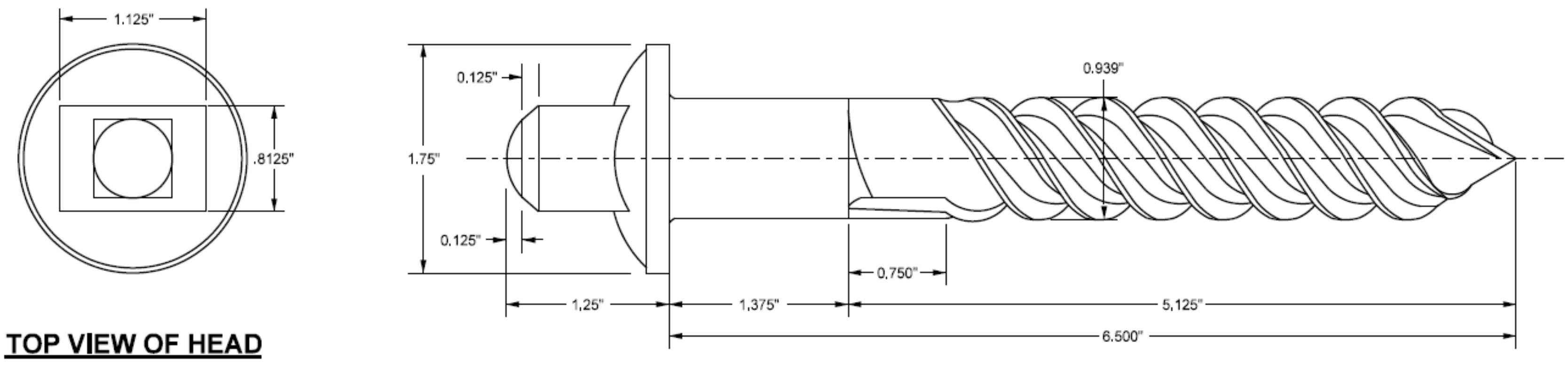


Figure 3-OO

3.5.6 Defective Fastener Repair

Actions Required for Defective Fasteners on Wood Ties

For 3 or more consecutive ties with defective fasteners in a curve ≥ 3 deg:

- Temporary repair of the defective lag screw fastening system can be completed by fully spiking the existing plate and placing a 10 MPH speed restriction.
- Temporary repair of the defective lag screw fastening system can be completed by replacing lag screw plate with a 16” standard tie plate (with same cant) and cut spikes, using plugging foam as necessary.
- Permanent repair of the defective lag screw fastening system requires foam plugging and relagging screws; if tie cannot be relagged, replace tie and/or install new fastening system according to current elastic fastening standard.
- For cut spike fastening systems, plug holes with foam or wood plugs and respike; if tie cannot be respiked, replace tie.

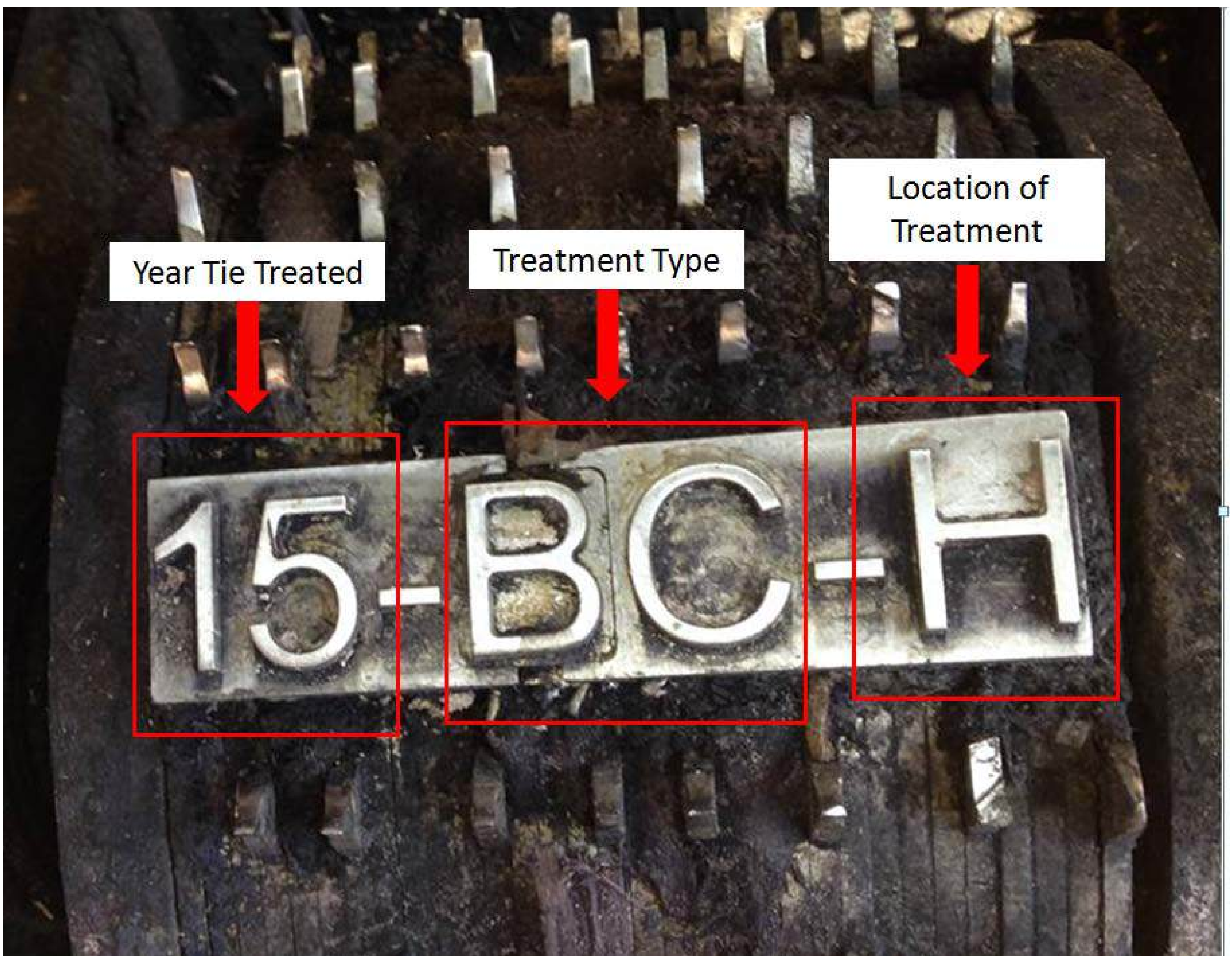
In a 39’ rail length of lag screw ties, a minimum of 50% of the ties must have a non-defective fastening system or a 10 MPH speed restriction must be in place until permanent repairs are made.

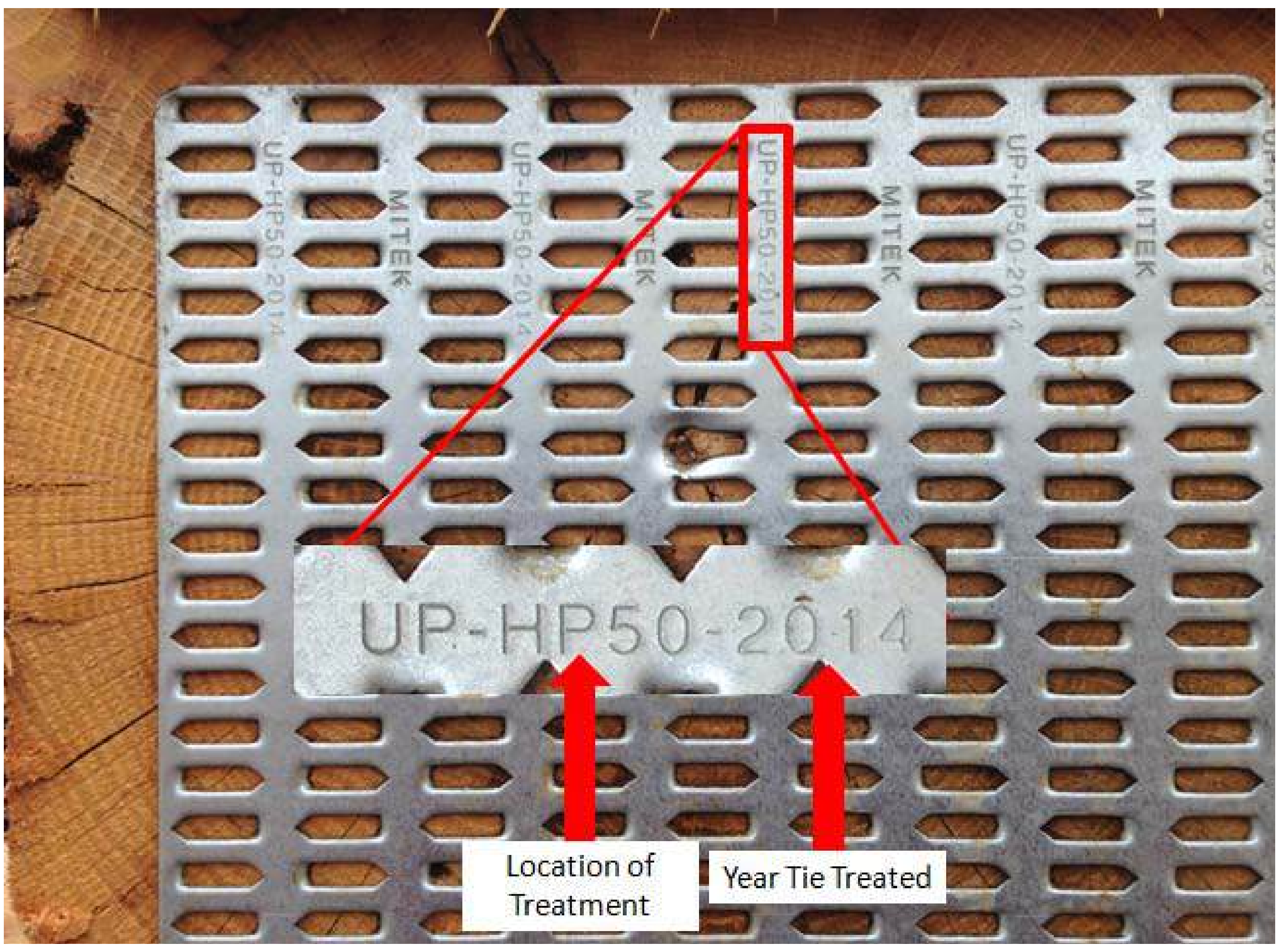
3.6 Tie Maintenance

Follow these requirements to maintain ties:

1. Adze the plate-bearing surface of a wood tie to the minimum depth required to return the tie plate area to a level plane.
2. Plug holes in wood ties with tie plugs or other approved plugging material before re-installing spikes.
3. Repair rail-seat abrasion in concrete ties as outlined in section 3.2.1

3.6.1 Wood Tie Identification




UP-HP50-2014
MITEK
UP-HP50-2014
Location of Treatment
Year Tie Treated

4.0 RAIL AND JOINTS

4.1 General

Rail is a rolled piece of steel laid parallel on ties to form a track on which trains operate. Rail is designed to distribute the load of the rolling stock to the ties and the roadbed.

4.2 Rail Identification

Rail branding and stamping identifies rail using a unique identification system. Rail manufacturers form the markings into the rail during the manufacturing process.

Check rail branding and stamping to determine the type of rail before welding.

4.2.1 Rail Branding

Branding appears as raised lettering on the rail web and identifies the rail weight and section, manufacturer name, and the year and month rolled. See Figure 4-A.

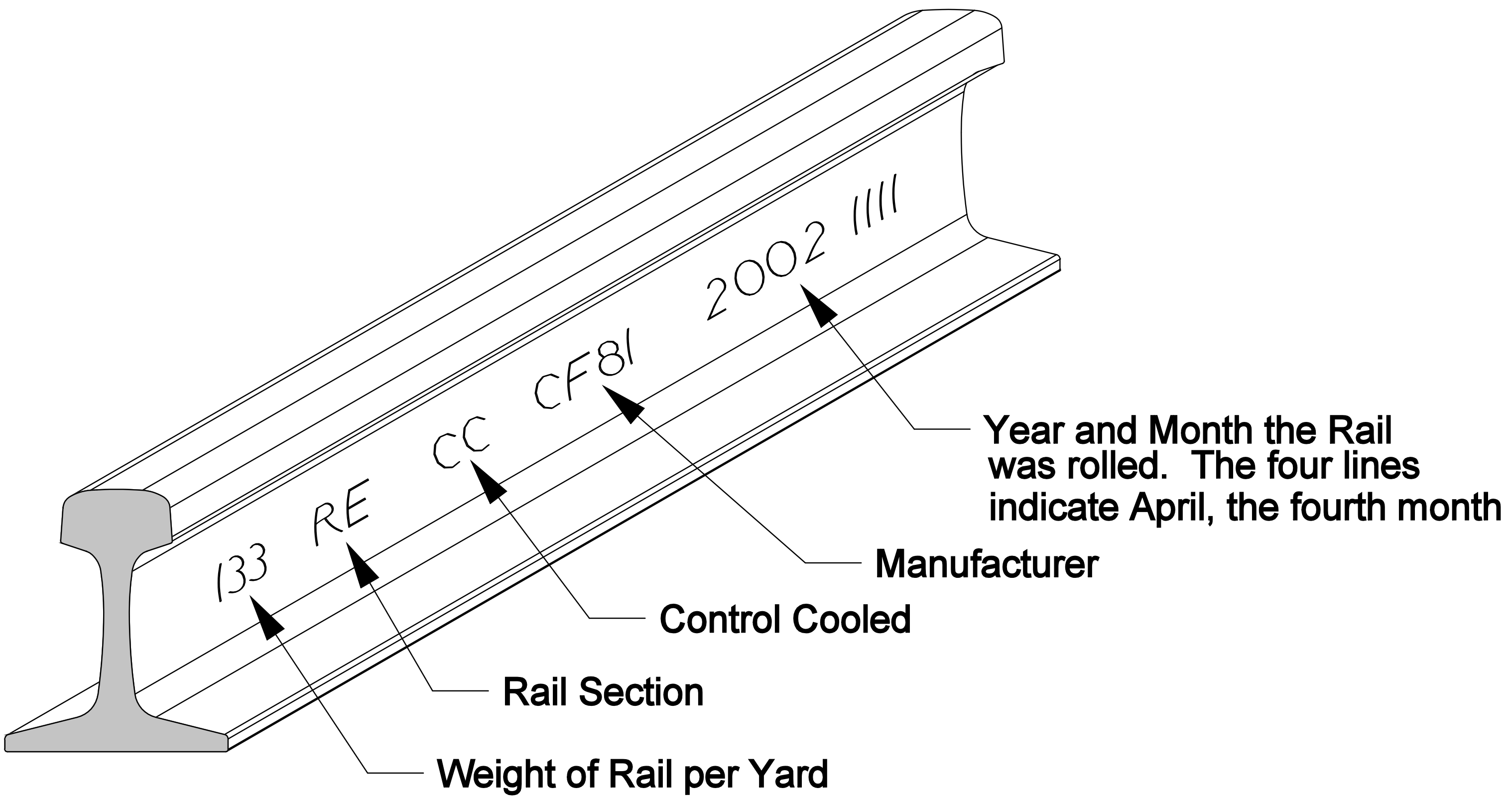


Figure 0-A

4.2.2 Rail Stamping

Rail stampings are imprinted characters on the web opposite the branding side. See Figure 4-B.

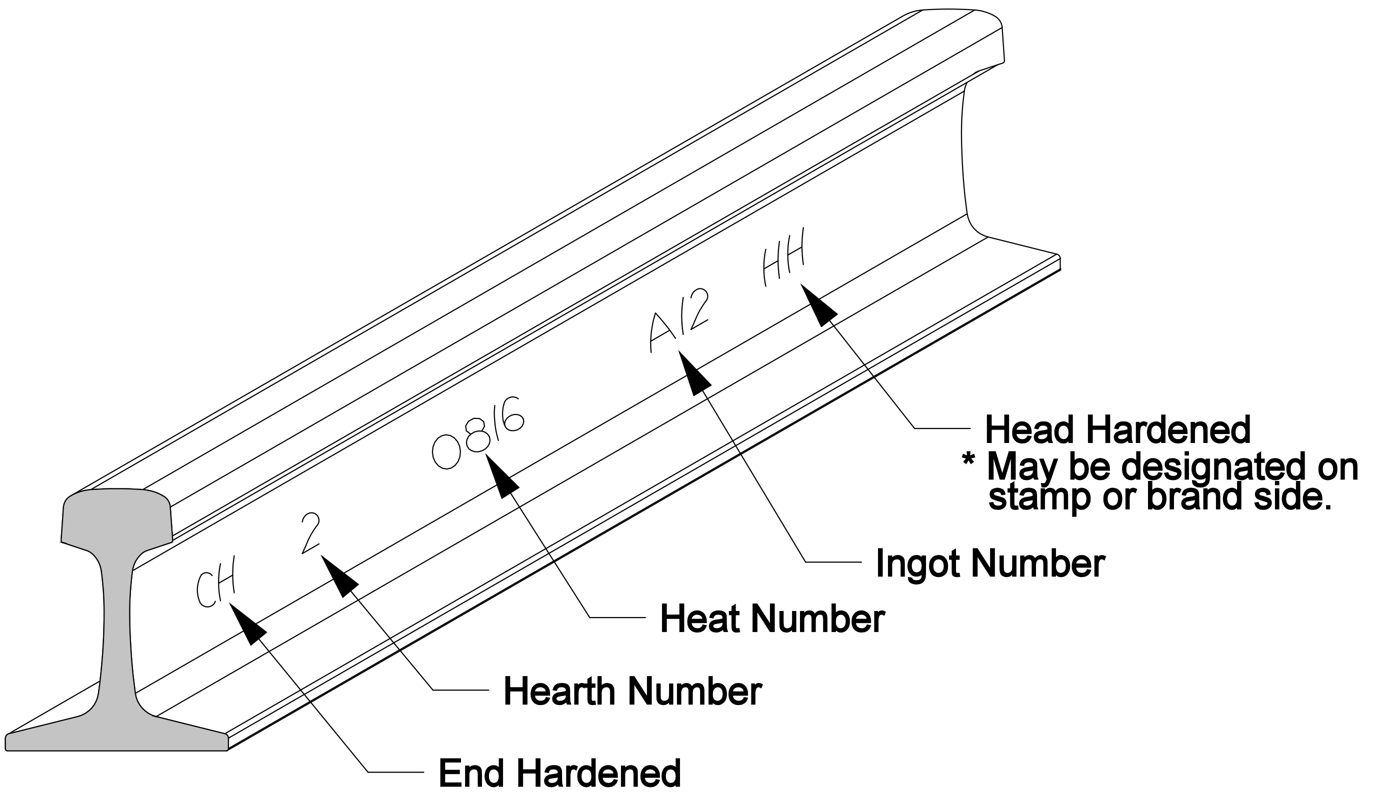


Figure 4-B

4.2.3 Hydrogen Elimination

During the rail manufacturing process, hydrogen is removed to reduce internal rail defects. Table 4-A identifies the process used during hydrogen elimination.

Hydrogen Elimination Processes	
Branding	**Process**
CC	Control cooled
CH	Control cooled and end hardened
BC	Control cooled blooms
VT	Vacuum treated
OP	Other practices

Table 4-A

4.2.4 Rail Chemistry

Rail chemistry determines specific maintenance and welding requirements. Use Table 4-B and Table 4-C to determine whether rail is alloy or non-alloy.

Alloy Rail		
Manufacturer Branding	**Stamping**	**Chemistry/Type**
CF&I	CROMO	Chrome/Molybdenum
CF&I	HI SI	High Silicon
W-P (WHEELING PITT)	CR	Chrome/Silicon
W-P (WHEELING PITT)	WR	Chrome/Silicon
KLOCKNER-AL	Blank	Chrome/Vanadium
KRUPP-AL	Blank	Chrome/Vanadium
THYSSEN-AL	Blank	Chrome/Vanadium
ATH	Blank	Chrome/Vanadium

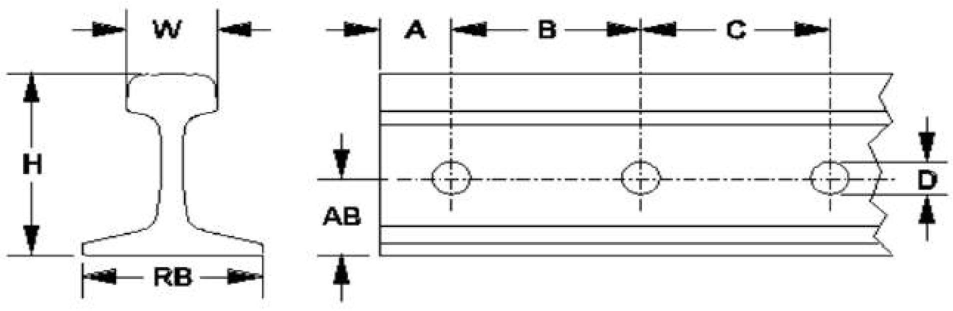
Table 4-B

Non-Alloy Rail		
Manufacturer Branding	**Stamping**	**Chemistry/Type**
BETHLEHEM STEEL	FT	Fully Heat Treated
BETHLEHEM STEEL	HH	Head Hardened
BETHLEHEM STEEL	MH	Standard Strength
BRITISH STEEL	FT	Head Hardened
CF&I (HH on glued tag)	IS	Head Hardened
CF&I	HH	Head Hardened
CF&I	DH390	Head Hardened
CF&I	IS	Standard Strength
CF&I	SS	Standard Strength
COLORADO	Blank	Standard Strength
HAY (HAYANGE)	Blank	Head Hardened
ILLINOIS	Blank	Standard Strength
INLAND	Blank	Standard Strength
ISG (INTERNATIONAL STEEL GROUP)	Blank	Standard Strength
ISG HH (INTL STEEL GROUP)	Blank	Head Hardened
KLOCKNER	Blank	Standard Strength
KRUPP	Blank	Standard Strength
MT (MITTAL USA)	Blank	Standard Strength
MT HH (MITTAL USA)	Blank or IS HH	Head Hardened
MMRA	Blank	Standard Strength
MMRA HH	Blank	Head Hardened
NIPPON	DH340	Head Hardened
NIPPON	DH370	Head Hardened
NIPPON	HE370	Head Hardened
NIPPON	HE400	Head Hardened
NIPPON	HEX	Head Hardened
NKK	NHH	Head Hardened
NKK	SP	Head Hardened
NKK HH	Blank	Head Hardened
PST (PENNSYLVANIA STEEL TECH)	Blank	Standard Strength
PST HH (PENNSYLVANIA STEEL TECH)	Blank	Head Hardened
RMSM	DH 390	Head Hardened
RMSM or ERMS	SS	Standard Strength
RMSM or ERMS	IS HH (IHHS)	Head Hardened
RMSM	HCP	Head Hardened
RMSM or ERMS	OCP	Head Hardened
RMSM or ERMS	Blank	Standard Strength
SDI (STEEL DYNAMICS INC.)	Blank	Standard Strength
TENNESSEE	Blank	Standard Strength
THYSSEN	HH	Head Hardened
THYSSEN	Blank	Standard Strength
TZ (CZECH)	SS	Standard Strength
W-P (WHEELING PITT)	MH	Standard Strength

Table 4-C

4.2.5 Rail Sections

Table 4-D lists some of the more common rail sections used in the construction of the railroads throughout their history. Though most of the sections are no longer used, the table can be used as a reference for rail identification and a guide for rail end drilling in repair situations.



Common Rail Section Information

Rail Weight (lbs/yd)	Rail Section Type	"H" Rail Height (inches)	"RB" Rail Base (inches)	"W" Head Width (inches)	Rail End Drilling "A-B-C" (inches)	"D" Hole Dia. (inches)	"AB" Above Base (inches)
75	40 (ASCE)	4 13/16	5	2 15/32	2 7/16 - 5 (UP)	1 1/8	2 15/128
					3 - 6 (WP)		
					2 1/2 - 4 (MP)		
					2 29/32 - 6 (MP, M&I)		
	CS	5	5	2 9/16	2 5/8 - 5 1/2 (UP)	1 1/8	2 1/4
					2 11/16 - 5 1/8 (WP & SP)	1 1/32	
85	40 (ACSE)	5 3/16	5 3/16	2 9/16	2 5/8 - 5 1/2 (UP)	1 1/8	2 17/64
					2 29/32 - 6 (CNW)		
					2 13/16 - 5 (WP)		
					2 15/16 - 6 (MP)	1	
	50	5 7/32	5 1/4	2 15/32	2 13/32 - 5 (MP)	1 1/8	2 21/128
90	RA (ARA-A)	5 5/8	5 1/8	2 9/16	2 5/8 - 5 1/2 (UP)	1 1/8	2 19/32
					2 13/32 - 5 (MP, WP)	1 1/16	
					2 11/16 - 5 1/2 (WP, SP)	1 1/32	
					2 29/32 - 6 (MP, CNW)	1 1/8	2 37/64
	CS	5 3/4	5 3/8	2 3/4	2 5/8 - 5 1/2	1 1/8	2 9/16
	RA Headfree	2 25/32	5 1/8	2 9/16	2 29/32 - 6	1 1/8	2 37/64
100	25 RE	6	5 3/8	2 11/16	2 5/8 - 5 1/2 (UP)	1 1/4	2 1/2
					2 11/16 - 5 1/2 (WP)		
	20 RA	6	5 1/2	2 3/4	2 13/32 - 5 (MP)	1 1/8	2 3/4
					2 1/2 - 6 1/2 (CNW)	1 3/16	
110	RE	6 1/4	5 1/2	2 25/32	2 11/16 - 5 1/2 (UP, SP)	1 1/4	2 5/8
					2 29/32 - 6 (MP)	1 1/8	
					2 23/32 - 5 1/2 (CNW)	1 1/4	2 13/16
	RE Headfree	6 7/16	5 1/2	2 11/16	2 29/32 - 6 (MP)	1 1/8	2 5/8
112	20 RE	6 5/8	5 1/2	2 23/32	2 1/2 - 6 1/2	1 3/16	2 7/8
					2 1/2 - 6 1/2 (SP)	1 1/4	
	RE Headfree	6 3/4	5 1/2	2 11/16	2 1/2 - 6 1/2 (MP)	1 1/8	2 7/8
113	Headfree	6 13/16	5 1/2	2 11/16	2 1/2 - 6 1/2 (SP)	1 1/4	2 7/8
115	25 RE	6 5/8	5 1/2	2 23/32	3 1/2 - 6 - 6	1 1/8	2 7/8
					2 1/2 - 6 1/2 - 6 1/2 (WP, SP)	1 1/4	
119	RE	6 13/16	5 1/2	2 21/32	3 1/2 - 6 - 6	1 1/8	2 7/8
					2 1/2 - 6 1/2 - 6 1/2 (WP, SP)	1 1/4	
130	PS	6 5/8	5 1/2	3	2 11/16 - 5 1/2 - 5 1/2 (SP)	1 1/4	2 3/4
	RE	6 3/4	6	2 15/16	2 11/16 - 5 1/2 (UP)	1 1/4	2 3/4
131	RE	7 1/8	6	3	2 1/2 - 6 1/2 - 6 1/2 (MP)	1 1/8	3 23/32
					2 15/16 - 6 1/2 - 6 1/2 (UP)		
	28 RE	7 1/8	6	3	2 23/32 - 6 - 7	1 1/8	3 1/4
132	25 RE	7 1/8	6	3	3 1/2 - 6 - 6 (MP)	1 1/8	3 3/32
					3 1/2 - 6 - 6 (UP)		
					2 15/16 - 6 - 6 (WP)		
	Headfree	7 5/16	6	2 31/32	2 1/2 - 6 1/2 - 6 1/2 (SP)	1 1/8	3 9/32
133	0 RE	7 1/16	6	3	3 1/2 - 6 - 6	1 1/8	3
136	0 RE	7 5/16	6	2 15/16	3 1/2 - 6 - 6	1 1/8	3 3/32
					2 15/16 - 6 - 6 (WP)		
	CF&I	7 5/16	6	2 15/16	2 1/2 - 6 1/2 - 6 1/2 (SP)	1 1/8	3 3/32
140	31 RE	7 5/16	6	3	6 - 3 - 2 23/32	1 1/8	3
141	AB	7 7/16	6	3 1/16	3 1/2 - 6 - 6	1 1/4	3 3/32

Table 4-D

4.3 Rail Relays and Wear Limits

Out-of-face rail and curve relay programs are based on accumulated gross tonnage, defect rates, and rail head wear.

4.3.1 Classification and Use of Secondhand Rail

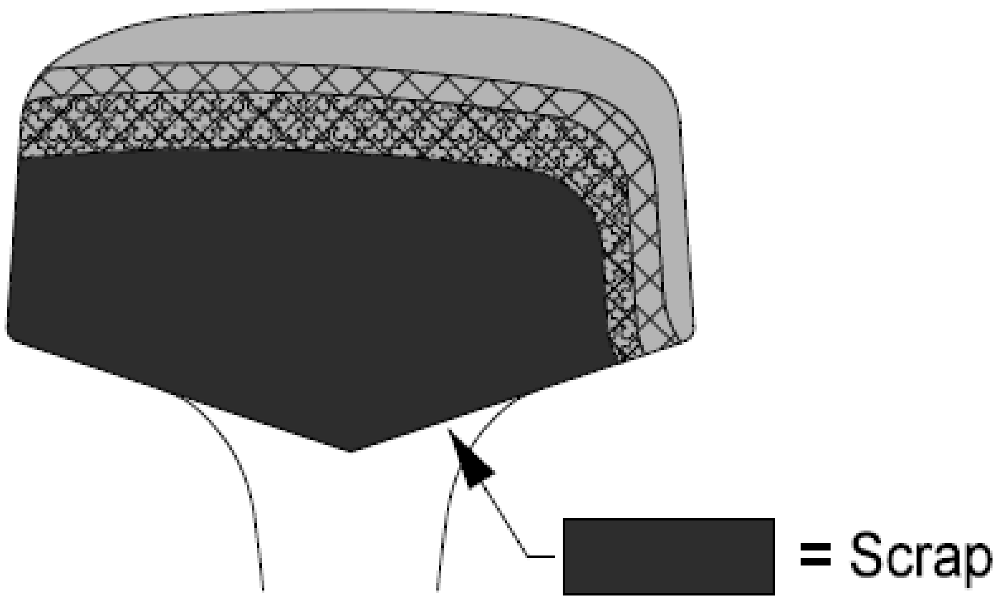
The specification and inspection parameters below detail the guidelines for the secondhand rail standards. These standards will be used to grade secondhand rail for recovery for re-use, or purchase from outside sources. The instructions outlined below are designed to provide consistent evaluation of secondhand rail throughout the system so that each rail is properly marked for its identity and use. Refer to Figure 4-C and Table 4-E.

Class 1-Principal use is for main line replacement rails, rail relays on lines carrying between 5 and 20 MGT per year and other areas requiring long term serviceable secondhand rail.

Class 2-Principal use is for secondary main line or siding replacement rails, rail relays of lines carrying less than 5 MGT per year, yard or industry tracks and other areas of low track speeds or demands on serviceable secondhand rail.

Class 3-Principal use is for yard or industry tracks and other areas of temporary service or low demands on quantity of secondhand rail.

4.0 RAIL & JOINTS



133 WEAR COMPARISON BETWEEN CLASS 1,2 AND 3

	Allowable Top Wear	Allowable Side Wear
CLASS 1	1/4"	1/8"
CLASS 2	3/8"	1/4"
CLASS 3	5/8"	3/8"

Figure 4-C

Class 1		
Rail Weight	**Max. Vert. Wear**	**Max. Hor. Wear**
141	5/16"	1/8"
133-136	1/4"	1/8"
131-132	3/16"	1/8"
119	5/32"	1/16"
112-115	1/8"	1/16"
Corrugation up to .010 allowed		
Class 2		
Rail Weight	**Max. Vert. Wear**	**Max. Hor. Wear**
141	7/16"	1/4"
133-136	3/8"	1/4"
131-132	1/4"	1/4"
119	1/4"	1/8"
112-115	3/16"	1/8"
Two dime sized engine burns per 39' corrugation up to .020 1/4" field size lip allowed		
Class 3		
Rail Weight	**Max. Vert. Wear**	**Max. Hor. Wear**
141	11/16"	3/8"
133-136	5/8"	3/8"
131-132	3/8"	3/8"
119	3/8"	5/16"
112-115	1/4"	5/16"
Three quarter sized engine burns per 39', corrugations and light spalling up to 0.030", pitting and oxidation up to 0.060" and 1/4" field side lip allowed.		

Table 4-E

A. Manufacturing Process Restrictions

A-rails and non-controlled cooled rails are to be used in yard, back or industry tracks only. These rails must be separated in inventory upon inspection and identification. Non controlled cooled rails (pre 1937) are not to be used in welded strings. If rail cannot be identified because of corrosion, rust scaling or otherwise, assume that the rail is an "A-rail" and inventory as such. Under current policy, no A-rails or non-controlled cooled rails can be purchased.

A-rail - Rails rolled from the top or "first rail" of the ingot casting process (past technology). This rail is identified with an "A" stamped on the heat number side between the heat and ingot/bloom numbers. This rail is prone to have the majority of defects in rails manufactured by the ingot process. A-rail is limited Class 3 Use.

The following rail chemistries must not be reinstalled on any track unless directed by the Chief Engineer:

"Algoma, British, Workington, Vilru, or Bethlehem FT" manufactured rails.

"Klockner, Thyssen, Krupp and CFI" chrome rails or any other manufactured chrome alloy rails.

B. Acceptable Lengths

The minimum acceptable length for secondhand rail classified at the weld plant is 25 feet. Minimum length for a plug rail is 15 feet.

C. Wear Measurement References

Vertical head measurement will be taken from the center of the rail's head (+/- 3/8") to its base plane (excluding base pitting). See Section 4.3.4 Curve Rail Wear Limits. Determine gage face wear loss by measuring the width of the railhead at a point 5/8" below the top surface of the railhead.

D. Weld Plant Classification Parameters

After cropping, no bolt holes can remain, no bond wires or bond pin holes are allowed within 18" from ends of the rails. Rail ends must be inspected for injurious pipe or segregation. No negative camber in the rails is allowed, a maximum of 3/4" uniform side sweep in 39 feet is permissible. Twisted rails (>0.060" on ends), or bent rails will be scrapped. Rail ends will be straight with a maximum 0.030" concave hook and no droop allowed, as measured with a 36" straightedge and taper gage.

E. Internal Defects

Rail subject to these specifications shall be free of known internal defects. All SH rails not generated by UPRR will be ultrasonically tested and free of any defects in excess of the following reflector set up criterion. Head - 1/16" flat bottom hole, Web - 3/32" flat bottom hole, Base - 1/16" deep by 1/4" long by 1/16" wide slot.

F. Drilled Stick Rail

When secondhand drilled rails are retained or purchased, the above requirements and parameters apply with the following additions. No extra bolt holes are allowed and end batter shall not exceed 1/16" on Class 1 rail or 1/8" on Classes 2 and 3 rails. Bolt holes shall be free of defects and fins and shall not be elongated in excess of 1/16". Bolt holes to be beveled per Standard Drawing No. 0745. To de-burr and bevel holes drilled in the field, use abrasive stone item number 411-3867.

G. Marking of Classified Rails

After cropping and classification, rails will be center marked to facilitate handling. Class number and weight of rail will be marked on top of the head on one end. In addition, A-rails and non-control-cooled rails will be marked with an A (i.e, #3 115RE A) and non-control-cooled rails marked NC. Marking will be done with high quality white paint or other approved method, with the objective of long term legibility. Drilled rails will have their pattern identified such as: #2 133RE 6H UP. This example is a Class 2 133RE rail drilled 3 holes both ends at 3 1/2 x 6 x 6 which is the UPRR standard bolt hole spacing.

H. Shipment Requirements of Stick Rail

All carloads of rail received at UPRR facilities, must be loaded per 'AAR Section 2, Rules Governing Loading of Steel Products Including Pipe on Open Top Cars' or per individual special agreements. Under no circumstances will rail be received loaded "loose fill", rail must be loaded on its base (head up) on spaced wood slats to prevent shifting, damage, etc.

4.3.2 Out-of-Face Rail Relays

For a list of guidelines of approved rail sections for out-of-face rail relay programs, refer to the Union Pacific Standard Rail Sections map. See Maps in the Engineering Bulletin Board on the Engineering Website.

Follow these requirements:

1. When second-hand rail is unavailable, a different rail size or kind may be substituted.
2. Under no circumstances will rail, with a roll date older than 1975, be installed in any main line application unless approved by a Chief Engineer.
3. During concrete tie renewals (TRT), replace existing rail when:
   - **The rail section is not 133 lb., 136 lb. or 141 lb. head hardened.**
   - **Vertical head loss is 3/8 inch or more.**
   - **Rail defect rate meets or exceeds replacement logic.**

4.3.3 Curve Rail Relays

Table 4-F lists guidelines for curve rail relay programs.

Curve Rail Relay Guidelines		
Territory	**New Intermediate Strength CWR**	**New Head Hardened CWR**
Concrete Tie Track	None	All curves
Wood Tie Track Over 50 MGT	None	All curves
Wood Tie Track 10 to 50 MGT	All curves up to and including 1 degree 30 minutes	All curves greater than 1 degree 30 minutes

Table 4-F

Follow these guidelines:

1. Consider relaying alloy rail curves prior to reaching established rail wear limits.
2. Consider laying short tangents between curves with the same rail type as the adjacent curve.
3. Take field measurements to determine the exact length of rail required for curve relays.
4. Mark the beginning and ending points of curve rail measurements on the tie plate or rail.

4.3.4 Curve Rail Wear Limits

Rail wears both horizontally and vertically as shown in Figure 4-D.

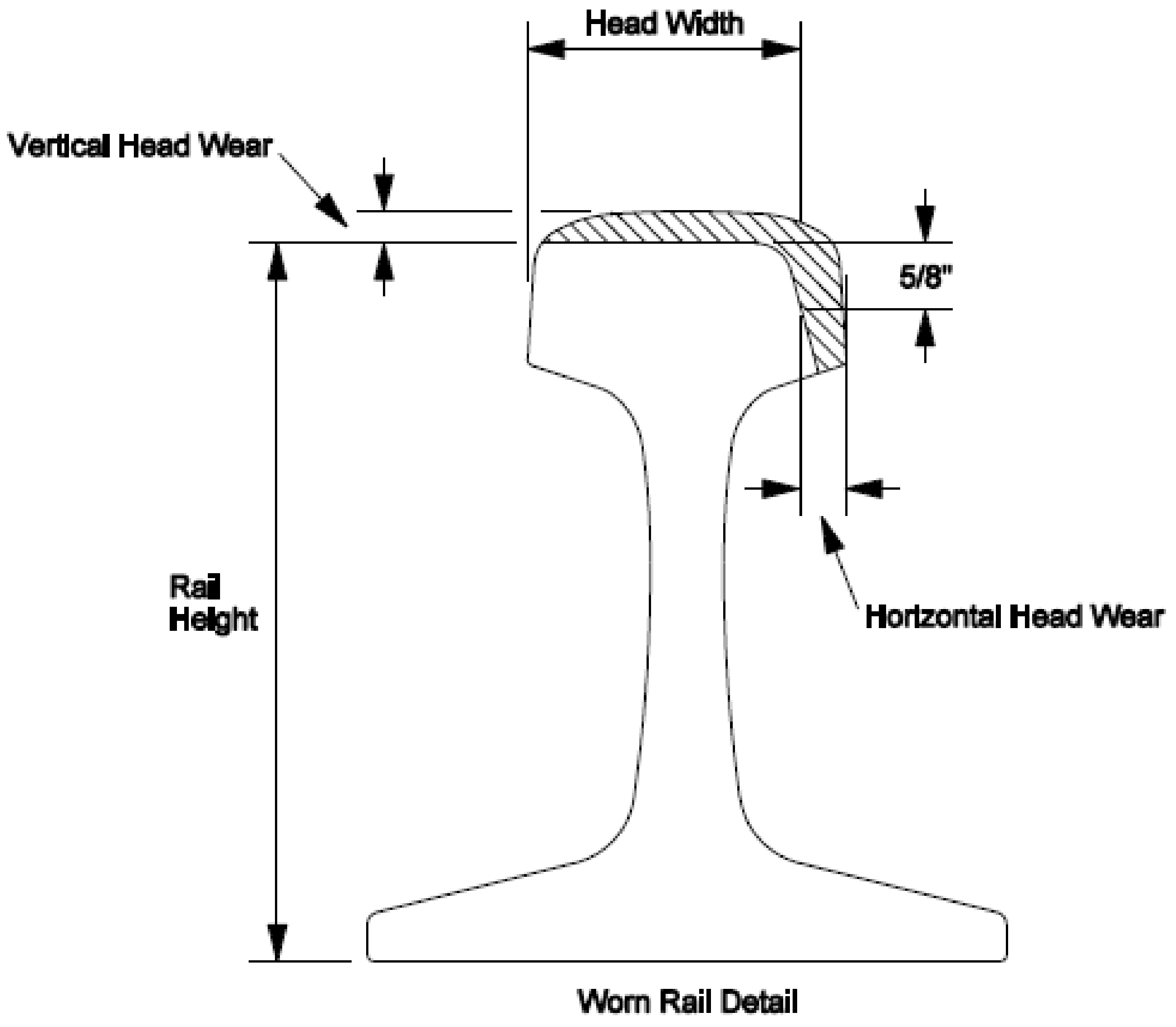


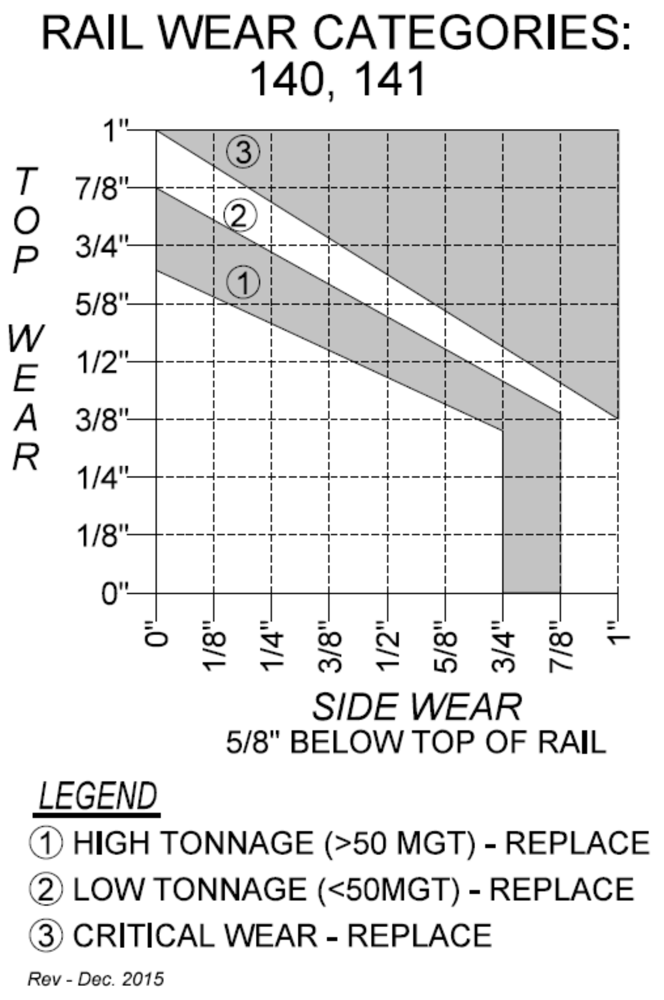
Figure 4-D

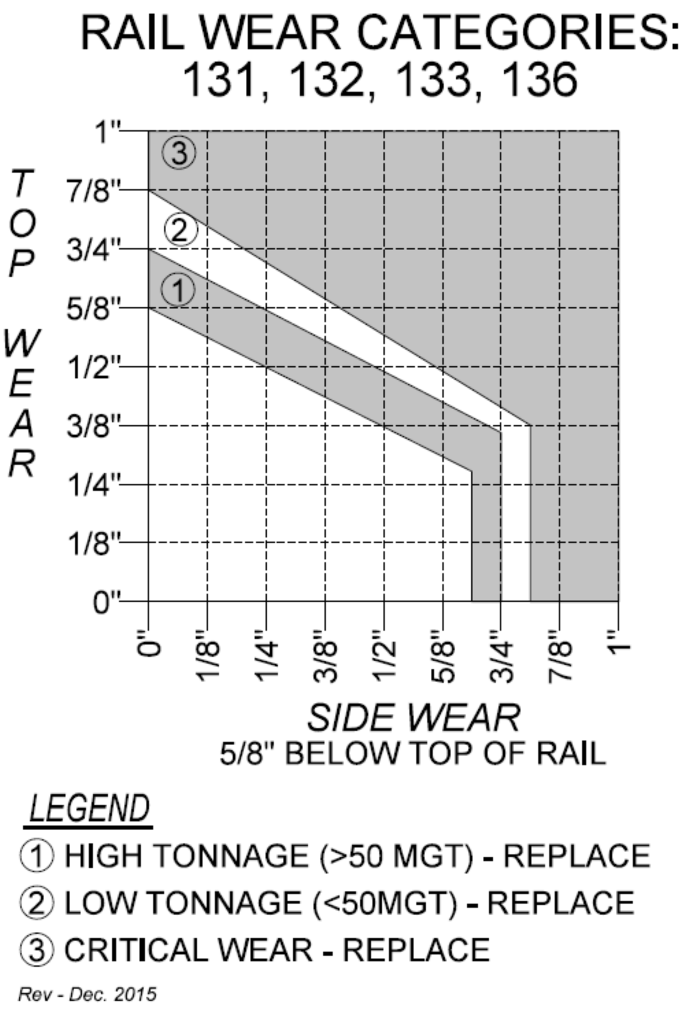
Follow these requirements to measure rail wear:

1. Measure head width at a point 5/8 inch below the top of the head.
2. Measure rail at regular intervals for excessive wear.
3. Take measurements at three locations in curves to avoid isolated readings.
4. For the standard rail measurement tool, order store stock item number 410-5462 for 5 ½ and 6 inch base rail.
5. Follow the guidelines for rail relays shown in the tables contained in Table 4-G.

NOTE: Curves having 5/8 inch Gage Face wear or greater will be considered for replacement on the following subdivisions: Ayer, Black Butte, Cascade, Canyon, Caliente, Huntington, La Grande, Moffat Tunnel, Mojave, Provo, Roseville, Spokane and Valley. This only applies to curves that are greater than 3 degrees of curvature.

Table 4-G





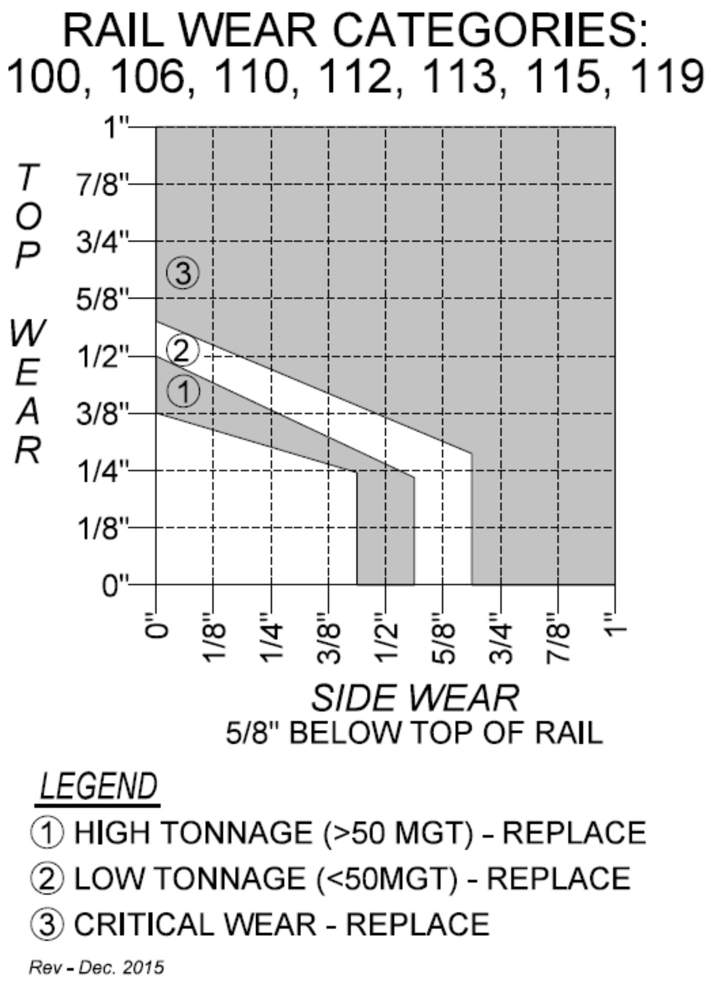
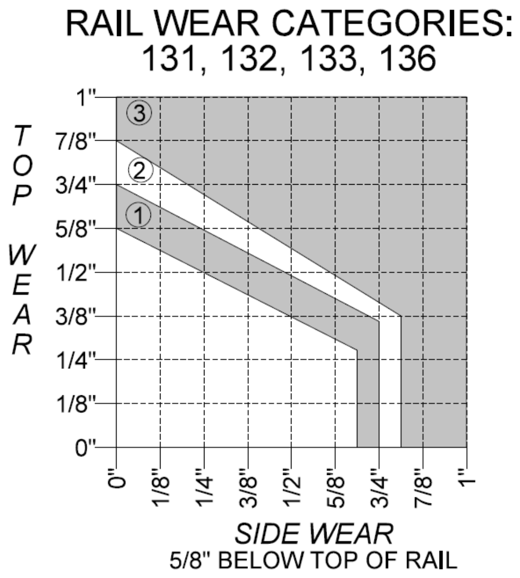


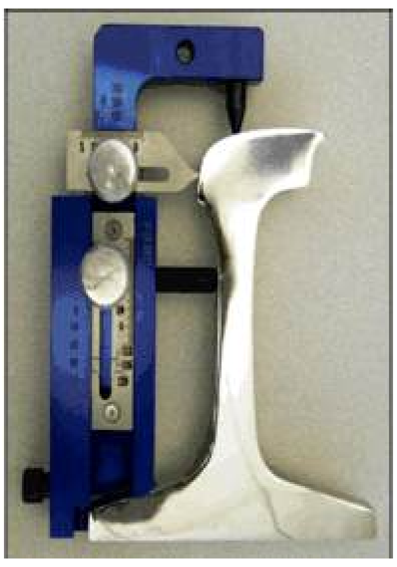
Table 4-G (cont.)

A. Critical Curve Wear (CCW)

Defect based upon established Level 3 Rail Wear Categories by rail weight. May be identified by Track Inspectors, Curve Raters, Evaluation Car, Rail Test Chiefs, and other Managers. Field personnel will provide Top and Side wear measurements for verification.

Critical Wear Defect: Limit Operating Speed over defect to 25 MPH until rail is replaced.





5. Do not transpose rail when:
   - **Head flow lip on the field side of the low rail is greater than 1/8 inch.**
   - **Shelling is evident.**
   - **The rail base is less than 6 inches.**
   - **Alloy rail is present.**

4.3.5 Curve Rating Process

The purposes of this document is to standardize procedures for measuring rail wear and help you understand the rail rating process for curve relay. The process is multilayered and requires input from Service Unit Managers, Track Inspectors and Foremen as well as Engineering, Central Function personnel and rail wear measuring capability.

To begin the process, there are two curve categories used in this system: Candidate and Non-Candidate Curves.

- Candidate curves are generated using UP's Evaluation Car rail wear data for curves which have not been recently relayed.
- The second is when a Service Unit requests inspection of curves which may not be on the candidate list due to wear, surface conditions etc. Curve rail is replaced due to rail wear or rail conditions which may adversely affect train ride, dynamics or track maintenance. Additional curve inspections are requested using the Curve Candidate Management Database. The database is located on the Employee website, Departments > Engineering > Capital Project Management > Proj Ident (tab) > Rail (sub-tab).
- When a curve meets or closely approaches rail change out criteria per rail wear category charts (tonnage and wear level), they should be candidates for the following year's inspection. Refer to 4.3.4, Curve Rail Wear Limits, Table 4-G. When not included in the candidate curve list, these curves should be included in the Service Unit requests.
- All candidate and non candidate curves will be inspected by a curve rater and all measurements must be entered into the Curve Inspection System.
- A service unit employee who is familiar with the territory and curve relay program must escort the curve rater to ensure the overall quality of the curve rating process including a working and calibrated JAMAR or measuring device. If one is not available the curve rater will not inspect candidate curves.

<u>Field Inspection Process</u>

When your position requires you to inspect rail wear on curves, the following procedures are used to rate curves for annual rail relay projects.

- The Design Curve Report is available in: TMP > Reports > Other Reports Section > Design Curve Report
- The Candidate Curve Report is available in: Capital Project Portal > Proj Ident Tab > Rail (sub tab) > Candidate Curve Report. Use this report for reviewing and measuring the upcoming curve relay project.
- All curves should be inspected and measured on a regular basis for excessive wear.
  1. Using ascending mile poles as your direction, a minimum of three locations must be inspected in each curve. The beginning, middle (full body) and the leaving end.
     - Measurements must be at average wear locations for both rails.
     - Mark each location on the rail, between tie cribs.
     - Paint adjacent tie plates with "Optic Green" paint to enable consistent subsequent measurements.
  2. Locate and record rail section / rail weight and branding to enable correct measurements. Refer to 4.2.1, Rail Branding
  3. Measure rail wear, both vertical and gauge face, using a standard Winchester Wear Gauge, UPRR Item # 410-54620.
     - A full video with instructions about the curve rail inspection process and how to utilize this wear gauge is available on the UP website. From the Employee site go to: Departments > Engineering > Capital Project Portal > Proj Ident (tab), Then select "Rail" near the center. In the section labeled Service Unit Curve Unit Management select the Curve Inspection Video resolution of your choice.
  4. Measure field curve length from Point of Tangent to Point of Tangent with a calibrated JAMAR or measuring device.
- Inspection and measurements are documented using the Curve Inspection Field form at the same website.
- Measurements are plotted and rated using rail wear category charts in section 4.3.4, Curve Rail Wear Limits, using Table 4-G **or** using Excel, Curve Wear Charts located at the above website.
- In addition to wear measurements, look for poor surface conditions such as wheel burns, rail head defects, Shelling, Sliver, Corrugation (SSC), Flattened Rail (FR), Crushed Head (CH) or a large number of joints or welds which may indicate previous rail problems / change outs.
- For Non-Candidate curves (Service Unit) all measurements must be entered into the Curve Candidate Management Database prior to the curve raters arrival.

4.3.6 Derailment Relays

Follow these requirements:

1. After installing track panels at derailments in CWR territory, arrange to remove the jointed rail as soon as possible.
2. In wood tie track, when more than five track panels are laid with square joints, limit the maximum allowable speed over the track to 40 MPH until the joints are staggered.
3. In concrete tie track, when more than five track panels are laid with square joints, limit the maximum allowable speed over the track to 25 MPH until joints are staggered and then 40 MPH until CWR is re-laid.
4. Field managers must notify Engineering Planning of derailment locations requiring CWR lengths of 720 linear feet or more.

4.4 Rail Handling and Placement

4.4.1 Rail Handling

When lifting rail:

1. Center mark rail before lifting to balance the load.
2. Use approved rail tongs or grapple buckets when handling rail 60 feet or less.
3. Use a spreader bar when handling rail more than 60 feet.

4.4.2 Rail Train Operations

Employees shall be trained on the safe and proper procedures for loading and unloading of rail trains. This training can be accomplished by either viewing a video (E-248-02) or reviewing written instructions. These instructions can be found on the intranet at: http://home.www.uprr.com/emp/engineering/bus_area_sys_gangs.cfm

4.4.3 Rail Placement

When unloading rail trains and placing rail in field locations for installation, follow these requirements:

1. Place rail as close as possible to the site where it will be installed.
2. Place rail where it will not contact other rail in the track.
3. When possible, place rail at the toe of ballast no closer than 6’ from the center line of the track. Any rail placed on ties shall be secured by restraining the rail from movement. For example, spikes may be used to restrain the rail from movement. In addition, a tie plate or equivalent is needed at the rail end to create a ramp preventing any dragging equipment from picking the rail. Rest the plate upside down on an angle to the rail end and spike it to the nearest tie. If rail is not properly secured, place a 25 MPH slow order on the track. Under no circumstances shall rail be left in the “area of no obstruction” as seen in Figure 4-E-1.
4. After removing unloading straps, mismatch rail ends by placing wooden blocks or other suitable material between the rail ends.
5. Point rail ends on all rail strings away from the track toward the field.
6. Securely fasten and support rail across bridges.
7. Cut only when necessary during rail train CWR unloading operations.
8. Bury rail below the road surface when unloaded through grade crossings.
9. Place rail in ditches cut by shoulder plow.
10. Place rail out of the way in walking areas such as yards and other switch locations.
11. Have the train dispatcher issue Form C, “Bad Footing Order,” if necessary.

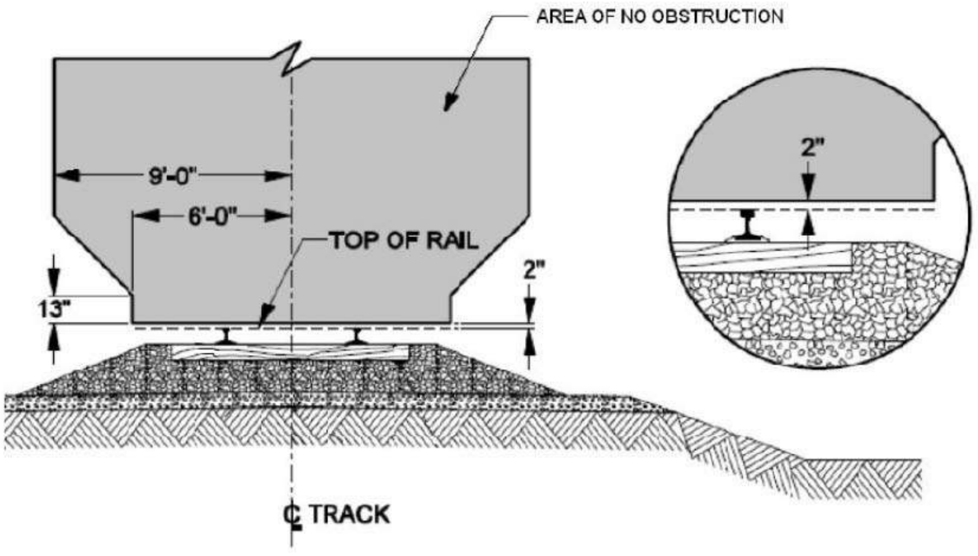


Figure 4-E-1

4.4.4 Rail Placement for Loading

When loading rail trains and placing rail for pick-up, follow these requirements:

1. Place rail where it will not contact other rail in the track.
2. Place rail a minimum of 6’ from the center line of the track when possible.
3. Any rail placed on ties shall be secured by restraining the rail from movement. For example, spikes may be used to restrain the rail from movement. If rail is not properly secured, place a 25 MPH slow order on the track. Under no circumstances shall rail be left in the “area of no obstruction” as seen in Figure 4-E-2.
4. Mismatch rail ends by placing wooden blocks or other suitable material between the rail ends.
5. Point one end of pick-up rail strings away from track toward the field.
6. Place rail out of the way in walking areas such as yards and other switch locations.

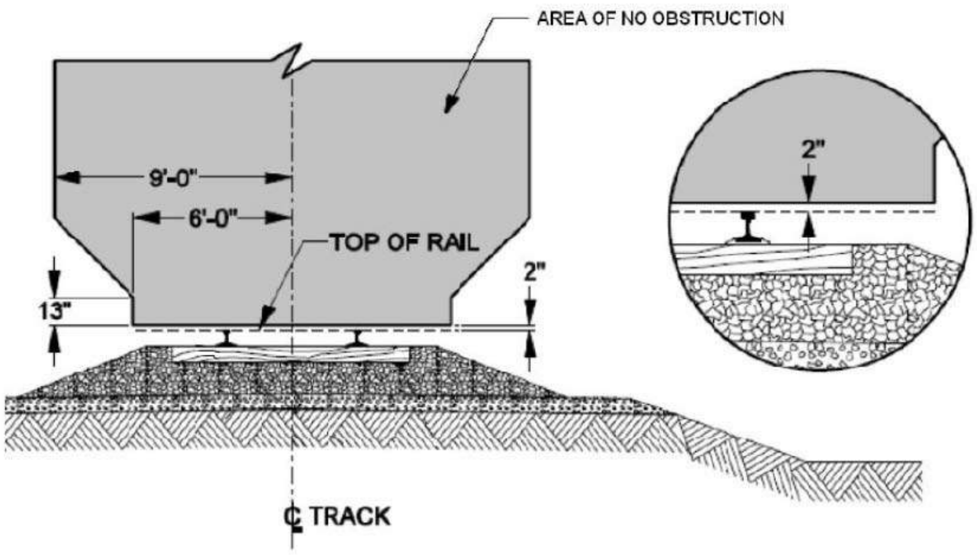


Figure 4-E-2

4.5 CWR Rail Laying Temperatures

Rail length that exceeds 400 feet is considered CWR. Rail installed as CWR remains CWR, regardless of whether a joint or plug is installed into the rail at a later time.

Temperature variations significantly affect rail length. Rail expands (lengthens) when heated and contracts (shortens) when cooled.

A. Neutral Temperature

The neutral temperature is the temperature at which a rail is neither in tension nor compression.

Designated rail laying temperatures have been established to provide a **high** neutral temperature to prevent track buckling. Lay or adjust CWR to the designated rail laying temperatures shown in Table 7-J. These temperatures have been adjusted for geographic location.

B. Temperature Differential

The **difference** between the **designated** rail laying temperature and the actual rail temperature taken at the time of installation is called the temperature differential. CWR laying and adjusting procedures have been established to correct this temperature difference.

Use this formula to calculate the length of unrestrained rail movement due to changes in temperature:

Rail Movement (inches) =
Rail Length (inches) × Temperature Differential (degrees F) × 0.0000067

4.5.1 Laying CWR

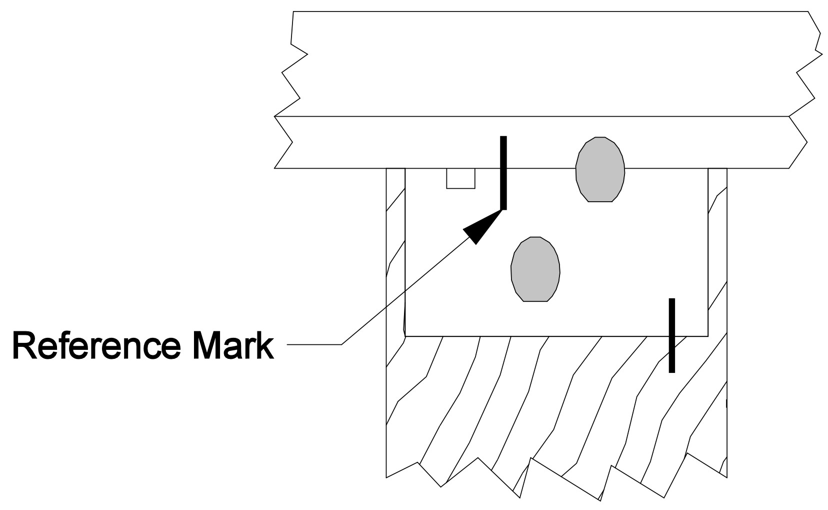
Follow these general requirements when laying CWR:

- **Refer to the current Table 7-J for the neutral rail laying temperature requirements in your area. (Chapter 7 contains rail laying temperatures for each subdivision).**
- **Follow all rail installation and documentation guidelines.**
- **Record the rail temperature and the expansion required before making adjustments.**
- **Record the rail laying temperature and expansion on approved forms. (Go to the Engineering Website at: Engineering> Track Programs> System Gangs> Rail Gangs> Engineering Heat Control Record> Add New Date> Add New Entry).**
- **Rail adjustment is not required when the actual rail temperature exceeds the designated rail laying temperature.**
- **Rail heaters, rail expanders or in-track welders may be used to adjust the rail to the correct length.**
- **If rail is laid at a temperature more than 40° F below the designated rail laying temperature, rail must be adjusted or a speed restriction of 40 mph must be placed prior to rail temperature above designated rail laying temperature.**

A. Monitor Rail Movement

When laying CWR, monitor rail movement as follows:

1. Make reference marks (Figure 4-F) on the rail, plate and tie that is to be left in track before rail is cut. Prior to heating of new rail, ensure that the reference mark on the existing rail is where it was before the cut. If pull back is encountered, heat rail 200 feet prior to original reference mark bringing the mark back to original location. Adjust anchors accordingly. This procedure is also required at tie-in location. Place marks at tie-in location before disturbing rail within 720 feet.



Reference Marks Prior To Cutting Rail

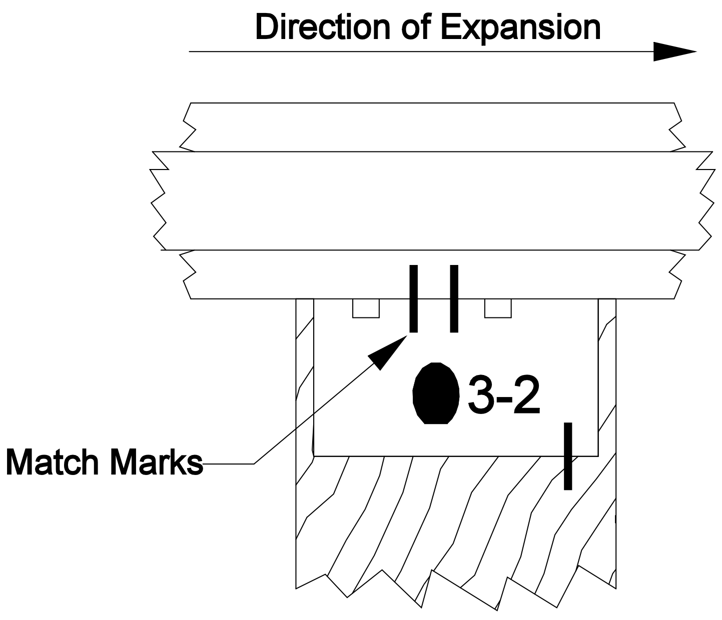
Figure 4-F

2. Determine the rail expansion (movement) required at each heat station using Table 4-H.

Continuous Welded Rail Adjustment Table								
Temperature Differential (°F)	**Amount of Adjustment Required (Inches) for a Length of CWR**							
	Station 1		**Station 2**	**Station 3**		**Station 4**		**Station 5**
	360 feet	**660 feet**	**720 feet**	**1,080 feet**	**1,320 feet**	**1,440 feet**	**1,520 feet**	**1,600 feet**
5	1/4	1/4	1/4	1/2	1/2	1/2	1/2	3/4
10	1/4	1/2	1/2	3/4	1	1	1-1/4	1-1/4
15	1/2	3/4	3/4	1-1/4	1-1/2	1-3/4	1-3/4	2
20	1/2	1	1-1/4	1-3/4	2	2-1/4	2-1/2	2-1/2
25	3/4	1-1/4	1-1/2	2-1/4	2-1/2	2-3/4	3	3-1/4
30	3/4	1-1/2	1-3/4	2-1/2	3	3-1/2	3-3/4	4
35	1	1-3/4	2	3	3-3/4	4	4-1/4	4-1/2
40	1-1/4	2	2-1/4	3-1/2	4-1/4	4-1/2	5	5-1/4
45	1-1/4	2-1/4	2-1/2	3-3/4	4-3/4	5	5-1/2	5-3/4
50	1-1/2	2-1/2	2-3/4	4-1/4	5-1/4	5-3/4	6-1/4	6-1/2
55	1-3/4	2-3/4	3-1/4	4-3/4	5-3/4	6-1/4	6-3/4	7
60	1-3/4	3	3-1/2	5	6-1/4	6-3/4	7-1/4	7-3/4
65	1-3/4	3-1/4	3-3/4	5-1/2	6-3/4	7-1/4	8	8-1/2
70	2	3-3/4	4	6	7-1/4	8	8-1/2	9

Table 4-H

3. Establish heat stations every 360 feet.
4. At first heat station of each string use a white metal marker to write the gang number, date and air temperature on the gage side of the rail web. Do not use soapstone, chalk or crayon.
5. At each subsequent heat station and before heating the rail, record the rail temperature and expansion required on the gage side web of the rail.
6. Continue numbering heat stations consecutively until a tie-in is made.
7. Establish match marks to identify rail movement at each heat station as follows (Figure 4-G-1).
   - On a spiked gage tie plate extend a mark from the plate onto the tie to verify that the plate does not move.
   - Extend match marks from the base of the rail onto the tie plate to monitor rail movement.
   - On the gage side of the same plate, record the string number and the heat station number.



Match Marks Prior To Expansion

Figure 4-G-1

8. Ensure the required rail movement is attained at each heat station. See Figure 4-G-2.
9. On concrete ties, a single reference mark on the base of the rail and edge of the tie is sufficient.

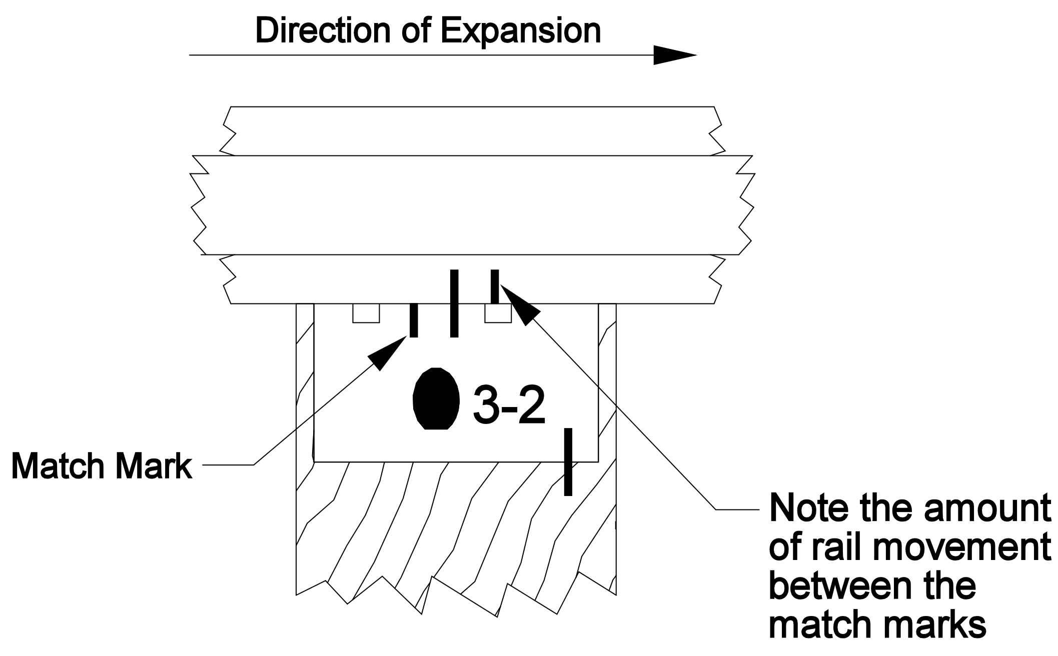


Figure 4-G-2

B. Heat Rail

Follow these requirements when heating rail:

1. Start the rail heater at the beginning of the string, behind the gage spiker, and uniformly heat the rail while moving the rail heater toward the first match mark. Use the minimum amount of heat required in order to avoid overheating the rail.
2. Position rail crucibles to concentrate heat on the web of the rail.
3. Maintain propane pressure between 10 and 12 psi.
4. Do **not** heat across open deck bridges.
5. While heating, vibrate rail to encourage movement through the tie plates.
6. Tap tie plates with a spike maul or sledge to free rail movement. Do **not** strike the rail.
7. If the required rail expansion is not accomplished during the first pass with the rail heater, make additional passes.
8. When using heat and rail vibration to expand the rail, do not thread more than 2 strings of CWR into the tie plates ahead of the rail heater.
9. Do not leave gaps between strings of CWR unless the joint will be immediately field welded.
10. On concrete tie track, care must be taken to avoid excessive heat damage to the plastic fastening components.

C. Rail Anchoring

Follow these requirements when heating rail:

1. Examine the first match mark to determine if the rail is being expanded by the necessary amount. If it is, begin anchoring behind the rail heater. If rail anchoring does not keep up with the rail heater, wait until after the rail heater passes the first match mark and anchor several ties beyond the match mark to preserve the expansion that has been achieved.

D. VERSE Testing For Track Construction

Contractors are required to lay Continuously Welded Rail (CWR) to the designated rail laying temperature for the Subdivision they are building track. Contractors should be familiar with UPRR CWR policy prior to performing destressing operations and should have a copy of the policy available. Contractors must ensure that rail is installed as close as possible to the designated Rail Neutral Temperature (RNT).

1. There is a slight variance in the accuracy of Verse testing of approx +/- 5 degrees. An acceptable range for a VERSE test is from – 10 degrees to + 15 degrees from the designated rail laying temperature.
   - Example: rail laying temperature for a subdivision is 100 degrees F. If the rail laying temperature did not fall into this threshold of $\geq$ 90 degrees F $\leq$ 115 degrees F, it must be readjusted.
2. VERSE testing cannot be conducted when the rail is in compression. If the newly laid rail is above RNT in which it was installed at the test must not be conducted until it falls below this temperature. In addition the rail must be unsecured 54’ on both sides of the testing location per the VERSE testing guidelines.
3. Final VERSE testing results will be logged on the VERSE testing form and will be logged into the UPRR VERSE system. The form and logging system can be found by visiting the Track Maintenance Planner – Track Assessment – VERSE. Results can be logged by a UPRR Manager or Supervisor.
4. VERSE testing is not required on tracks that will not be designated as Mainline or Siding, however VERSE testing may be conducted in other locations at the discretion of the designated UPRR Engineering Representative.

The frequency and location of VERSE testing is critical to ensure potential problems are identified. The recommended frequency of VERSE testing is as follows:

1. In tangent track RNT must be measured every 1/4 mile.
2. Both rails must be measured at every location as differentiations can cause high stresses.
3. VERSE testing can only be used for tangent track and curves that are less than 2

degrees. Due to the difficult nature of testing in curved track, curves should only be tested if the contractor has failed to pass multiple VERSE tests and the curves are questionable. The designated UPRR Engineering representative will make the decision on testing in curves. All curves shall be closely inspected for signs of rail movement visually prior to placing into service.

4. A VERSE measurement cannot be taken closer than 150 ft. from any switch, open deck bridge, road crossing or other fixed structure as the fixed nature may skew the results. This does not include the 54 ft. of unsecured rail which can be within the 150 ft. range.
5. At a minimum, VERSE testing shall be taken at each switch location. Test shall be done a recommended 150 ft. behind the point of frog. It is recommended that the test be done behind the frog to avoid potential problems with allowing switch points to move during the testing process.
   - In areas where multiple switches exist (such as universal crossovers), perform testing on each track no closer than 150 ft. from one of the outside switches of the crossover.
6. If a bridge or bridges are located within the 1/4 mile area for the VERSE test, the test should be performed at the bridge end no closer than 150 ft. of one of the bridge ends. Designated UPRR Engineering representative will provide recommendation for bridges > 1/4 mile. If any open deck bridges are located within the project limits testing must be done 150 ft. from both ends of the bridge.
7. VERSE measurements cannot be taken if there are any bolted joints, expansion joints or differential rail sections within 150 ft. of the test as they will skew the results.
8. If any road crossings are within the 1/4 mile area for the VERSE test an attempt should be made to satisfy the testing requirement nearby to a crossing.
9. Once a track is placed into service the CWR policy takes precedent. Placing into service indicates running revenue service trains on the track, not MOW material or equipment trains.
10. Any deviation or change from this policy must be approved by the UPRR designated Engineering representative.

4.5.2 CWR String Indication

When laying new CWR strings heat control engineer is responsible for the proper documentation of exact location where each end of string is installed in track. Follow procedures as outlined on the Engineering Website (http://home.www.uprr.com/emp/engineering/bus_area_sys_rail_gangs.cfm).

Figure 4-H shows how the end of each string is to be marked by welding plant. One end of the string will be marked A and the other B.

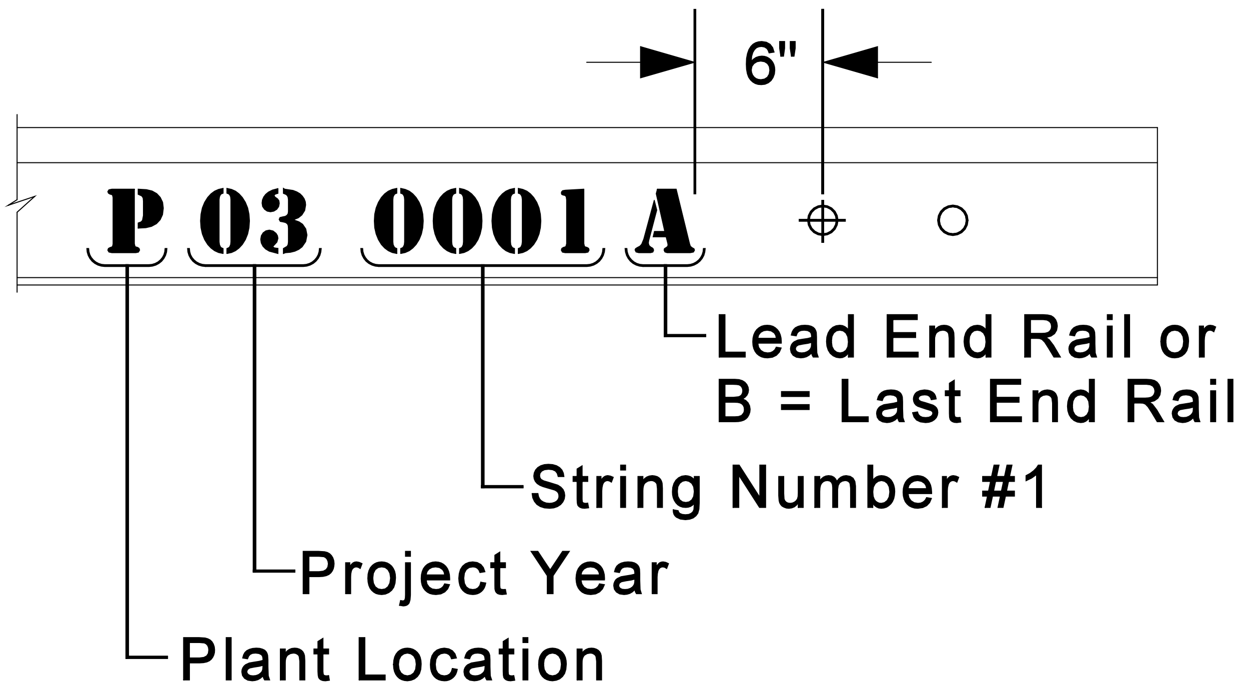


Figure 4-H

4.5.3 Laying CWR to Proper Neutral Temperature – New Construction

Do not apply heat to the rail during new construction until the track is fully ballasted, surfaced and lined.
Follow these requirements to neutralize rail temperature in the CWR during new construction:

1. Determine the ambient temperature.
2. Determine the designated rail laying temperature. SEE Standard Drawing 0045.
3. Use Table 4-H to determine amount of rail movement required to adjust rail to its neutral temperature.
4. Remove joint bars.
5. Remove the amount of rail as prescribed in table 4-H.
6. Remove rail clips or anchors for at least 550 ties (275 each way from the joint).

NOTE: In wood tie track, rail will be pulled through the spikes.

7. Stretch or heat the rail for the required distance.
8. Re-clip or re-anchor the ties.
9. Weld the joint.
10. Using a permanent paint stick, mark the date, air temperature, gang number, and amount of rail adjustment on the web of the rail.
11. Tamp ties that have been moved or disturbed.
12. Restore the ballast section with a ballast regulator.

4.5.4 Installing Maintenance CWR

It may be required to install rail on an emergency or maintenance basis because it is in need of replacement or when panel rail is being removed from a derailment location.
Follow these procedures when installing the rail.

1. Apply applicable reference marks on rail that will be cut. (Refer to Section 7.9.2 Placing Reference Marks)
2. Remove the rail to be replaced.
3. Install the new rail.
4. Based on the length of the rail being installed, refer to Section 7.9.1 Managing CWR Events to determine which method to use to manage the rail neutral temperature. Depending on the rail temperature at the time of rail installation additional adjustments may not be required.
5. Ensure standard anchor pattern is installed per Section 4.17 Rail Anchors for anchor requirements.

4.5.5 Installation of Track Panels

The term track panel includes turnouts, road crossings, rail crossings and any other installation of track panels.

NOTE: This section is not applicable to track panels installed because of derailments, refer to Section 4.5.6 - Installation and Adjustment of Track Panels at Derailments

Follow these guidelines when installing track panels:

1. If rail is in compression during warm weather the rail will expand. If rail is in tension during cold weather the rail will contract. To minimize rail movement in cold weather adjust or add any missing rail anchors in wood or concrete track at both ends of track panel zone.
2. Mark rail cut locations.
3. Apply applicable reference marks on each rail that will be cut. Refer to Section 7.9.2 Placing Reference Marks.
4. Remove existing track panel(s).
5. Install new track panel(s).
6. Determine the total length of the track panel(s) being installed. Refer to Section 7.9.1 Managing CWR Events to determine which method to use to manage the rail neutral temperature. Depending on the rail temperature at the time of repair additional rail adjustments may not be required.
7. Ensure standard anchor pattern is installed per Section 4.17 Rail Anchors for anchor requirements.

4.5.6 Installation and Adjustment of Track Panels at Derailments

The installation of track panels at a derailment requires additional steps compared to normal track panel installation due to the fact that reference marks cannot be established. The installation of track panels at a derailment requires additional attention pertaining to installation, temporary destressing and final rail relay.

Follow these requirements for the installation and adjustment of track panels at derailments:

1. When installing multiple track panels be aware of the joint gap between the rail ends, the effectiveness of rail anchors to resist longitudinal rail movement, ambient temperature during panel installation, the correct speed restriction for the condition and the risk of adding rail.

   Follow these requirements:

   a. Place hardwood shims to provide the correct gap when installing track panels as per the Section 4.5.7 Laying Bolted Rail.
   b. If rail is in compression during warm weather the rail will expand. If rail is in tension during cold weather the rail will contract. To minimize rail movement in cold weather adjust or add any missing rail anchors in wood or concrete track at both ends of track panel zone.
   c. Record the rail temperature on the web of the rail at the time of panel installation at each end of the panel zone.
2. After panels have been installed follow these requirements:
   a. In wood tie track, when more than five track panels are laid with square joints, limit the maximum allowable speed over the track to 40 MPH until the joints are staggered.
   b. In concrete tie track, when more than five track panels are laid with square joints, limit the maximum allowable speed over the track to 25 MPH until joints are staggered and then 40 MPH until CWR is relayed.
   c. When installing track panels at derailments in CWR territory, arrange to remove the jointed rail as soon as possible.
   d. Field managers must notify Engineering Planning of derailment locations requiring CWR lengths of 720 linear feet or more.

e. Rail neutral temperature adjustment may be required prior to CWR placement. Use the rail temperature that was recorded at the time of the derailment as the neutral temperature for the panelized section. Refer to section 7.9.5 Maintaining Desired Rail Neutral Temperature Range to determine if slow order is required. When an adjustment is going to be made to panels refer to section 7.9.6 Rail Neutral Temperature Readjustment to determine the amount of rail to remove.

3. At the time of CWR rail relay utilize the following process:
   a. If rail is in compression during warm weather the rail will expand. If rail is in tension during cold weather the rail will contract. To minimize rail movement in cold weather adjust or add any missing rail anchors in wood or concrete track at both ends of track panel zone.
   b. Mark rail cut locations.
   c. Apply applicable reference marks on each rail that will be cut. (Refer to Section 7.9.2 Placing Reference Marks)
   d. Remove existing jointed rail.
   e. Install new CWR rail.
   f. Determine the total length of rail being installed. Refer to Section 7.9.1 Managing CWR Events to determine which method to use to manage the rail neutral temperature. Depending on the rail temperature at the time of rail relay additional rail adjustments may not be required.
   g. Ensure standard anchor pattern is installed per Section 4.16 Rail Anchors for anchor requirements.

4.5.7 Laying Bolted Rail

Follow these requirements when laying bolted rail:

1. Do not install rails less than 15 feet.
2. Do not use rail that has been cut with a torch or that has holes that have been made with a torch.
3. When sawing rail for re-use, make the cut at least 2 inches from any torch mark on the rail.
4. Use hardwood shims to provide the correct gap at each joint to allow for rail expansion. Use Table 4-I-1 and Table 4-I-2 to determine the correct shim thickness.

39-Foot Rail Lengths	
Rail Temperature	**Opening**
Below 25° F	1/4 inch
25°-50° F	3/8 inch every other joint
51°-75° F	1/8 inch
Above 75° F	1/8 inch every other joint

Table 4-I-1

78-Foot Rail Lengths	
Rail Temperature	**Opening**
Below 50° F	3/8 inch
51°-75° F	1/4 inch
76°-100° F	1/8 inch
Above 100° F	1/8 inch every other joint

Table 4-I-2

5. Apply rail anchors immediately after laying rail. Do not leave track unanchored overnight.
6. After spiking the joint and tightening the bolts, remove the shims.
7. After installing the rail, surface and line the track as soon as possible to avoid damaging the new rail at old joint locations.

4.6 Inside Guard Rails

Refer to Engineering Standard Drawing Nos. 4000 to 4016 to determine which structures require inside guard rails. Refer to Engineering Standard Drawing Nos. 4019 to 4090 to determine turnout guard rail use. These drawings also show construction details.

Follow these guidelines for keeping inside guard rails fully plated, bolted and spiked:

1. On tangent track, spike the inside guard rail with two spikes per plate on each rail on the tangent portion, and four spikes per plate on each rail on the curved portion.
2. On curved track, spike the entire inside guard rail with four rail spikes per plate on each rail.
3. Do not install joints in the curved portion of the inside guard rail except where an insulated joint is required in signalized territory.

4.7 Track Bolts

Bolts secure rails in frogs and joints to minimize rail movement and maintain rail-end alignment. Bolts of proper diameter and length accommodate rail movement and minimize stress in the bolt holes of rail ends.

NOTE: Keep bolts tight in all applications. Use proper length and diameter bolt.

4.7.1 Track Bolt Sizes

Determine the proper bolt and washer size for a specific rail section from Standard Drawing No. 0950.

4.7.2 Track Bolt Installation

Follow these requirements when installing track bolts:

1. Replace track bolts that are missing, bent, cracked, or worn more than 1/8 inch in diameter, or that cannot be tightened to compress the washer.
2. Install bolts in joints through all holes drilled in rail ends.
3. Replace bolts in jointed rail as follows:
   - **Use only one washer per bolt.**
   - **Tighten the nut until the lock washer is compressed.**
   - **Avoid over-tightening bolts.**
   - **Tighten all of the bolts in a joint.**
4. Replace bolts in CWR as follows:
   - **Use only one washer per bolt.**
   - **Tighten nut to refusal.**
   - **Tighten all bolts in a joint.**
5. Tighten bolts in rail joints alternately and equally with a hand-operated or power-operated wrench as shown in Figure 4-I-1 and Figure 4-I-2.

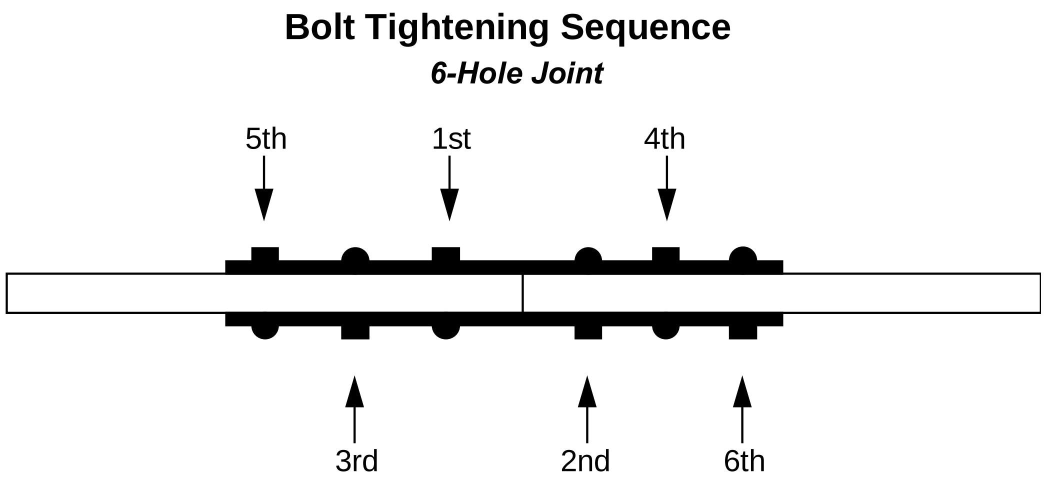


Figure 4-I-1

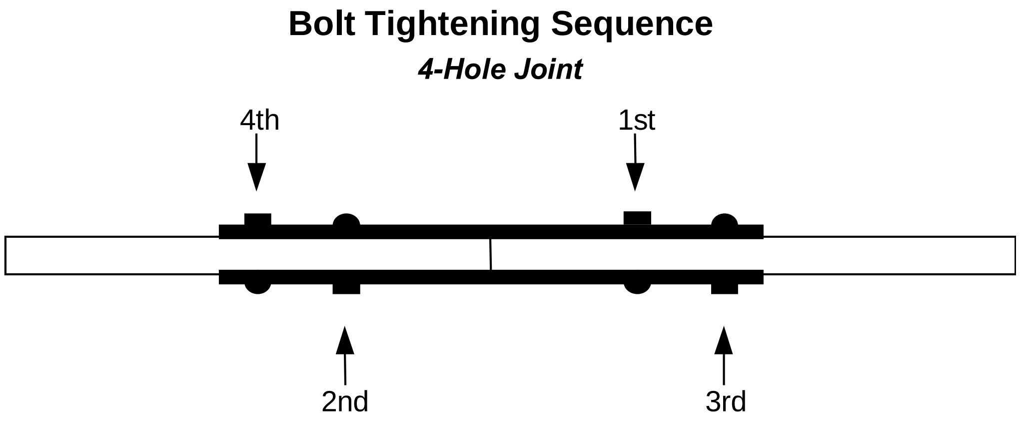


Figure 4-1-2

4.8 Joint Bars

Joint bars join two rail ends of the same size. Follow these requirements:

1. Connect rails with joint bars of the proper design and dimension for the rail section.

NOTE: Markings on the side of joint bars indicate their rail section design.

2. Visually inspect all joint bars for cracks or damage before use. **Cracks may be visible at top or bottom where the bar contacts rail head or base.**
3. Joint bars found to be defective shall be marked with Safety Red enamel paint, scrapped and must not be reused.
4. Never reconfigure joint bars by grinding, welding or torch cutting.
5. Use a high relief joint bar on the gage side of joint when rail is worn to an extent that the flange of the wheel would make contact with a standard joint bar.
6. When drilling rail ends, do not drill through joint bars.
7. Apply the standards for joint bars to compromise bars and insulated joints unless otherwise noted.
8. Use insulated joint bars only where necessary to isolate track circuits.
9. Field weld straps are **not** joint bars. Use them only in conjunction with a field welded joint as outlined in Section 4.14 Reinforcing Weld Straps.

4.8.1 Installation of Joint Bars

When tightening bolts in joint bars, use a sledgehammer to:

- Tap along the bottom flange of non-skirted joint bars to seat the bar against the rail.
- Tap along the base of base-supported (skirted) joint bars to seat the bar against the rail to obtain full-base bearing.

4.9 Compromise Joint Bars

Compromise joint bars align the tread and gage lines of adjoining rails of different sizes. Follow these requirements:

1. Connect rails with compromise bars of the proper design and dimension for the rail sections joined.

NOTE: Compromise joint bars are marked with the weight of the rail on each side.

2. Due to various amounts of wear on the rail head, adjoining rails may require build up or grinding. Refer to Section 4.10.7 Rail Mismatch.
3. Never reconfigure compromise joint bars by grinding, welding or torch cutting.
4. Avoid installing compromise joints that join rails with different size rail bases at these locations:
   - **Within the limits of curves.**
   - **On open-deck bridges.**
   - **In turnouts on switch ties.**

4.9.1 Offset ("Handed") Joints

Offset or "handed" compromise joint bars join and align the tread and gage area of rails of different rail base size. The joint bars are offset to align the gage area of the rails in the joint. Offset joint bars are manufactured in sets identified as right hand and left hand.

Identify the right or left hand of the compromise joint bars as follows:

1. Stand with your back to the larger size rail and face the smaller size rail. The joint on your left-hand side would be designated as the left-hand (LH) joint and the joint on your right side would be the right-hand (RH) joint.
2. Use Figure 4-J-1 to identify and install offset or "handed" compromise joint bars.

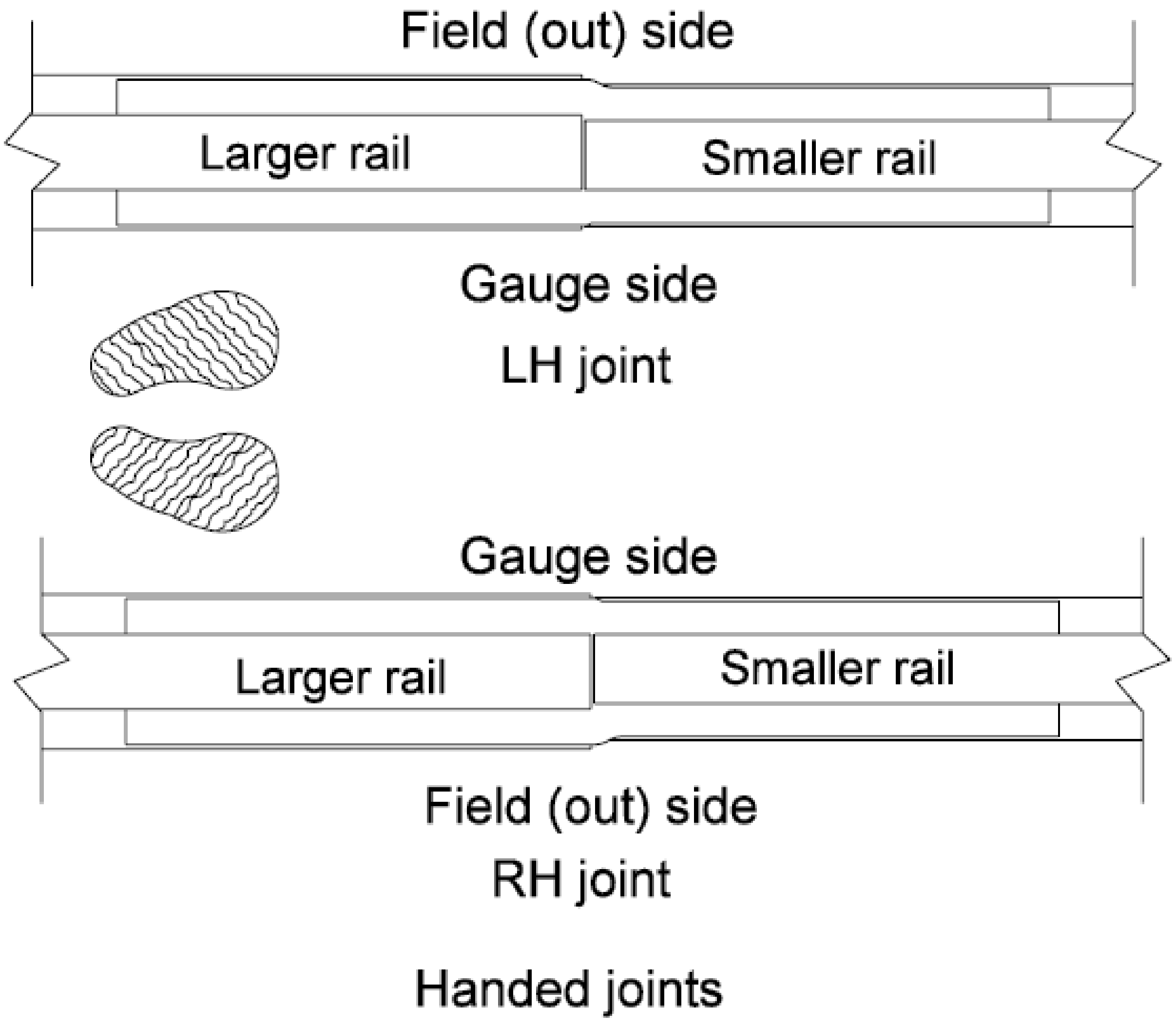


Figure 4-J-1

4.9.2 Step ("Non-Handed") Joint Bars

Step or "non-handed" joint bars align the tread area of rails with the same rail base size. Apply step joint bars when the difference in the width of rails does not exceed 1/8 inch at gage lines.

1. Bars are identified as A and B. Together they make up a joint set that fit either side of the rail.
2. Depending on which rail the joint bars are to be applied, the individual bars will be placed on either the gage side or field side of the rail. See Figure 4-J-2.

4.0 RAIL & JOINTS

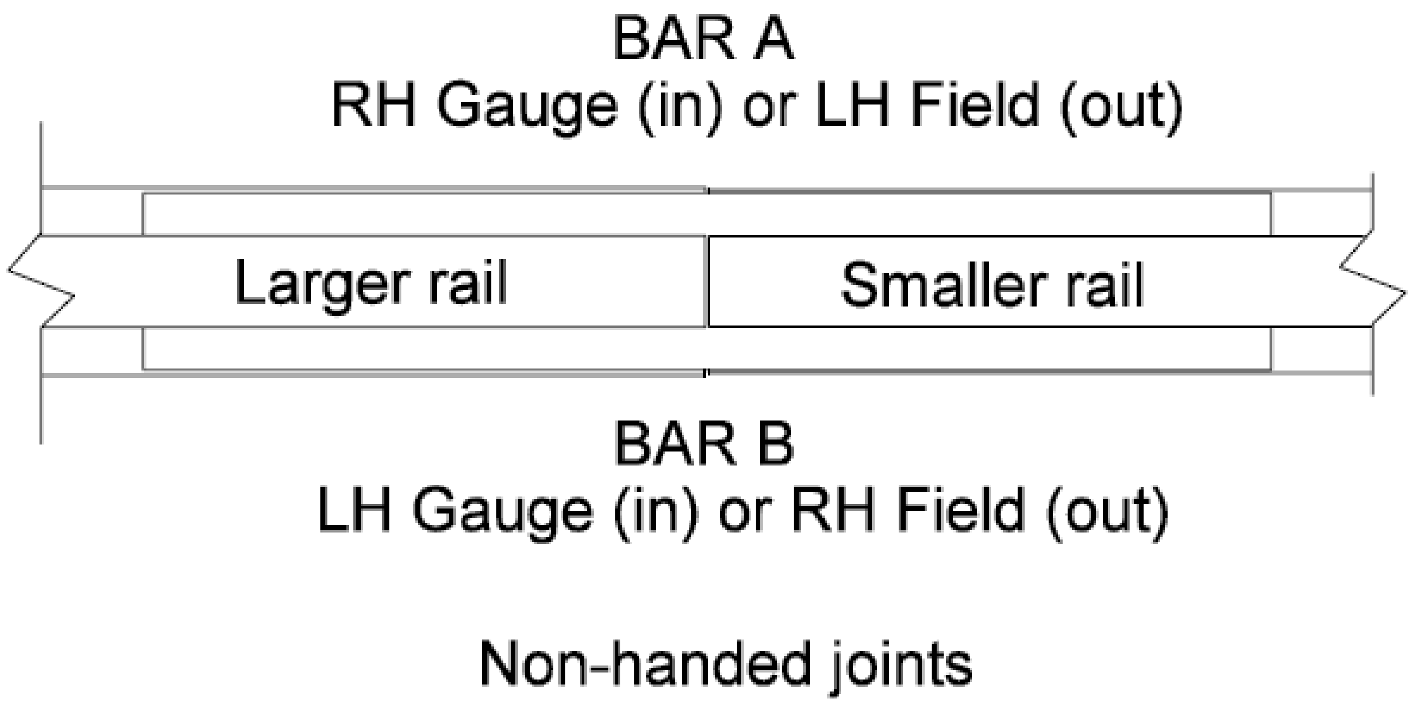


Figure 4-J-2

4.9.3 Compromise/Transition Rails

Compromise and Transition Rails are manufactured rails that are used to connect rails of different heights and or different rail sections.

In compromise rails, if a defect is found within 30 inches in either direction of the forged area, the entire rail must be replaced.

Available Compromise/Transition Rails				
New Rail Section	Worn Rail Section	Vertical Wear	Total Length	Item Number
115	90	3/8"	25' LH	552-2219
115	90	3/8"	25' RH	552-2220
133	115	1/8"	20' LH	552-3820
133	115	1/8"	20' RH	552-3821
115	136	3/8"	24' LH	552-4385
115	136	3/8"	24' RH	552-4386
136	115	0"	24' LH	552-4387
136	115	0"	24' RH	552-4388
136	115	1/8"	24' LH	552-4389
136	115	1/8"	24' RH	552-4390
136	133	7/8"	37.5'	552-4393
136	136	7/8"	40'	552-4395
141	133	7/8"	37.5'	552-4400
141	132	11/16”	40’	552-4405
N/A	136 to 115	7/8” and 3/8”	37.5’	552-4407

Table 4-I-3

Follow these instructions when installing Compromise/Transition Rails:

A. 141/133# Compromise/Transition Rails

Compromise transition rails shall be used whenever joining 141# rail to 133# rail. See Figure 4-K. Compromise joint bars are available for temporary installations but must never be used for permanent installations.

a. Measure the height of the rail to remain in the track.
b. Look at the transition rail drawing and determine where the height of rail exists in the tapered area that matches the height of the rail to be left in the track.
c. Locate where the forged area of the rail will be in the track. (Transition area must not be on top of ties).
d. Locate all cuts in tie cribs to facilitate welding.
e. Cut tapered end of rail at the location determined to match height of existing rail in track. (Forged area must not be on top of ties).
f. Make remaining cuts in track and install transition rail.
g. Weld all rail joints.

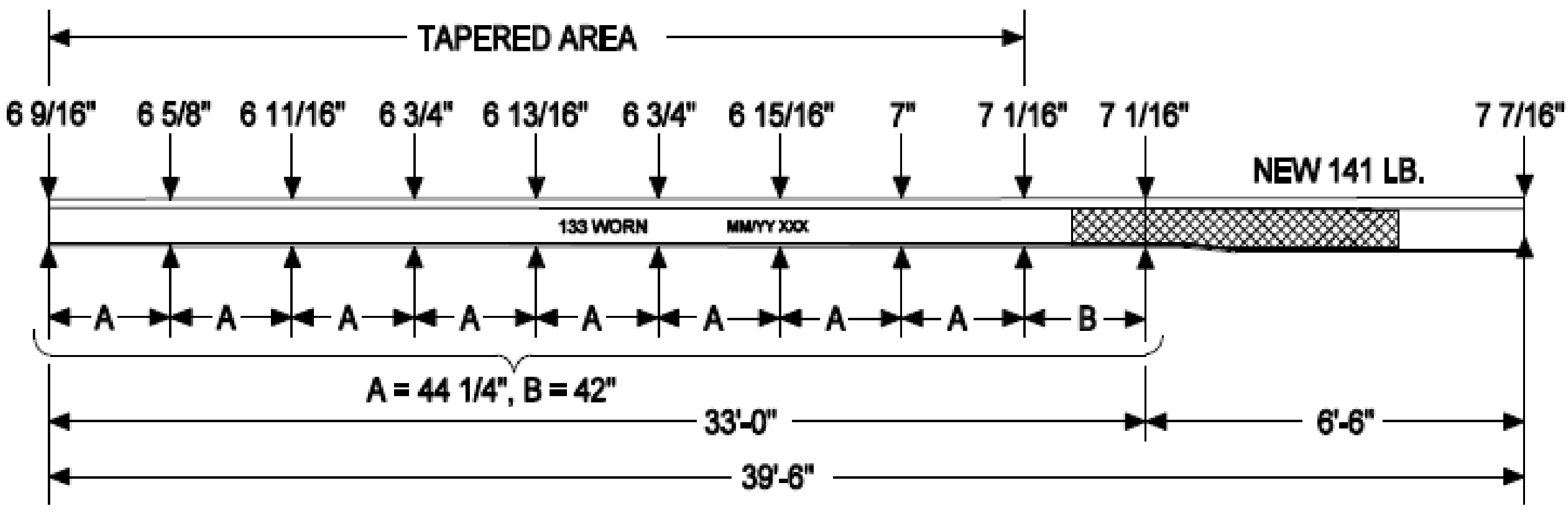


Figure 4-K

B. 136# to 115# Compromise/Transition Rails:

In all main line applications when joining 136# rail to 115# or 119# rail, use the 136/115# compromise/transition rail. See Figure 4-L. Compromise joint bars are available for temporary installation, but must never be used for permanent installations.

a. Measure the height of the rail to remain in the track.

b. Look at the transition rail drawing and determine where the height of rail exists in the tapered area that matches the height of the rail to remain in the track.

c. Locate where the forged area of the rail will be in the track. (Transition area must not be on top of ties).

d. Locate all cuts in tie cribs to facilitate welding.

e. Cut tapered end of rail at the location determined to match height of existing rail in track. (Forged area must not be on top of ties).

f. Make remaining cuts in track and install transition rail.

g. Weld all rail joints.

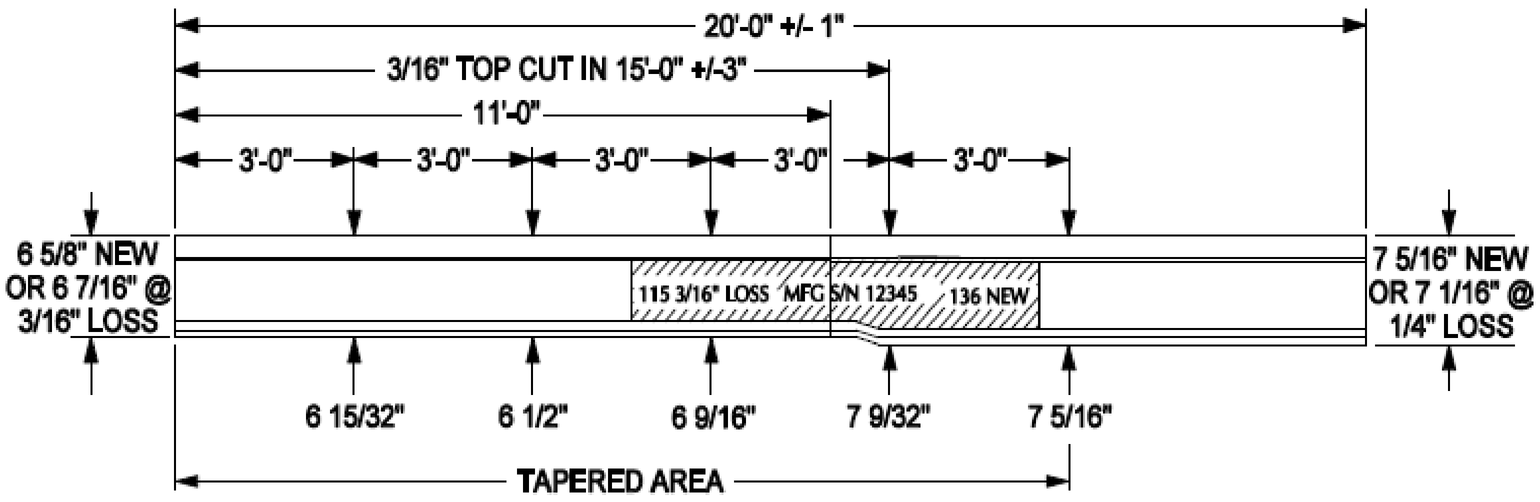


Figure 4-L

4.9.4 141# to 136# Transition Rails

Transition rails must be used whenever joining 141# rail to 136# rail if the rail height difference is more than 1/4 inch. See Figure 4-M. If the rail height difference is between 1/8 and 1/4 inch a 141# new/worn thermite weld may be used. If height difference is 1/8 inch or less a standard 141# thermite weld may be used.

Follow these instructions when installing 141# to 136# transition rails:

a. Measure the height of the rail to remain in the track.

b. Look at the transition rail drawing and determine where the height of rail exists in the tapered area that matches the height of the rail to remain in the track.

c. Cut transition rail at the location determined to match height of existing rail in track.

d. Make remaining cuts in track and install transition rail.

e. Weld all rail joints.

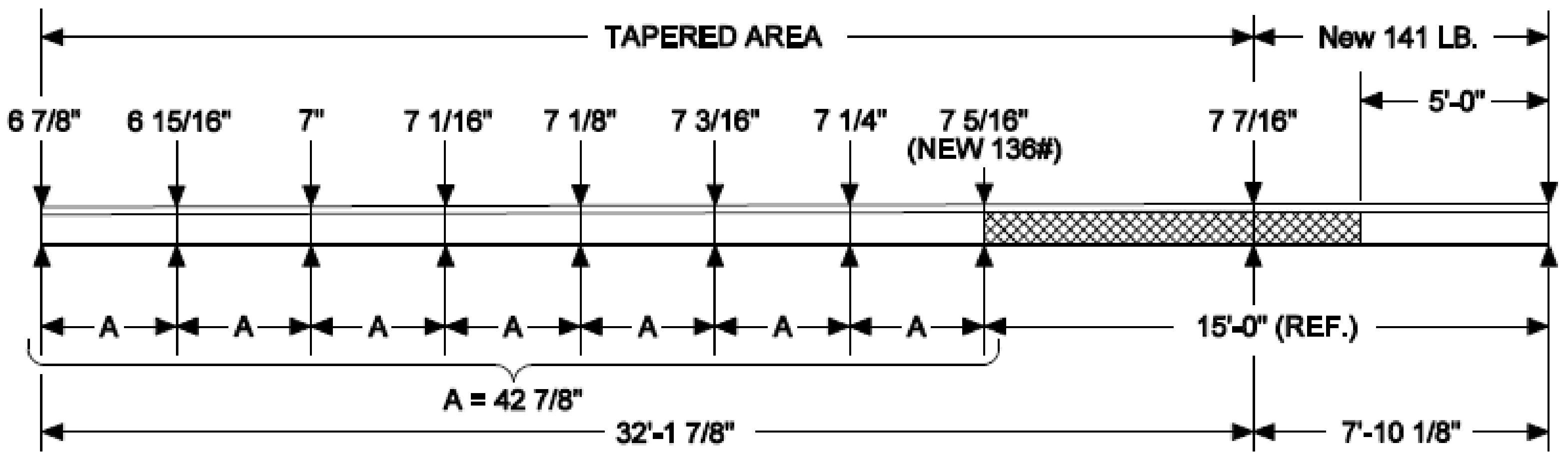


Figure 4-M

4.10 Rail Joints

The rail joint consists of the rail area and Other Track Material (OTM) within the entire length of the joint bars.

> **NOTE: If rail has been torch cut, remove with rail saw, 2 or more inches of rail before installing rail to make a joint.**

4.10.1 Permanent Joints

Permanent joints are joints that are not intended to have the rail ends welded together.

Permanent joints include:

- **Insulated joints.**
- **Joints in bolted rail territory.**
- **Joints in CWR that will remain in track (examples are: Joints in turnouts and crossing frogs).**

Permanent joints must be:

- **Fully drilled.**
- **Fully bolted.**
- **Bolt holes and rail ends to be beveled and slotted per Standard Drawing**

No. 0745. To de-burr and bevel holes drilled in the field, use abrasive stone item number 411-3867.

- **Fully box anchored per Section 4.16 Rail Anchors in CWR territory.**

4.10.2 Joint Placement and Support

To enable joint removal in CWR with thermite field welds, do the following:

1. Except in an emergency to pass trains over a broken rail, joints must not be located within:
   - **30 inches from an existing plant or in-track weld or 15 feet from an existing rail joint or field weld on subdivisions with greater than or equal to 75 MGT or as specified by the Chief Engineer. Refer to the Track Maintenance Planner home page with the tab named "15' weld rule" for the subdivisions over 75 MGT or identified by the Chief Engineer.**

   NOTE: The only exception to this 15' weld rule is in special track work around or near turnouts and rail crossings (diamonds) where because of geometry layout or component spacing, the 15' is not obtainable.

   - **30 inches from an existing rail joint or weld of any type on subdivisions with less than 75 MGT or not specified by the Chief Engineer.**

   NOTE: In order to prevent weld clusters or a multitude of field welds installed closely together, no more than four field welds are allowed in a 39' section of rail.

   NOTE: When installing replacement rail, effort must be made to eliminate thermite welds.

2. Center joints between ties to enable field welds to be made without moving or adzing tie. Field welds must not be located directly over a tie. Refer to Section 4.13 Field Welding (Thermite).

Joints must be properly supported by the correct tie arrangement. Reference Section 3.1.9 Joint Tie Support for minimum requirements.

4.10.3 Rail Joint Stagger

Follow these requirements for staggering rail joints:

1. The standard stagger between consecutive rail joints on opposite rails is 12 feet, plus or minus 2 feet.
2. Staggered rail joints are preferred but not required on industry leads and yard tracks where the speed does not exceed 25 MPH and the curvature is less than 4 degrees.
3. When trying to figure the stagger of rail around a curve use this rule of thumb: For every 80 feet of rail laid, the low rail will become 1 ½ inches longer for every one degree of curvature.

4.10.4 Joint Counting Definitions

Count only those joints in CWR that can be eliminated by either welding or laying rail. (**Do not include joints in jointed rail territory).** Do not count the joints that cannot be eliminated (non-extended length frogs and insulated joints primarily), even though we will inspect them as part of our joint inspection process.

<u>Do not put a joint into more than 1 category</u> - even though it may fit the description of more than one category. For example, a joint on concrete that falls within 500' of a bridge should only be counted as a bridge joint – not a mainline concrete joint.

To eliminate double counting of joints, please use the following hierarchy to determine the proper category for each joint:

1. **Mainline Bridge –** Any joint that is on or within 500 feet of a bridge should be counted as a bridge joint, regardless of whether it is in a switch, on concrete ties, etc. (only exception are heel block joints, that is a separate category)
2. **Mainline Concrete –** Any joint that is on concrete ties, except bridge joints (#1), should be counted as a concrete joint.
3. **Turnout Joint(s) –** Any weldable joint, other than frog joints, in the **<u>Turnout Side</u>** of any mainline switch associated with a Main Track Junction, Mainline Connection (any powered turnout connecting track that connects to any mainline tracks), Mainline Siding or Mainline Crossover. See Figure 4-N-1. **(NOTE: Don't count turnout side on Industry, Yard, Setout, or other none mainline tracks). (Turnout Joints that are within 500 feet of a bridge should be included in the Bridge Joint Category).**
4. **Mainline –** All joints that are not included in #1 through #3 above should be counted as mainline joints. Including joints in a mainline side running rail of a switch and Dead Insulated joints.
5. **Jointed Heel Block -** Mainline side of switch and also the turnout side of a Main Track Junction, Mainline Connection (any powered turnout connecting track that connects to any mainline tracks), Mainline Siding or Mainline Crossover. The Heel Block Joint is in a category of its own. **(Remember heel blocks can be eliminated by use of an extended point).**

6. **Dead Insulated Joint(s)** – Any insulated joint to be removed (“bond-arounds”). Do not include active joints in this count.

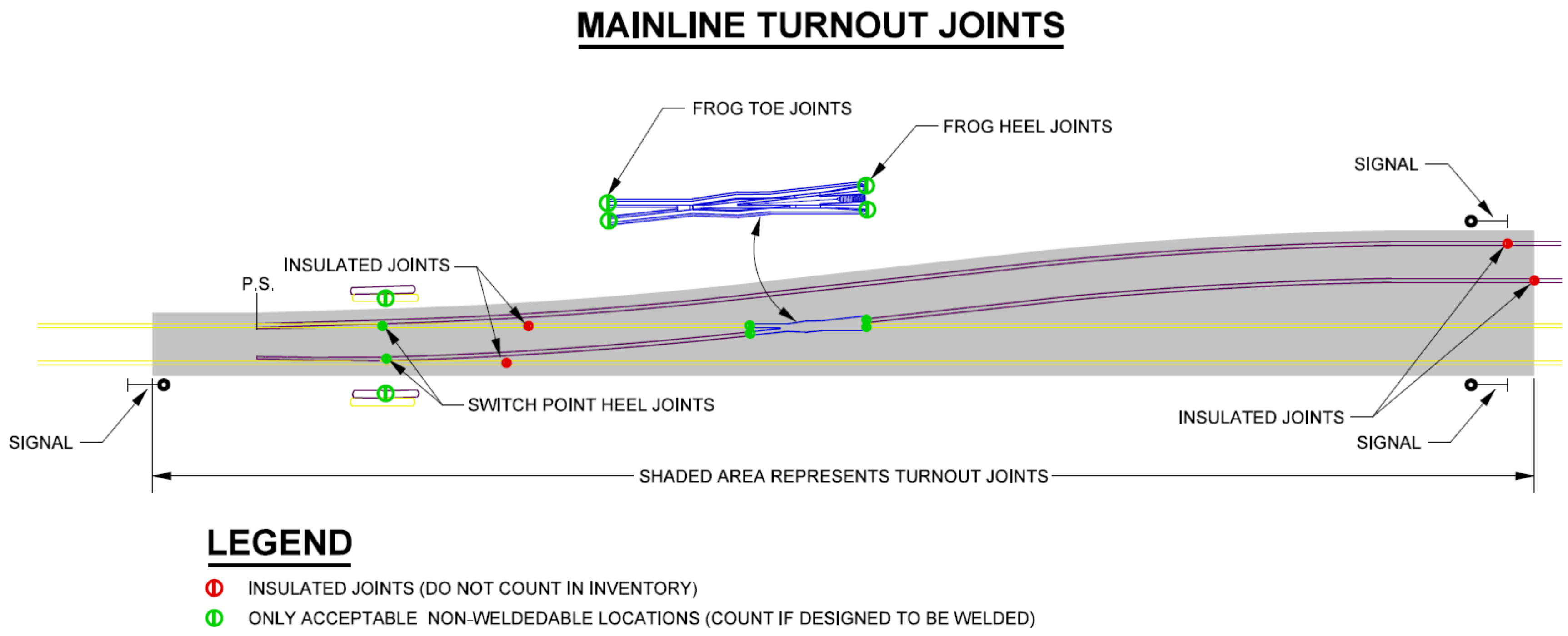


Figure 4-N-1

4.10.5 Pull-Aparts

Pull-aparts or “stripped joints” result from insufficient, missing, or defective bolts, insufficient rail anchors, or both. Follow these requirements for pull-aparts:

1. If a pull-apart is 4 inches or less and the rail ends are not damaged, close the pull-apart by using a hydraulic rail expander or by applying heat.
2. If unable to close rail ends using heat or hydraulic rail expander, or a pull-apart is more than 4 inches, or rail end damage is apparent, install a rail that is 15 feet or longer using reference marks and record the rail adjustment. Refer to Section 7.9.2 Placing Reference Marks.
3. When repairing pull-aparts, visually inspect each joint bar, install all new bolts and adjust rail anchors tightly against the ties per CWR adjustment requirements.
4. In CWR territory, four hole joints that pull-apart more than once must be fully drilled, bolted and anchored or field welded within 30 days.
5. Six hole joints that pull-apart more than once should have a rail cut in and joints welded. When repairs are made to a stripped joint or failed joint bar, the adjustment or addition of anchors will be as prescribed in Table 4-J-1.

Condition	Action
Bolted joint in CWR experiencing service failure (stripped joint) or failed bar(s) with gap* present *Gap exists if it cannot be closed by drift pin	1. Weld joint, **OR** 2. Remediate joint conditions (per Section 4.9 Rail Joints), replace bolts (new, in-kind or stronger), **and** weld joint within 30 days, **OR** 3. Replace failed bar(s), install 2 additional bolts **and** adjust anchors, **OR** 4. Replace failed bars, bolts (if broken or missing) **and** anchor every tie for 195’ in both directions, **OR** 5. Add rail.

Table 4-J-1

4.10.6 Rail Drilling

When drilling rail:

1. Refer to Standard Drawings 0700 to 0735 for drilling requirements.

NOTE: Do not install rail in the main track that has extra drilled holes. However, you may leave rail with bolt holes in the track when removing joint bars and field welding.

2. Remove joint bars from rail when drilling bolt holes. Do not drill holes through joint bars.
3. Use the correct indexing bar and drill fillet template for the rail section.
4. When using the index bar for setting the hole spacing, set the end of the bar flush with the rail end, as shown in Figure 4-N-2. Do not “split” joint gap.
5. Fully drill each rail end for the joint bar that will be applied. If the joint will be field welded, drill only the two outermost holes.
6. In CWR territory, drill the two outermost holes on each rail end only when the joint will be field welded within 90 days. Fully drill the joint if temperature conditions are likely to produce a pull-apart.

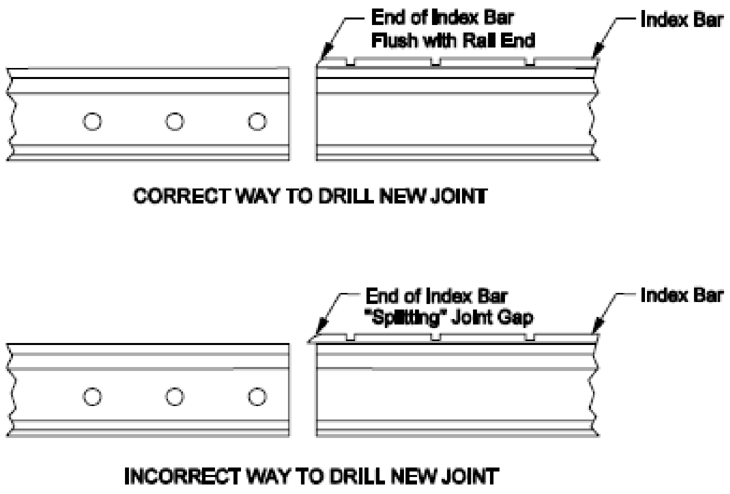


Figure 4-N-2

7. Holes drilled in rail ends for standard joint bars should be sized 1/16”-1/8” larger than the diameter of the bolt to be used. (Table 4-J-2).

Rail Section	Rail End Hole Spacing (inches)			Bolt Size (Inches)	Above Base (inches)	Hole Size (inches)
	Hole 1	Hole 2	Hole 3			
141 lb. UP	3-1/2	6	6	1-1/8 X 6 ½	3-3/32	1-1/4
136 lb. UP	3-1/2	6	6	1-1/8 X 6 ½	3-3/32	1-1/4
136 lb. MP and WP	3-1/2	6	6	1 X 6	3-3/32	1-1/8
136 lb. SP	2-1/2	6-1/2	6-1/2	1-1/8 X 6 ½	3-3/32	1-1/4
133 lb. All	3-1/2	6	6	1-1/16 X 6	3	1-1/8
132 lb. CNW, UP, & MP	3-1/2	6	6	1 X 6	3-3/32	1-1/8
132 lb. WP	2-15/16	6	6	1 X 6	3-3/32	1-1/8
132 lb. MP 4 hole	3-1/2	6		1 X 6	3-3/32	1-1/8
131 lb. MP	2-1/2	6-1/2	6-1/2	1 X 6	3-23/32	1-1/8
131 lb. UP	2-15/16	6-1/2	6-1/2	1-1/16 X 6	3-3/32	1-1/8
131 lb. 4 hole	2-1/2	6-1/2		1-1/16 X 6	3-3/32	1-1/8
119 lb. UP and all others	3-1/2	6	6	1 X 6	2-7/8	1-1/8
119 lb. WP	2-1/2	6-1/2	6-1/2	1 X 6	2-7/8	1-1/8
119 lb. SP	2-1/2	6-1/2	6-1/2	1-1/8 X 6 ½	2-7/8	1-1/4
115 lb. UP, WP	2-1/2	6-1/2	6-1/2	1 X 6	2-7/8	1-1/8
115 lb. SP	2-1/2	6-1/2	6-1/2	1-1/8 X 6 ½	2-7/8	1-1/4
115 lb. CNW, all others	3-1/2	6	6	1 X 6	2-7/8	1-1/8
113 lb. SP	2-1/2	6-1/2	6-1/2	1-1/8 X 6 ½	2-7/8	1-1/4
112 lb. All 4 hole	2-1/2	6-1/2		1 X 6	3-1/16	1-1/8
112 lb. MP 6 hole	3-1/2	6	6	1 X 6	2-7/8	1-1/8
110 lb. UP	2-11/16	5-1/2		1-1/16 X 5 ½	2-13/16	1-1/4
110 lb. CNW and SP	2-11/16	5-1/2		1 X 5 ½	2-13/16	1-1/8
110 lb. MP	2-15/16	6		1 X 5 ½	2-5/8	1-1/8
100 lb. UP	2-5/8	5-1/2		1 X 5 ½	2-1/2	1-1/8
100 lb. WP	2-11/16	5-1/2		1 X 5 ½	2-1/2	1-1/8
100 lb. MP	2-13/32	5		1 X 5 ½	2-3/4	1-1/8
100 lb. CNW	2-1/2 or 2-21/32	6 or 5-1/2		1 X 5 ½	2-34 or 2-1/2	1-1/8
90 lb. UP	2-5/8	5-1/2		15/16 X 4 5/8	2-9/16	1-1/8
90 lb. UP and CNW	Varies	Varies		7/8 X 5	Varies	Varies

Table 4-J-2

8. When drilling bolt holes:
   - **Apply the proper amount of pressure to the drill bit to ensure drill bit does not overheat.**
   - **Keep drill bits lubricated.**

Water is the only recommended lubricant. When temperatures are below freezing use a mixture of windshield washer fluid and water as lubricant.

   - **Bolt holes and rail ends to be beveled and debured per Standard Drawing 0745.**

NOTE: DO NOT torch cut bolt holes under any circumstances.

4.10.7 Rail Mismatch

Rail mismatch is an uneven railhead surface or exposed rail end on the gage or running surface of a rail at a joint location. Rail end mismatch is caused by loose joint bars, or a new or slightly worn rail installed against a heavily worn rail.

Follow these requirements for avoiding or correcting rail mismatch:

1. Except in an emergency, do not install rail ends with a mismatch exceeding 1/4 inch on the tread or running surface or the gage side.
2. When replacing rail, select and install a replacement rail that most closely matches both the gage side and running surface. Use the rail wear measuring device. Item 410-5462.
3. Correct rail mismatch by welding the rail ends and/or grinding using a method described in Form 7913, "Instructions for Inspecting, Welding and Grinding of Rail and Track Components".
4. Place speed restrictions according to the table below when mismatched rails at a joint exceed the values in Table 4-K.

Joint Type	Class of Track	Tread mismatch of rails at joints more than:	Gage mismatch of rails at joints more than:	Batter at joints more than:
Standard rail joint	Class 1 track	.250" (1/4")	.250" (1/4")	.250" (1/4")
Standard rail joint	Class 2 track	.250" (1/4")	.187" (3/16")	.250" (1/4")
Standard rail joint	Class 3 track	.187" (3/16")	.187" (3/16")	.250" (1/4")
Standard rail joint	Class 4 and 5 track	.125" (1/8")	.125" (1/8")	.187" (3/16")
Standard rail joint	Class 6 track	.092" (3/32")	.092" (3/32")	.125" (1/8")

Table 4-K

4.10.8 Rail Joint Gap

The rail joint gap is the distance between rail ends of a bolted joint. The design gap in a rail joint is 1/8".

1. Excessive rail gap is caused by:
   - **Mis-drilled rail ends.**
   - **Deformed (stretched) bolts due to longitudinal rail forces.**
   - **Insufficient or improperly applied rail anchors.**
   - **Elongated or oversize bolt holes.**
   - **Undersized bolts.**
2. Excessive rail joint gap causes large impact loads on the joint system which can lead to:
   - **Joint bar failure.**
   - **Broken rail ends and rail defects.**
   - **Premature tie failure.**
   - **Ballast degradation.**
   - **Surface geometry defects.**
3. Rail joint gaps that do not meet the criteria in Table 4-L should be repaired within 10 days to achieve a maximum rail gap of 7/16 inch.

Class of Track	Maximum Allowable Rail Joint Gap (inches)
Class 6	1/2"
Class 4 or 5	1"
Class 2 or 3	1-1/2"
Class 1	2"

Table 4-L

4.0 RAIL & JOINTS

4.11 Insulated Joints

Insulated joint bars perform the same function as standard joint bars. In addition, they isolate the rail ends from each other to allow the signal track circuit to work properly. Figure 4-O shows a typical cut section.

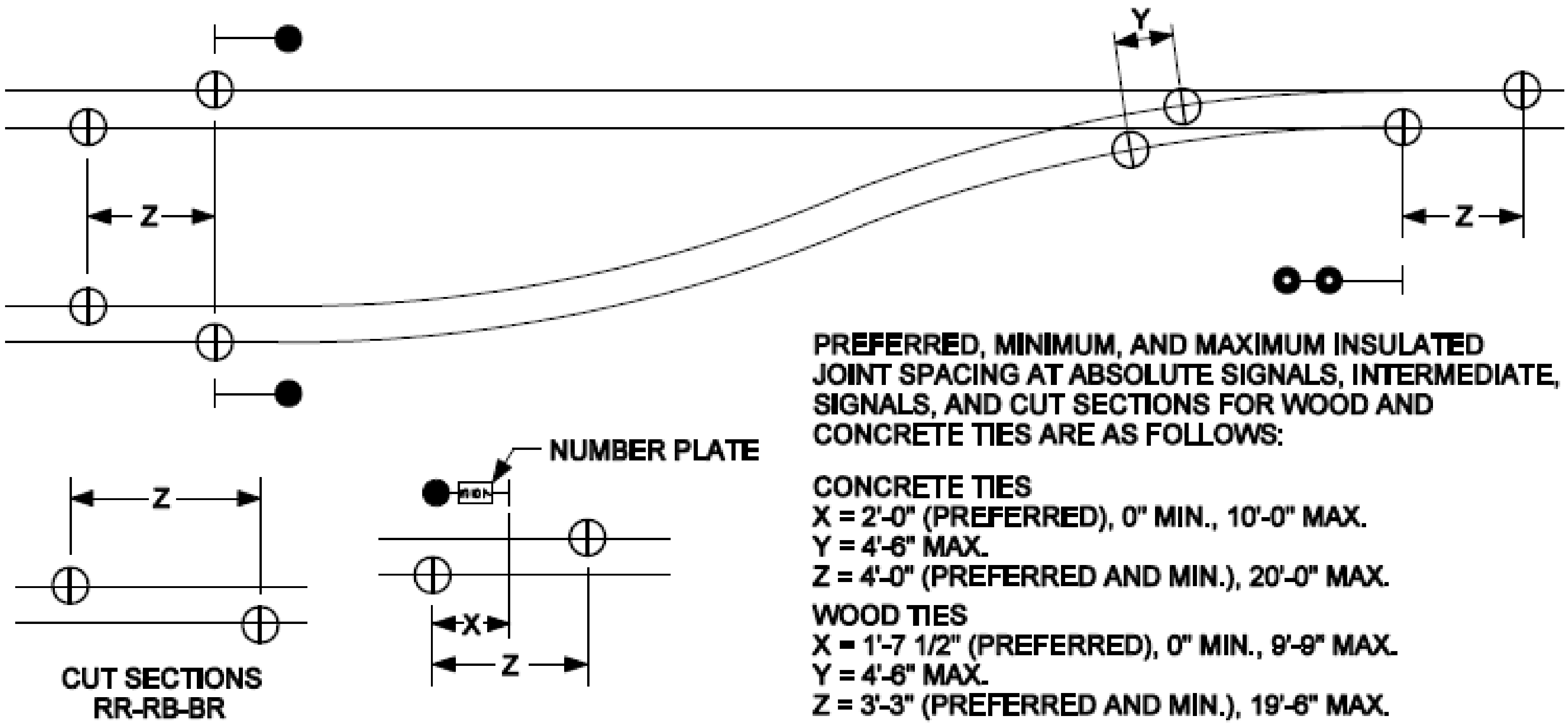


Figure 4-O

Follow these requirements:

1. Verify the proper placement of insulated joints with a signal representative before moving their location or installing a new location.
2. The track and signal departments are jointly responsible for installing and maintaining insulated joints.
3. Remove from track within 30 days any insulated joints that are no longer required due to track circuit changes.
4. On wood ties do not place the middle of an insulated joint on top of a tie plate.

4.11.1 Types and Applications

Insulated joint rail plugs are constructed from head hardened rail. See Table 4-M.

Insulated Joint Applications		
Type	**Rail Type**	**Track Speed**
Long Angle Profiled (LAP)	CWR	Any
I-Bond	CWR	Any
Poly-Coated	Jointed	Over 10 MPH
Fiberglass	Jointed	10 MPH or Less

Table 4-M

A. Long Angle Projection (LAP) Insulated Joints (Maintenance Only)

1. LAP joints as in Figure 4-P-1, do not have a left hand or right hand. They can be installed either way.
2. On Safelok 1 concrete ties, LAP joints require standard IJ fasteners (Item Number 503-5518 or Item Number 503-6230). See Standard Drawing No. 0432.
3. On Safelok III concrete ties, LAP joints require a specialized IJ insulator (Item Number 503-6170) and clip (Item Number 503-6172).
4. Concrete ties can support any location under the LAP joint as long as the bolts do not interfere with the fasteners.

NOTE: LAP joints must be installed at a staggered spacing in accordance with Figure 4-O. Failure to do so may cause gage issues due to the machined rail head.

Figure 4-P-1

Requirements for inspection and remedial actions for defective insulated joints are located in Section 8.6.15 Insulated Joint Bar Inspections.

4.11.2 Poly-Coated and Fiberglass Insulated Joints

A. Poly-Coated Insulated Joints

Follow these requirements:

1. Poly-coated insulated joints may be installed in any jointed rail application.
2. Do not install in CWR territories except as a temporary or emergency repair. Reduce track speed to 25 MPH until removed from track.
3. Poly-coated insulated joints may be installed in the turnout side of yard and industry switches in CWR territory.

B. Fiberglass Insulated Joints

Follow these requirements:

1. Install fiberglass insulated joints in jointed rail applications where physical clearances will not allow the installation of poly-coated insulated joints.
2. Do not install in CWR territories under any condition.
3. Do not install in any track where maximum speed exceeds 10 MPH.

4.11.3 I-Bond Installation

When installing I-Bonds (insulated joint rail plugs):

1. Use I-Bonds in all CWR territories where required by the signaling system.
2. Use 18-foot to 29-foot I-Bonds on tangent track and curves up to 1 degree.
3. Use 39-foot I-Bonds where curvature exceeds 1 degree.
4. Crop I-Bonds back in length to allow for future replacement with longer I-Bond rails. I-Bond rail length must remain at least 15 feet.
5. Field weld or In-Track weld I-Bonds in place as soon as possible.
6. On wood ties with cut spike plates, turn spikes so the spike heads face away from the rail to ensure that spikes do not touch any part of the insulated joint.
7. Use insulated tie plates on ties that are within 2 inches of the end post of all insulated joints except armored-type insulated joints.
8. Suspend joints between ties in wood tie track unless an IJ support plate is utilized. See Figure 4-P-2

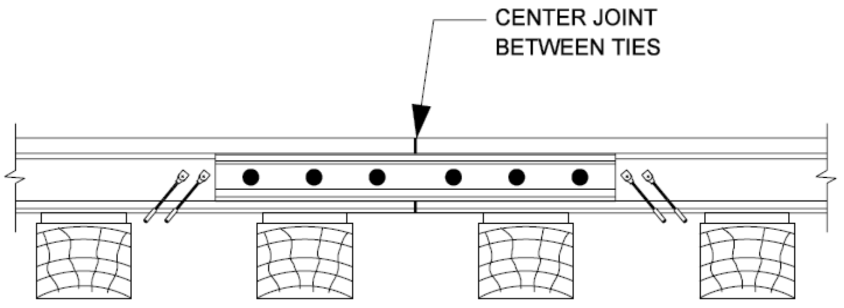


Figure 4-P-2

9. On concrete ties use supported joint tie arrangement and use appropriate clips per the fastening system utilized. See Figure 4-P-3

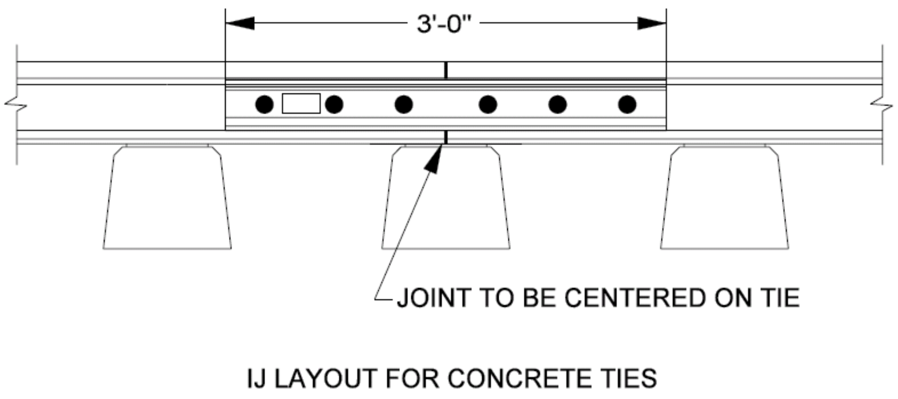


Figure 4-P-3

10. Refer to Standard Track Drawing No. 0960 for further information.

Insulated Joint Colors	
Rail Weight	**Color**
115	Light Green
133	Light Purple
136	Light Blue
141	White

Table 4-M-1

4.12 Cutting Rail

Follow all instructions outlined in the CWR adjust policy. Use reference marks as outlined in Section 7.9.2 Placing Reference Marks.

In addition, refer to the standard work document by searching for, “abrasive rail saw cutting procedures” on the UP Way website at the following address:

https://home.www.uprr.com/mcs_java_swm/secure/jas/SWSHome

1. Any time rail is cut using a torch, do the following:
   - Use a rail saw to trim at least 1/4 inch to square the rail end immediately after the torch cut is made to eliminate the growth of deep thermal cracks. All indication of

torch cut must be removed.

- If a rail saw is not used to square the torch cut rail end within 15 minutes after the torch cut is made, an additional 2 inches of rail must be removed from rail end to get past thermal crack growth formed as the rail end cools.
- Any hole created in rail using a torch must be cut back with a rail saw no less than 2 inches from the torch cut.

2. When abrasive wheel cutting or grinding, arms must be fully covered with an approved welding jacket or welding sleeves.
3. Equipment must be checked on a regular basis to ensure optimum performance.
   - Obtain necessary testing of equipment from a work equipment mechanic or supplier.
   - Truck or hydraulic power unit must be checked and maintained to ensure proper hydraulic fluid flow rate.
   - Rail saw RPM must be checked to ensure abrasive wheel is turning at the proper speed for the cut.
4. The following are required:
   - Use required PPE.
   - All Safety guards must be in place.
   - Spark shields are required during rail cutting operations. Refer to Section 6.3 Fire Protection for complete instructions for fire prevention.
   - All required instructions as outlined in the fire prevention policy must be followed.
   - Rail must be well supported to prevent the saw blade from binding or breaking.

Approved Abrasive Cut-off Wheels

Item #	**Description**
411-6352	14” DIA x 1/8”, 1-inch Arbor, Double reinforced, Standard Composition
411-6620	16” DIA x 1/8”, 1-inch Arbor, Double reinforced, Premium Composition
411-6621	16” DIA x 1/8”, 1-inch Arbor, Double reinforced, Premium Composition
411-6625	16” DIA x 1/8”, 1-inch Arbor, Double reinforced, Premium Composition (for Gas Saws)

4.13 Field Welding (Thermite)

Make all thermite welds according to current procedures in “Track Welding Rules and Procedures for Inspecting, Welding and Grinding of Rail and Track Components”.

In addition, refer to the standard work document for thermite welding on the UP Way website at the following address:

https://home.www.uprr.com/mcs_java_swm/secure/jas/SWSHome

4.13.1 Standard Thermite Welds

Follow these requirements for making thermite welds:

Thermite Weld Placement;

1. 30 inches from an existing plant weld or in-track weld.
2. Subdivisions with 75 MGT or greater, or as specified by the Chief Engineer, make thermite welds at least:
   - 15 feet from an existing rail joint or thermite weld.
   - For a list of subdivisions that must comply with the 15 foot weld rule, refer to TMP home page link named: “15’ Weld Rule Subdivisions”.
   - Note: Special track Work including Switches and Rail Crossings (Diamonds), make welds at least 30 inches from an existing rail joint or weld of any type.
3. Subdivisions with less than 75 MGT or not specified by the Chief Engineer, make thermite welds at least:
   - 30 inches from an existing rail joint or weld of any type.

NOTE: In order to prevent weld clusters or a multitude of field welds installed closely together, no more than four thermite welds are allowed in a 39’ section of rail.

NOTE: When installing replacement rail, effort must be made to eliminate thermite welds.

4. Thermite Weld Installation
   - Install thermite welds in the cribs, not on top of ties.
   - If a rail end is ground down to eliminate mismatch, ground portion must be cut out or replacement rail installed on main track prior to thermite welding. Rail ends must be square to get proper crown. This also applies to battered rail ends.
   - Use compromise /transition rails when required to reduce or eliminate the use of compromise thermite welds in main track and siding.

- On main tracks and sidings, rail ends that have been previously electric arc welded are prohibited from being thermite welded on rail manufactured after 1975 and on alloy rail.
- Do not make thermite welds on alloy rail when the rail temperature is below 32° F.
- Do not make thermite welds on non-alloy rail when the rail temperature falls below 5° F.
- When rail temperature is below 40º F, or in windy conditions, thermite weld must be covered immediately after shearing with a cooling cap or welding blanket until the weld cools to below 700º F., to prevent weld from cooling too quickly.
- During light rain, sleet, snow or mist;

  Do not begin the welding process unless properly protected from the wet weather.

  If the thermite weld process is already in progress, protect the weld from excessive moisture or stop the welding operation.

  Take the following measures to prevent moisture from entering the mold, crucible or welding charge:

  - Use of a welding tent with a solid top is allowed to prevent moisture from entering the molds and crucible.
  - Use of an umbrella is allowed only if moisture can be entirely prevented from entering molds and crucible.
  - Ensure that rain, sleet, snow, or mist does not cool the rail placing the weld in tension as the rail contracts.
  - Use a rail puller, when conditions require, to prevent rail movement.
  - During takedown, all welding mold remnants and slag must be properly disposed of to eliminate all hazards including slip, trip and fall hazard.

5. Grade (Road) Crossing Requirements:
   - Installation of new track panel(s) through grade crossings must have rail joints and thermite welds placed no closer than 15 feet from either end of a grade crossing.
   - In an effort to reduce rail /weld defects, when cutting rail, place rail joints and thermite welds as far away as practical from the end of a grade crossing.
   - Distance of rail joints or thermite welds from the end of grade crossing must allow sufficient distance for use of a rail puller when making CWR adjustments.
6. Use reference marks as outlined in Section 7.9.2 Placing Reference Marks.
7. Replacement rail used for maintenance welding must be at least 15 feet in length and meet the following guidelines:
   - Vertical height difference from existing rail must not exceed 1/4 inch.
   - If vertical offset is more than 1/4 inch on same base width rails, a compromise/transition rail must be installed.
   - Torch cut rail ends must have at least 2 inches removed with a rail saw.
   - Rail must be certified per Section 4.18.7 Maintenance Replacement Rail Certification.
   - Thermite welds are not allowed to be in length of replacement rail.
8. Crop rail to eliminate bolt holes and bond pin holes in rail ends where the centerline of the hole is:
   - **Closer than 6 inches to the rail end when making welds that does not require reinforcing straps.**
   - **Closer than 8 inches to the rail end when making welds that require reinforcing straps.**
   - **Remove signal bond wires by grinding only. Use of a chisel is not allowed.**
9. De-burring Bolt Holes
   - De-burr and bevel bolt holes immediately after drilling is completed.
   - Use only the following approved abrasive wheel to de-burr and bevel bolt holes
     - 2” x 3” 5/8-11 arbor (Item Number 411-3867)
   - If no indication of de-burring or beveling is evident, this must be completed before the thermite welding process begins.
   - Inspect bolt holes for signs of cracks before beginning the thermite welding process.
10. Torch cut rail:
    - **Any time rail is cut using a torch, do the following;**
    - **Use a rail saw to trim the torch cut rail end square immediately after the torch cut is made to eliminate the growth of deep thermal cracks.**
    - **All indication of torch cut must be removed.**

- **If a rail saw is not used to square the torch cut rail end within 15 minutes after the torch cut is made, an additional 2 inches of rail must be removed from rail end to get past thermal crack growth formed as the rail end cools.**

11. Rough grinding can begin after weld shearing is completed to reduce the height of excess weld material to approximately 0.030 inch, but must allow for weld shrinkage as metal cools.
12. Gage face mismatch must be ground to provide for a uniform transition using the following formula.

    Welds with gage face mismatch shall be finish blended over the length of transition of which the minimum length is determined by the following formula below. See Table 4-N-1 below.

$$\text{Minimum Taper Length (feet)} = \frac{\text{Offset (thousandths of an inch)}}{0.008\ \text{inches}}$$

Gage-face Mismatch	Mismatch Taper
0.030 inch	4 inches
0.060 inch	8 inches
0.090 inch	12 inches
0.125 inch	16 inches

Table 4-N-1

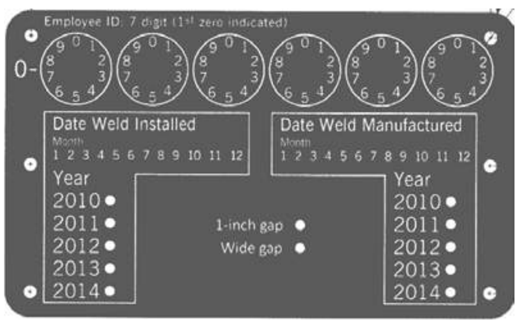
13. Finish grinding the top of the weld must be completed after the weld has cooled to below 700°F. Do not grind onto the parent rail unless vertical offset is present. Doing so will result in a low weld.
    - Additional effort may be necessary to allow more radius relief on the field side of a thermite weld when rail exhibits excessive wheel/rail contact.
14. Apply a 30 MPH slow order when thermite welding alloy rail for a minimum of 24 hours after completion of the weld. Do not remove the slow order until the thermite weld is visually inspected and weld reinforcing straps are applied.
15. The Engineering Department requires the placement of weld tags on all welds.

    The following items can be ordered through the eProcurement system.

Item #	Description
412-7660	Silicon Adhesive, 6oz. tubes, Railtech
410-5260	Metal punch, 1/8 inch hole diameter, for use with Engineering Weld Tag

Thermite weld tags will be punched to indicate the following:

1. Employee ID
2. Month and year installed
3. Month and year weld manufactured
4. 1-inch or wide gap



Install the weld tag supplied by the manufacturer on the web of the rail. Placement of the weld identification tag will be on the field side of the rail web beyond the required CWR written information, as shown in the illustration below and applied with a silicon adhesive, see Figure 4-Q-1.

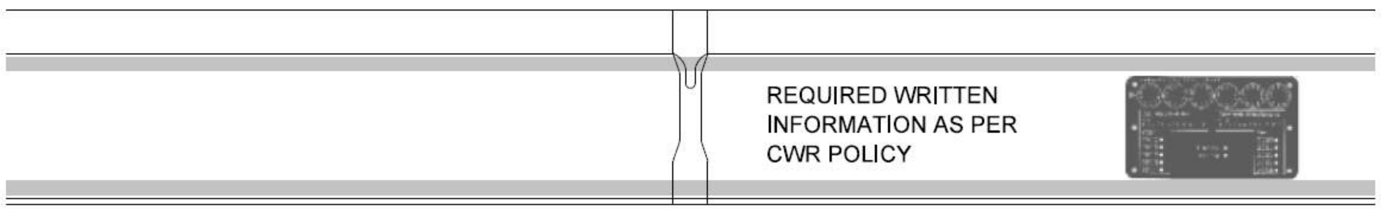


Figure 4-Q-1

16. In Class 6 and higher track, all thermite welds must be ultrasonically inspected within 30 days of installation. Inspection must not be conducted less than one day after weld is installed.
17. In Class 6 and higher track, all finished thermite weld tolerances will be measured and reported in the Welding Time and Attendance Production Reporting System. Refer to 4.16 Weld Tolerance Specifications.

4.13.2 Head Repair Thermite Welds

The requirements herein are intended for the installation of thermite head repair welds with specific rail head material removal as determined by supplier, and do not address the specific use of brands/models of associated auxiliary equipment aids such as rail grinders. Use of thermite head repair welds is determined by approval of VP – Engineering.

1. Subdivisions < 75 MGT:
    - Based on the tonnage chart, DF defect size and SSC defect length.
2. Types of Defects That Can Be Repaired:
    - Detailed Fracture (DF) size is limited to rail head thickness (no defect into rail web). See additional instructions in “Marking Defect” below.
    - Defect size of 60% or smaller in relation to actual rail head thickness.

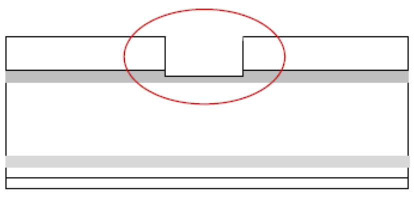
- Thermite head repair welds will be limited to the upper range of rail wear category (1) as shown in section 4.3.4.
- Consideration must be given to condition of rail including excessive Shell, Sliver and Corrugation (SSC) immediately adjacent to defect area.

  If excessive SSC length is present that will have a negative impact on the weld, replacement rail must be installed instead of head repair weld.

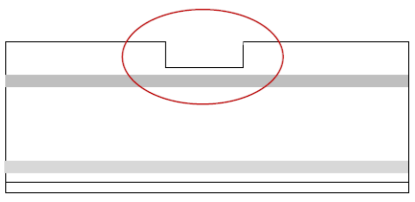
  2-inch wide maximum gap created by grinding out defect from rail head.
- Shell, Sliver and Corrugation (SSC) size is limited to 4 inches maximum in length including any surface batter.

  Grinding must be able to remove all defective metal on surface of rail.

3. Limit Installations to Wood Ties:
   - Consistent with current initiatives to limit use of thermite welds in heavy tonnage routes and concrete track.
   - Install weld no closer than 30 inches from an existing weld of any type.
   - Thermite head repair welding on alloy rail is prohibited.
4. Temperature Limitations:
   - Thermite head repair welding is prohibited when rail temperature is below 5°F. See thermite welding instructions on Track Welding Rules and Procedures for weather restrictions.
5. Marking Defect:
   - Ensure accurate defect marking (critical to success). DC operators must ensure precise defect location with defect centered within a 2-inch wide area that will be removed by grinding.
   - DF defect must be in the rail head only and not into the web of rail.
   - Orgo-thermite welds – entire rail head is removed by grinding.



   - Railtech-Bouted welds – most of the rail head is removed by grinding except the lower 1/4 inch. Defect cannot be in or below this 1/4 inch.



6. Welder Training and Qualification:
   - Supplier and UP Manager of Track Welding will provide necessary training.
   - Training will be conducted on UPRR property at a location chosen by the UP Manager of Track Welding.
   - Training will be provided until it is determined that the welding employee is proficient in the installation procedures through a skills assessment.
   - Welding employee must be qualified by the UP Manager of Track Welding before installing thermite head repair welds.
   - Welding employees must have a copy of the Thermite Head Repair Standard and Installation Procedures available when performing thermite head repair welds.
7. Dye Penetrant Testing:
   - Use of dye-penetrant to verify DF defect removal is REQUIRED to ensure no cracks exist after defect removal by grinding.
   - UP Manager of Track Welding must provide training and product to track welding employees.
   - If cracks are found to be present after maximum allowable grinding is completed, thermite head repair weld must not be used.

4.14 Reinforcing Weld Straps

Apply weld reinforcing straps to thermite welds under any of the following conditions:

a) Any compromise thermite weld made on rails with different size rail bases.

b) Any thermite weld involving alloy rail. (Head hardened rail is **not** alloy rail).

Reinforcing straps must be fully bolted and kept tight. Never use reinforcing weld straps in place of joint bars.

4.15 In-Track Welding

The following instructions must be adhered to when making all Electric Flash Butt (EFB) welds utilizing In-Track Welder (ITW) equipment according to current procedures in the Track Welding Rules and Procedures for Inspecting, Welding, and Grinding of Rail and

4.0 RAIL & JOINTS

Track Components".

1. Do not make welds:
   - On top of ties - Ensure finished weld is in the tie crib.

     Exception: Welds made out of track may be installed on ties when the underside and sides of the weld base have been ground smooth.
2. Refer to Section 7.9.2 Placing Reference Marks when installing welds with an In-track welder.
3. Weather Restrictions:

   Welding manager or welding supervisor will determine if conditions are safe for operation.
   - Welding is prohibited if the first 30 inches of rail measured from each rail end cannot be kept dry.
   - Precautions must be taken to shield the weld from excessive moisture.
   - Welding is permitted when the web of the rail can be headed, dried and kept dry until the weld is completed.
   - If raining or snowing, a welding blanket must be placed over the weld immediately after shearing to prevent moisture from contacting the weld; or during high wind conditions until the weld temperature is below 700° F.
4. To minimize longitudinal stresses on track components, do not make closure welds within 150 feet of any rail crossing (diamond) or turnout. All rail restraints must be applied between closure weld and frog. Apply solid box pattern rail anchors as per ETMFH specification in turnouts. Closure welds must not change UPRR switch point to stock rail specifications.
5. When making welds in track, do not make a weld on top of a tie. If welds are made out-of-track and it is unknown where the weld will lie once rail is installed, excess weld material must be ground from the bottom of, and both sides of the rail base flush with the parent steel to properly fit in the tie plate or seat. Ensure there are two good ties immediately under each side of the weld for proper support.
6. All bolt holes should be eliminated when possible. Completed welds must not be closer than 6 inches from the center of any hole including bolt holes and rail bond holes. All bolt holes must be deburred, beveled and inspected for defects when left in the track.
7. Aligning Rail: Rail must be aligned vertically to provide finished welds that are within the vertical crown and vertical off-set dimensions at ambient temperature.
   a. If vertical rail height between rail ends is less than 1/8 inch, align the rail heads even and provide the off-set in the base.

   b. If vertical rail height between rail ends is 1/8 inch to 1/4 inch, spilt the difference between the base and rail head. (Do not off-set the base more than 1/8 inch)

   c. If vertical rail height between rail ends is more than 1/4 inch, a better matching rail or compromise/transition rail must be installed.
8. Squaring Rail Ends: Any rail end cut with a rail saw shall be cut square to within 1/8 inch both vertically and horizontally.
   - Rail ends being welded that have a combined deviation of more than 1/4 inch will be rejected and must be re-cut.
     - As checked with the two rails touching.
   - If rail ends are not cut square top to bottom or side to side, the EFB equipment operator must not manually burn rails more than 1/4 inch before starting the weld process. Any remaining excessive rail must be cut off with a rail saw.
9. Torch Cut Rail Ends: All rail ends prepared for electric flash butt welding shall be cut square with a rail saw. Welding torch cut rail ends is prohibited.

   Rail ends cut with an oxy-fuel torch will be trimmed back no less than 1/4 inch if done within 15 minutes of the initial torch cut.
   - If rail ends cannot be re-cut with a rail saw within 15 minutes of the torch cut, a minimum of 2 inches must be removed to get beyond the thermal heat cracks.

   If a completed weld must be re-welded and is torch cut due to rail in compression, trim back each rail end no less than 1/4 inch. Trimming must completed within 30 minutes of the torch cut.
   - If the <u>re-weld</u> torch cut rail ends cannot be re-cut (trimmed) with a rail saw within 30 minutes, then a minimum of 2 inches from each rail end must be removed to get beyond the thermal heat cracks.

   Note: If rail is not in compression it may be possible to simply cut the rail with a rail saw.
10. Train traffic or heavy work equipment (spikers, tampers, etc.) must not be allowed over an EFB weld until: (ITW equipment exempt)

    a. The running surface and gage face are rough ground to within thirty thousandths (0.030) of an inch.

    b. The weld has cooled below 700° F.

    c. All wedges, jacks and blocks are removed.

    d. Ties in each side of the weld have been tamped.
11. Finish Grinding

Rail Head:

When grinding rail head:

a. Do not over-grind welds. Do not remove parent material.

b. When tapering rail due to vertical offset, do not grind off the weld onto the lower rail.

c. Use the following formula to determine proper length of taper.

$$\text{Minimum Ramp Length (feet)} = \frac{\text{Off-set (thousandths of an inch)}}{0.008 \text{ inch}}$$

Vertical Offset	**Offset Ramp Length**
0.030 inch	4 inches
0.060 inch	8 inches
0.090 inch	12 inches
0.125 inch	16 inches

12. Rail Web, Fillets and Base:

When grinding rail web, fillets and base:

- Grind all welds smooth to within 1/16 inch of the original contour of the web and fillets. Do not grind into the parent metal.
- Grind the top of the base to within 1/16 inch of the original contour.
- Grind the sides of the base smooth.
- Visually inspect all welds for defects including where the current carrying electrodes make contact with the rail web.
- When shearing the upset, inspect the area on the web of every weld for gouges or smear. Reject any weld that has gouged into the parent material. All smears must be ground from welds.

13. Weld Rejection/Acceptance:

If welding system indicates the weld is out-of-spec or an interruption occurs during the welding cycle, weld must be considered defective, removed and rail re-welded.

If an out-of-spec weld or bad weld is identified and marked by the welding system as shown on the weld certificate or chart, weld must be removed and rail re-welded.

If no chart is available for weld, it must be removed and rail re-welded.

Weld charts and certificates must be reviewed by Union Pacific supervisory personnel and verified as a good weld before signing daily weld production form, for each weld produced and left in track.

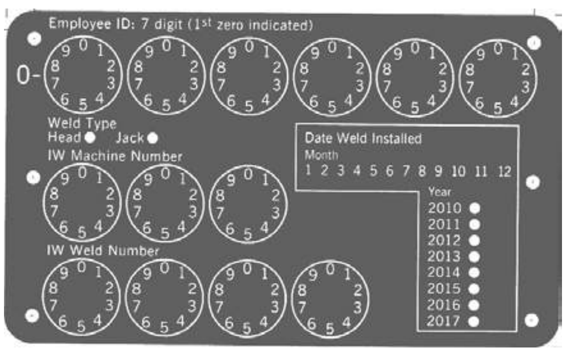
14. The Engineering Department requires the placement of weld tags on all mobile in-track welds.

The following items can be ordered through the eProcurement system.

Item #	**Description**
412-7661	Weld tag for In-Track Welders only, 500 tags per pack
412-7660	Silicon Adhesive, 6oz. tubes, Railtech
410-5260	Metal punch, 1/8 inch hole diameter, for use with Engineering Weld Tag

In-track weld tags will be punched to indicate the following:

- Welding employee ID number
- Weld type
- ITW machine number
- ITW weld number
- Consecutive number starting the first of each year
- Month and year weld installed



Install the weld tag on the web of the rail. Placement of the weld identification tag will be on the field side of the rail web beyond the required CWR written information, as shown in the illustration below and applied with a silicon adhesive, see Figure 4-Q-2.

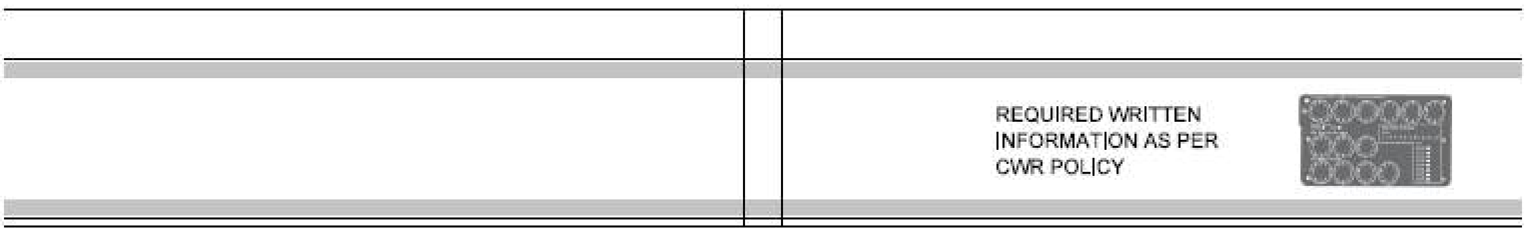


Figure 4-Q-2

15. In Class 6 and higher track, all in-track weld tolerances will be measured and reported in the In-Track Weld Production Reporting System. Refer to 4.15 Weld Tolerance Specifications.

4.16 Weld Tolerance Specifications

To improve overall track geometry and reduce Evaluation Car exceptions, the Thermite and In-Track maximum weld tolerances below must be followed.
Where one tolerance is shown, the measurement applies to both types of welds.
These are cold (ambient temperature), finish ground specifications.

1. Use Table 4-N-1 to determine weld tolerance specifications for Class 1 through Class 5 Tracks.

	Vertical Crown	Vertical Offset	Horizontal Offset	Horizontal Kink	Base (HOS) Horizontal Offset	Base (VOS) Vertical Offset
Thermite	0.040”	0.020” (a)	0.040”	0.025”	0.060”	0.250” (b)
In-Track	0.060”					0.125” (c)

a. Any vertical offset after welding must be tapered by grinding to provide for a smooth transition and eliminate impact forces.
b. Maximum base vertical offset will not exceed 0.250” on same base width rails.
c. If rail height difference is greater than 0.125”, offset top of rail head and grind. Any offset on the top of rail must be tapered to provide a smooth transition.

Combined Vertical crown and Offset: 0.060 inch maximum expressed as tangential deviation 18 inches from the center of weld.

Combined Horizontal Kink and Offset: 0.060 inch maximum expressed as tangential deviation 18 inches from the center of weld as measured on the convex side of the rail.

Table 4-N-1

NOTE: Maximum allowable rail end mismatch is 0.250” on same base width. Transition rail to be used on rail end mismatch greater than 0.250” on the same base width. ***Over grinding is not allowed.***

Welds with vertical offset of the rail head shall be finish blended over a ramp of which the minimum length is determined by the following formula. See Table 4-N-2 below.

$$\text{Minimum Ramp Length (feet)} = \frac{\text{Offset (thousandths of an inch)}}{0.008 \text{ inches}}$$

Vertical Offset	Offset Ramp Length
0.030 inch	4 inches
0.060 inch	8 inches
0.090 inch	12 inches
0.125 inch	16 inches

Table 4-N-2

While blending the offset ramp, care must be taken to avoid sharp deviations in transition, avoiding locations of impact loading.

2. Use Table 4-O-1 to determine weld tolerance specifications for Class 6 Tracks, High Speed Mainlines, (Joliet and Springfield Subdivisions Only).

	Vertical Crown	Vertical Offset	Horizontal Offset	Horizontal Kink	Base (HOS) Horizontal Offset	Base (VOS) Vertical Offset
In-Track	0.030”	0.020” (a)	0.030”	0.025”	0.060”	0.125”(b)

(a) Any vertical offset after welding must be tapered by grinding to provide for a smooth transition and eliminate impact forces.
(b) If rail height difference is greater than 0.125”, offset top of rail head and grind. Any offset on the top of rail must be tapered to provide a smooth transition.

Combined Vertical crown and Offset: 0.040 inch maximum expressed as tangential deviation 18 inches from the center of weld.

Combined Horizontal Kink and Offset: 0.040 inch maximum expressed as tangential deviation 18 inches from the center of weld as measured on the convex side of rail.

Table 4-O-1

NOTE: Maximum allowable rail end mismatch is 0.250” on same base width.

Transition rail to be used on rail end mismatch greater than 0.250” on the same base width. ***Over grinding is not allowed.***

Welds with vertical offset of the rail head shall be finish blended over a ramp of which the minimum length is determined by the following formula. See Table 4-O-2 below.

$$\text{Minimum Ramp Length (feet)} = \frac{\text{Offset (thousandths of an inch)}}{0.008 \text{ inches}}$$

Vertical Offset	Offset Ramp Length
0.030 inch	4 inches
0.060 inch	8 inches
0.090 inch	12 inches
0.125 inch	16 inches

Table 4-O-2

While blending the offset ramp, care must be taken to avoid sharp deviations in transition, avoiding locations of impact loading.

4.17 Rail Anchors

Rail anchors control longitudinal rail movement on ties from temperature variations, traffic, grade, and train braking.

Anchors are not required on ties with elastic fastening systems unless additional restraint is necessary to control undesired rail movement or ties are in a turnout.

On CWR installations completed before September 21, 1998, existing anchoring may remain if rail is restrained to prevent track buckles, but rail must be adjusted (by increasing or decreasing the length of rail or by lining on curves) or anchors added to rail if restraint is not sufficient.

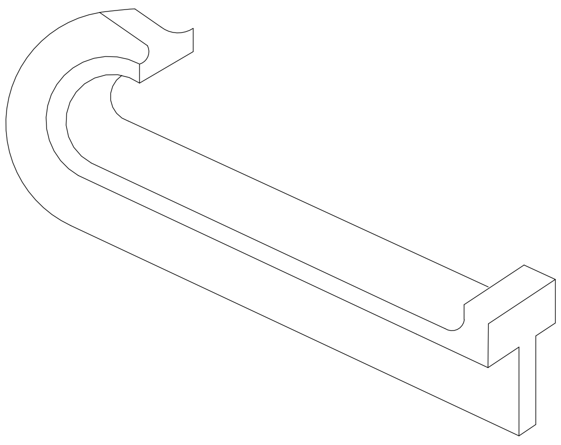
In turnout tie or component replacements existing anchoring pattern may remain if rail is restrained to prevent track buckles, but rail must be adjusted (by increasing or decreasing the length of rail or by lining on curves) or anchors added to rail if restraint is not sufficient.

Note: Locations with permanent speed restrictions must have anchor patterns based on a subs predominant class of track.

4.17.1 Anchor Types

The two rail anchor types commonly used are Drive-on and Wrench. Within these types are a number of different styles and sections.

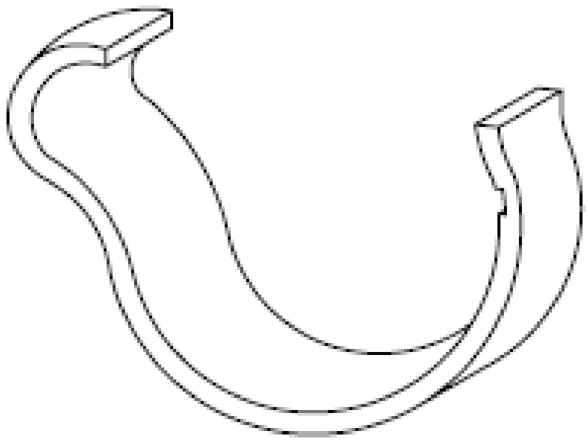
- Drive-on type anchors are manufactured in channel sections, solid bar stock steel, and T- sections. See Figure 4-R-1.



T-SECTION ANCHOR

Figure 4-R-1

- Wrench type anchors are manufactured from spring steel and are commonly referred to as spring anchors. They are available in a variety of shapes. An example is pictured in Figure 4-R-2.



SPRING ANCHOR

Figure 4-R-2

- Concrete tie anchors are drive-on type bar stock anchors with a specially designed nylon isolator (Item Number 550-1653) over the anchor to prevent damage to the tie. The item number for the anchor w/isolator is 550-1652. An example is pictured in Figure 4-R-3.

CONCRETE TIE ANCHOR WITH ISOLATOR

Figure 4-R-3

4.17.2 Anchor Applications

Determine the kind of replacement anchor for rail relays on wood and composite ties as follows.

1. Use new anchors:
   - **When laying new rail on any track.**
   - **Rail relays in main track and siding with track speed of 30 MPH and over.**
   - **In place of second-hand anchors when not available.**
2. Use second-hand anchors:
   - **For ordinary maintenance.**
   - **To replace missing or ineffective anchors from existing patterns.**

- **On every other tie where every tie must be box anchored (95 MGT and above).**
- **On secondhand rail relays less than 30 MPH.**

  On secondhand rail relays when track speed is 30 MPH and over, when approved by the Chief Engineer.

4.17.3 Anchor Installation

Properly installed rail anchors provide maximum restraint against rail movement.

Second-hand anchors should be inspected before and after installation to ensure they fit the rail properly.

Rail anchors should be applied just far enough that the locking lip or groove of the anchor snaps into place on the rail base. Where drive-on type anchors are applied by mechanized equipment, allow a dime-width of space between the rail base and the anchor (shown in Figure 4-R-4) to compensate for base width tolerances of the rail.

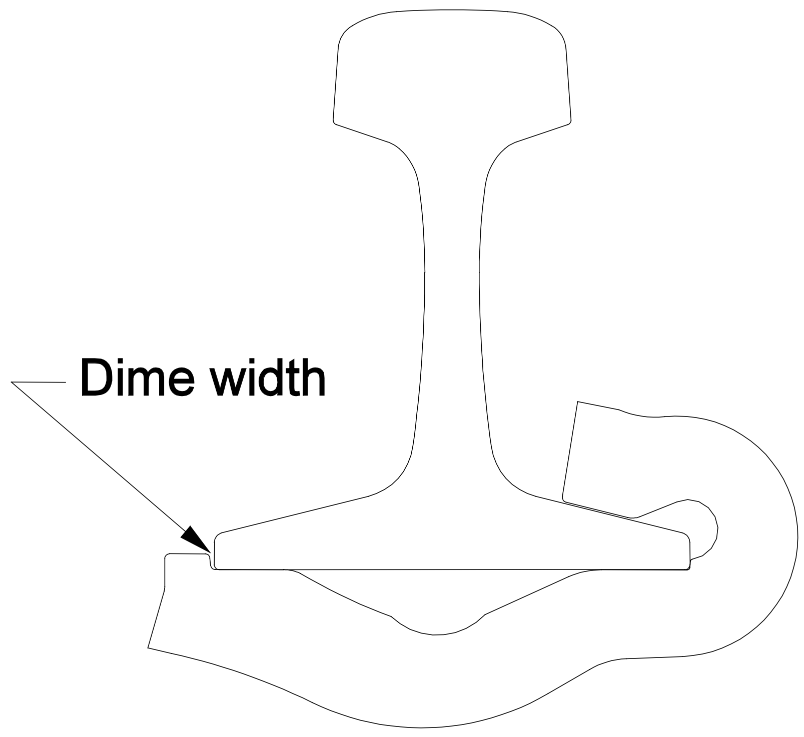


Figure 4-R-4

When installing rail anchors:

1. Apply rail anchors of the same size as the rail base.
2. If installing or removing drive-on type anchors manually, use a sledge hammer.
3. Apply wrench type anchors only when you use a wrench tool designed for that purpose.
4. Apply anchors at a right angle to the rail base.
5. Where practicable, install the anchor from the gauge side of rail.
6. Apply on each side of the tie across from one another with full bearing against the sides of the tie.
7. Do not install rail anchors on the rail across from permanent joints, except when box anchoring switch ties in turnouts.

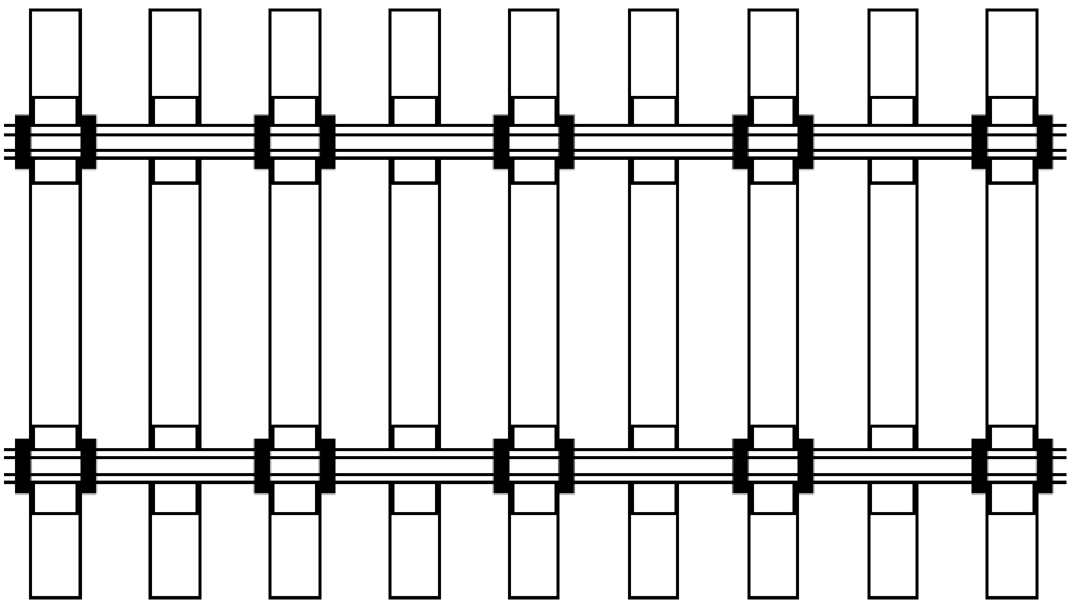
NOTE: Anchors not applied to one rail must not be applied to the opposite rail on the same tie at locations other than turnouts.

8. Box anchor each tie on each side of a field weld.
9. Box anchor switch ties to the fullest extent possible.
10. Avoid installing rail anchors within 1 inch of:
    - **Field welds.**
    - **Joint bar ends.**
    - **Switch rods on turnouts.**
    - **Transducers on hot box detectors.**

4.17.4 Standard Box Pattern

Follow these requirements:

1. On all tracks, apply rail anchors out-of-face along each rail, directly across from each other on the same tie, according to Rail Anchor Pattern No. 1 shown in Figure 4-S-1.



ANCHOR PATTERN NO. 1

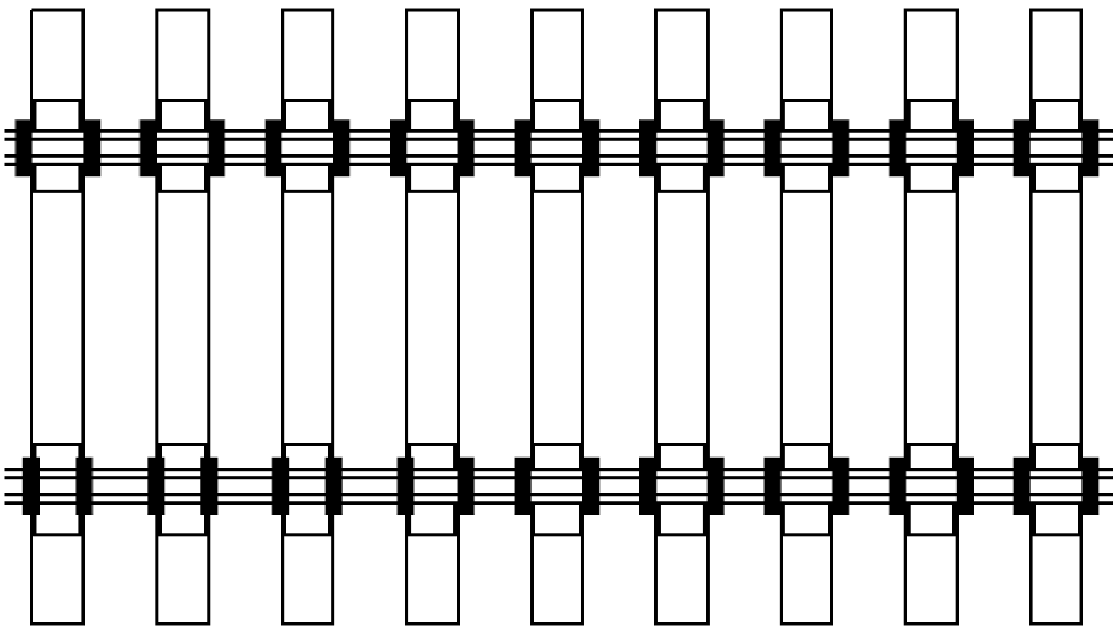
Figure 4-S-1

2. Establish the standard rail anchor pattern shown above on both rails throughout relay limits and for 5 rail lengths on either side of the work limits during:
   - **Single- or double-side rail relays.**
   - **Double curve rail transpositions.**
3. Additional rail anchors may be required to provide additional longitudinal rail restraint.

4.17.5 Solid Box Pattern

Follow these requirements:

1. Solid box anchor every tie as shown in Figure 4-S-2 for Rail Anchor Pattern No. 2 at specific locations to provide additional restraint against rail movement.



ANCHOR PATTERN NO. 2

Figure 4-S-2

2. Use Table 4-P to determine where box anchoring of every tie is required in wood, composite and concrete tie track. For composite ties, follow the same standards as for wood ties. Also reference Standard Drawing No. 0460.

Location	Rail Type	Requirement
Turnouts (Concrete and Wood Ties)	CWR	All switch ties and 120 ties in all directions
Turnouts (Wood Ties Only)	Jointed	All switch ties and 48 ties in all directions
Crossing Frogs (Concrete and Wood Ties)	CWR or Jointed	120 ties in all directions
Hot Box / Dragging Equipment Detectors (Wood Ties Only)	CWR or Jointed	120 ties in each direction
All Permanent and Insulated Joints (Wood Ties Only)	CWR	120 ties in each direction
Expansion Joints (Concrete and Wood Ties)	CWR or Jointed	120 ties in each direction
Lines with traffic of 95 MGT or more annually (Wood Ties Only)	CWR	Every tie, as directed by Chief Engineer
Open-Deck Bridges (Concrete and Wood Ties)	CWR	All bridge ties and 120 ties in each direction EXCEPTION: See Standard Drawing 0461 for steel spans.
Road Crossings (Wood Ties Only)	CWR or Jointed	Every tie through the crossing limits

Table 4-P

4.0 RAIL & JOINTS

4.17.6 Bridge Pattern

Follow these bridge anchoring requirements:

1. Ballast deck bridges should be anchored according to Standard Drawing No. 0461.
   - **Anchor ballast deck bridges with the same pattern as the rail leading onto the bridge.**
2. Open deck bridges should be anchored according to Standard Drawing No. 0461.
   - **Solid box anchor every bridge tie across open-deck bridges and 120 ties each side of bridge headwalls.**

     Exception: For steel spans more than 125 feet long:

     – Box anchor all bridge ties in at least one-third of the total number of panels of the bridge at the fixed end of the span.

4.17.7 Turnout Pattern

Follow these turnout anchoring requirements:

1. Box anchor all switch ties to the extent that the anchors will not interfere with the proper operation of the turnout. Refer to Standard Drawing No. 0460.
2. Anchor the switch point and stock rail at the heel block as follows:
   a. Locate the heel blocks on the mainline and turnout sides, refer to Figure 4-T-1.
   b. Anchor the switch point and stock rail on the mainline side as follows:
      i. Begin by installing two anchors next to one tie and two additional anchors next to the other tie in a crib.

         NOTE: Solid anchoring of a single crib will require 6-8 anchors.

      ii. Continue to apply anchors to fill in area between the first four anchors installed.

         CAUTION: Ensure anchors are tight against the edge of ties with no gaps. If a gap is too small to be filled with an anchor ensure that gap is in the middle of the anchors.
   c. Repeat step b for the switch point and stock rail on the turnout side.
   d. In turnouts that utilize a Movable Point Frog the same pattern in the heel block area can be utilized to limit rail movement in the frog. Fully anchor the MPF as shown in Figure 4-T-2. Care must be taken to not place anchors where they may interfere with point movement. Locations shown may be adjusted, however both point and wing rails must have minimum of one crib on each side fully box anchored.

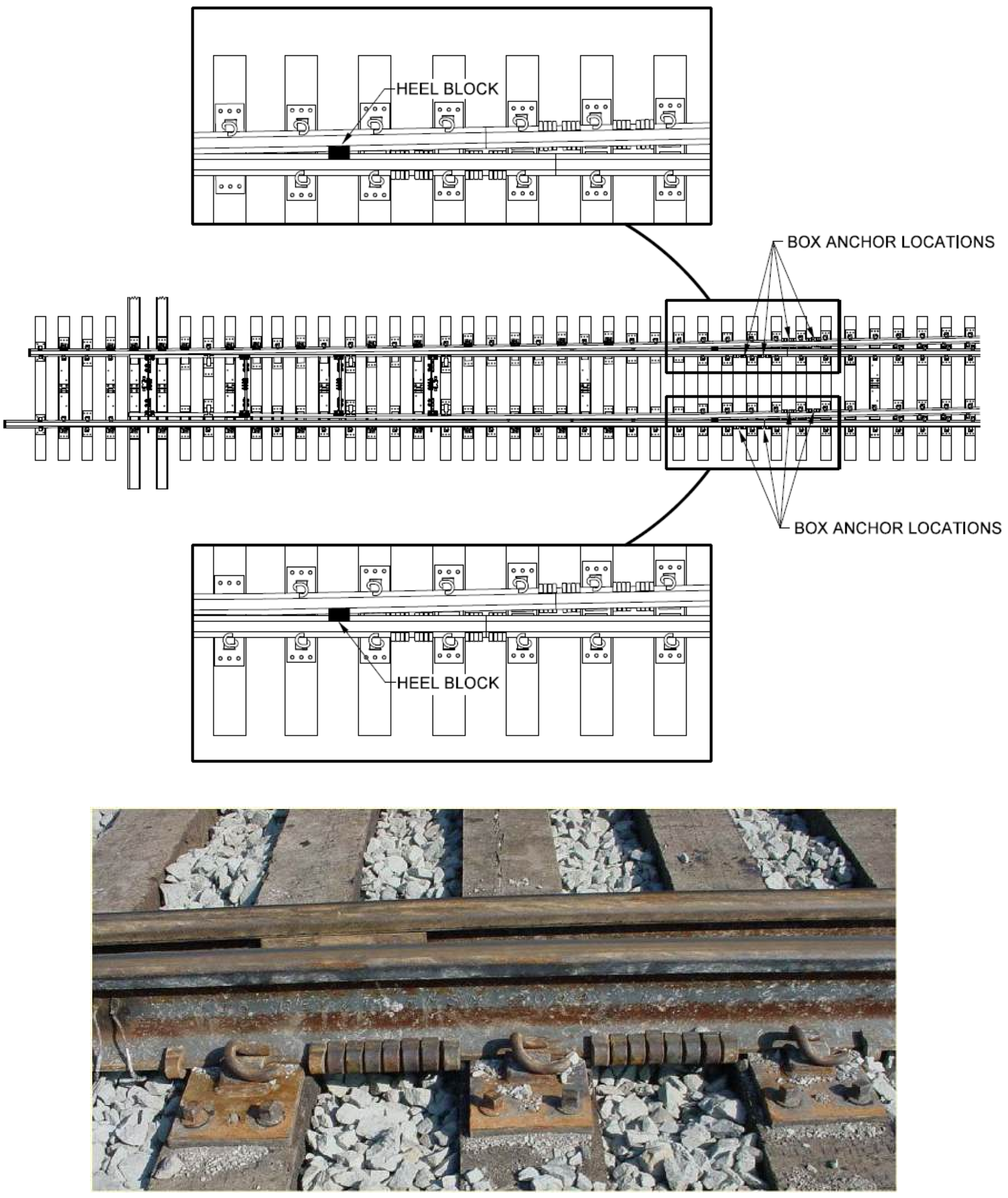


Figure 4-T-1

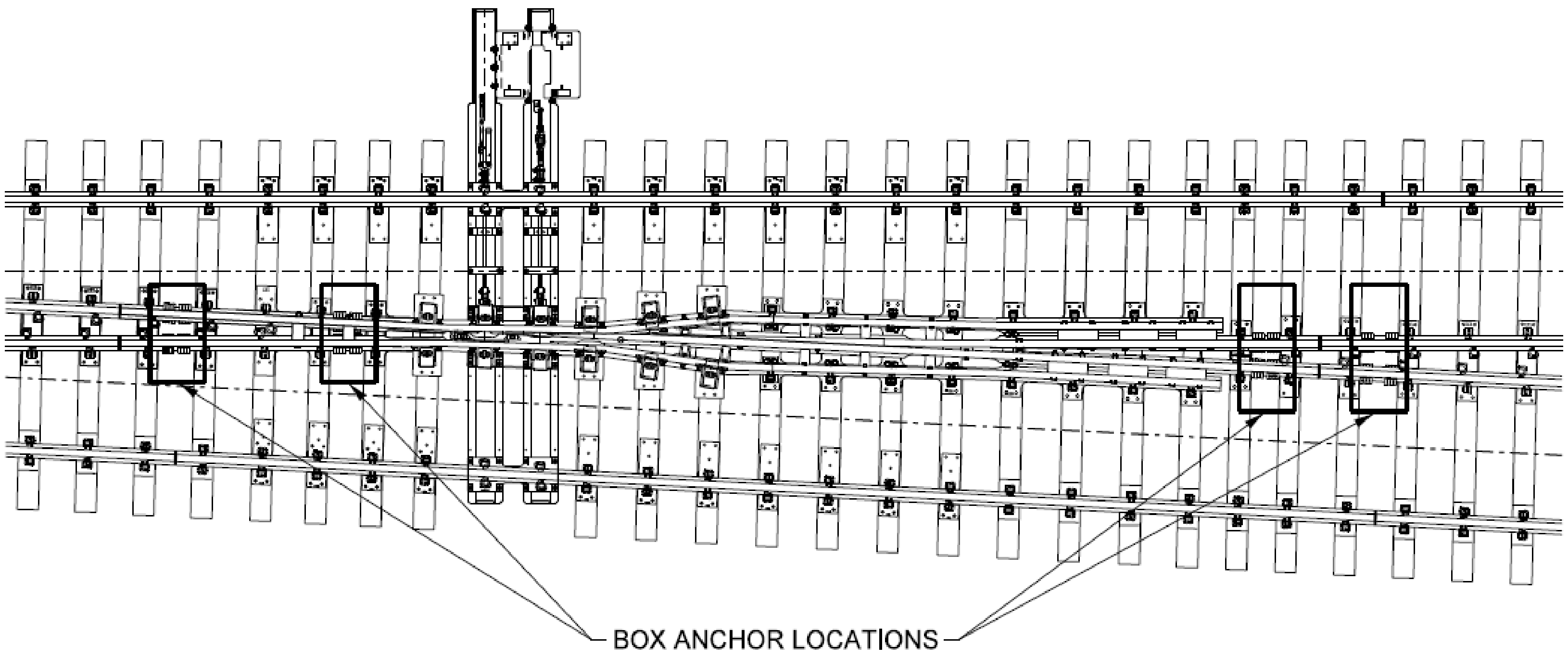


Figure 4-T-2

4.17.8 Transition Pattern

Transition anchor pattern at locations where CWR connects to jointed rail as shown in Figure 4-U.

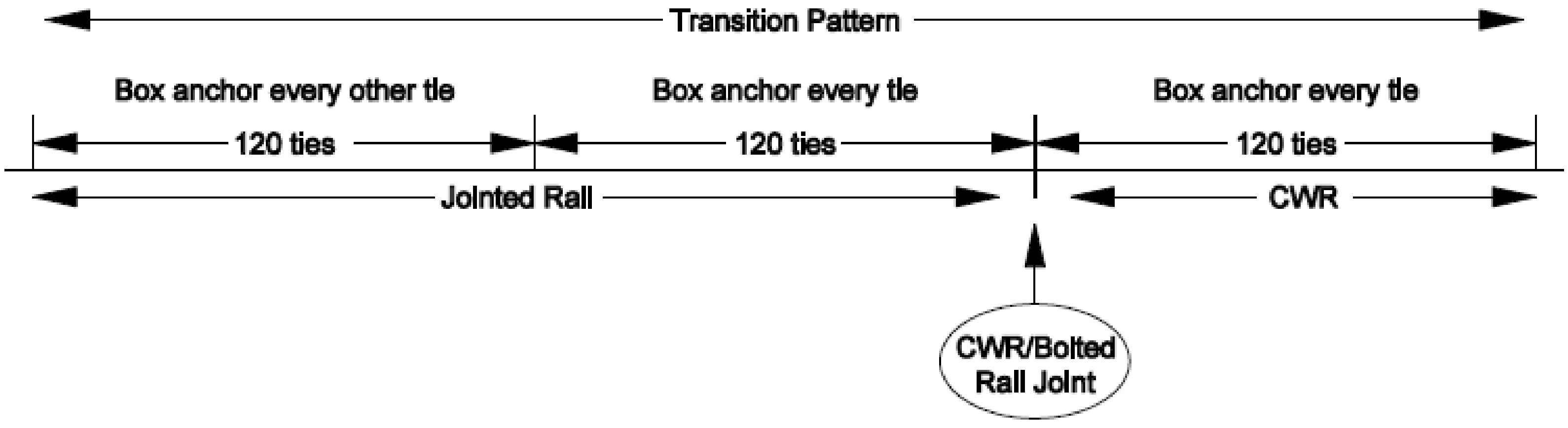


Figure 4-U

When transitioning from CWR to jointed rail:

1. Solid box anchor the CWR for 120 ties before the jointed rail.
2. Solid box anchor the first 120 ties in the jointed rail next to the CWR.
3. Box anchor every other tie in the next 120 ties in the jointed rail next to the 120 solid box anchored ties.

4.17.9 Adjustment and Maintenance of Rail Anchor Patterns

Adjust and maintain rail anchors and their patterns as follows:

1. When relaying rail on one side only adjust the anchors on the other rail to the standard anchor pattern.
2. Replace broken, damaged, missing or otherwise ineffective rail anchors during track maintenance.
3. Adjust rail anchors to provide full bearing against the side of ties during track maintenance.
4. Reapply rail anchors removed during track maintenance.
5. Restore the existing rail anchor pattern when eliminating or relocating joints. Add, remove, or relocate anchors as required.
6. Do not slide anchors along the rail except when adjusting with power-operated equipment.

4.18 Rail Defects

4.18.1 Defect Descriptions

Subsections A through R show the common rail defects and their associated abbreviations.

A. Bolt Hole Break (BH)

A bolt hole break is a progressive crack that spreads in any direction from a bolt hole. This defect is caused by contact between the bolt hole and a bolt. See Figure 4-V.

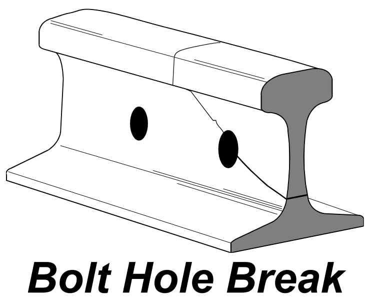


Figure 4-V

B. Broken Base (BB)

Any type of defect in the base of the rail is called a broken base rail. The cause of this defect is the rail bearing unevenly on the tie plate. The cause of this defect may be the rail bearing unevenly on the spike, tie plate, spike, etc. These defects may also be caused by corrosion or impacts to the base. See Figure 4-W and pictures below:

Broken Base

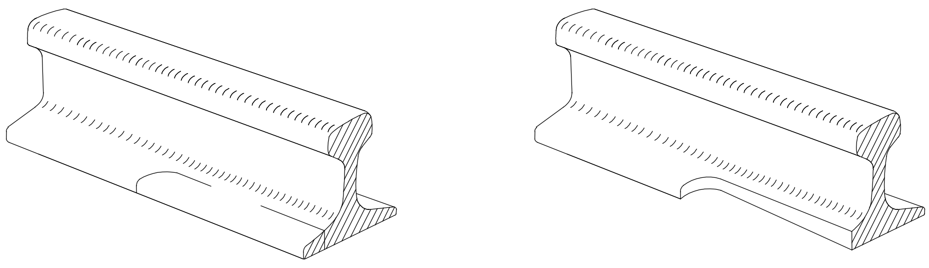


Figure 4-W

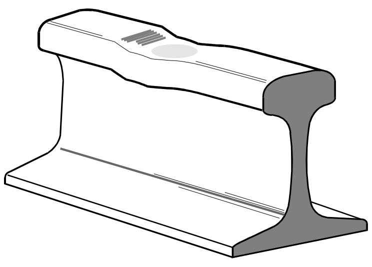
Broken Base – Transverse *Photo Examples of Broken Base - Transverse*

C. Crushed Head or Flattened Rail (CH or FR)

A crushed head (sometimes referred to as flattened rail) is a short length of rail that has flattened out across the entire width of the rail head with no repetitive or regular pattern. See Figure 4-X.

NOTE: Do not classify corrugations or battered rail ends as crushed heads.

Measurements will not include localized chips or pitting.



Crushed Head or Flattened Rail

Figure 4-X

D. Shell, Sliver Corrugation (SSC) and Battered Weld SSC (SSC-W)

Definition: Shell, Sliver, Corrugation are locations where, rail defects may originate or may be hidden under surface conditions. These defects are at risk of not being detected by ultrasonic test systems. SSC defects are usually localized surface conditions between 8-inches and one rail length. SSC-W (Battered Welds SSC) defects usually begin within 6" of welds. See examples below:

SSC (Shell, Sliver, Corrugation) condition can be identified by any one qualified to inspect track. Visual observation of rail condition (excessive spalling, corrugation, head check or shelling) and general track condition (ballast churned out of the cribs, swinging ties, rail out of the plate, battered ties, etc.) are all indications that a SSC condition may exist.

When it is determined by visual observation that a SSC condition may exist, an on the ground inspection must be made.

Any area where rail head deformation is ¼ inch or more below the running surface of the adjacent rail head and other more restrictive defects are not present must be marked as a SSC defect. For example, if you slide a 36” straight edge on top of the rail, any location along the straight edge that you can place a ¼ inch step gauge under the straight edge, you have a defect. If rail surface conditions are persistent down the length of the rail, continue to move the straight edge along the rail until conditions no longer exist. Measurements shall not include localized chips or pitting.

If the rail is worn and has ¼ inch head loss, the wear will be much more gradual and will not show up as a defect. Examples of more restrictive defects would be a visible VSH, a flattened rail or break out in the head of the rail.

Pay particular attention to head sag or deflection, “bleeding” rust areas, excessive head flat and corrugation. Corrugation deeper than .030 (about the thickness of a dime) should be considered an SSC.

In addition to visual detection, a SSC defect can be identified during rail test operations. Poor rail surface conditions may cause false response (multiple channel surface indications) or lack of expected response (loss of bottom signal, failure to properly indicate bolt holes or other known track structures). These rail surface conditions may prevent performance of a continuous ultrasonic test and result in rail defects not being detected. Locations where these rail surface conditions exist require an on the ground inspection. All ultrasonic indications that appear to be a rail defect must be hand tested and entire area visually inspected. Defects identified during this inspection must be properly marked and remediated. If it is determined during inspection that a continuous ultrasonic inspection cannot be performed due to rail surface conditions the area must be marked as an SSC defect.

As with all types of rail defects, pay particular attention at rail ends, dead zones in switches and within 500 feet of structures (bridges, over passes, tunnels, etc).

E. Defective Weld (DPW, DFW, DIW, DWG)

A defective weld is a progressive fracture at or near any weld. This may occur in plant welds, in-track welds and thermite welds. See Figure 4-Y.

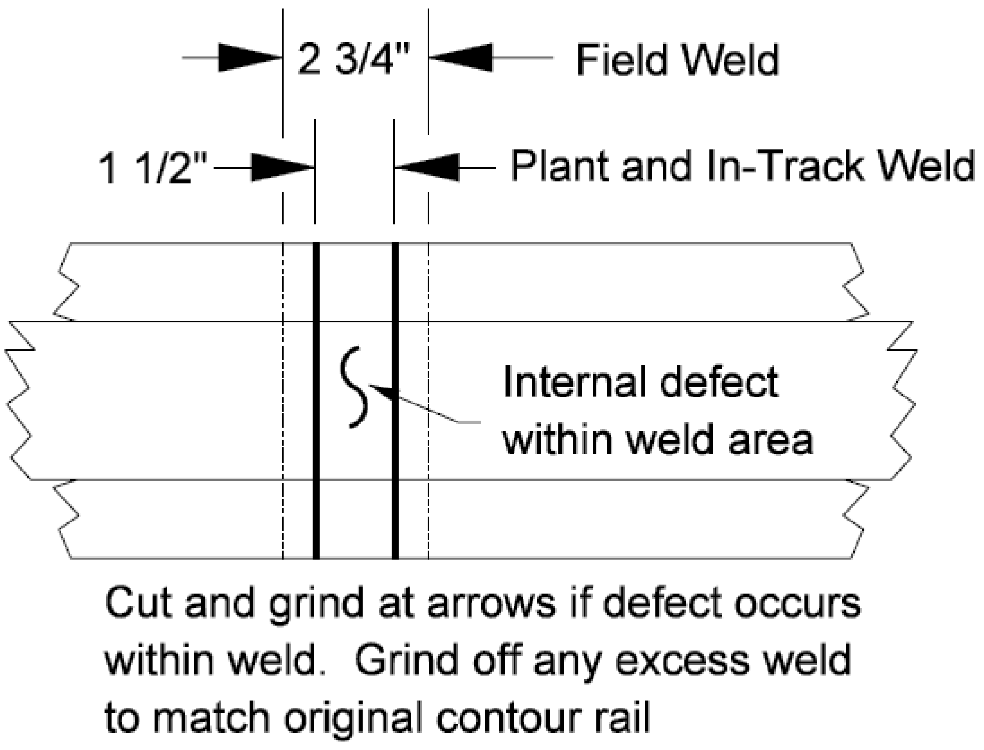


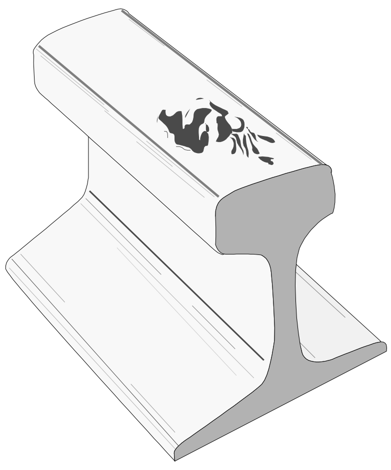
Figure 4-Y

NOTE: When a detector car identifies a defective weld, cut out the weld and apply joint bars or field weld immediately. Cut out a defective plant weld by removing a 1-1/2-inch section of the rail, 3/4 inch on either side of the centerline. Cut out a defective field weld by removing a 2-3/4-inch section of the rail, 1-3/8 inches on either side of the centerline. If field welding, ensure the final gap width is 1 inch for standard welds or 2-3/4 inches for a wide gap weld.

4.0 RAIL & JOINTS

F. Engine Burn Fracture (EBF)

An engine burn fracture is a progressive fracture starting at the spot where locomotive driver wheels have slipped on top of the rail head. When these fractures spread downward, they resemble compound or transverse fissures. See Figure 4-Z.

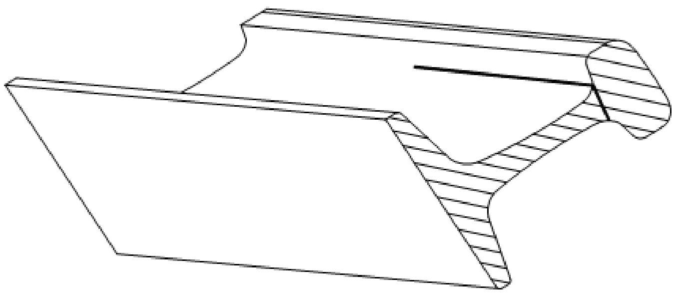


Engine Burn

Figure 4-Z

G. Head-Web Separation (HW)

A head-web separation is a progressive longitudinal fracture under the rail head that separates the head from the web. See Figure 4-AA.

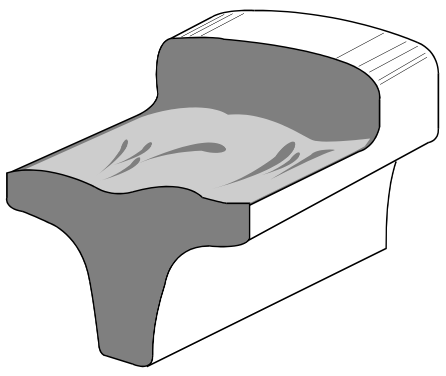


Head-Web Separation

Figure 4-AA

H. Horizontal Split Head (HSH)

A horizontal split head is a progressive horizontal defect originating inside the head that moves horizontally in either or both directions. Before breaking out, a horizontal split head will appear as a flat spot on the running surface. There may be a slight widening of the rail head, and a crack will appear lengthwise along the rail when it reaches the surface of the rail head. See Figure 4-BB.



Horizontal Split Head

Figure 4-BB

I. Ordinary Break / Sudden Rupture (SR)

An ordinary break is a partial or complete break in the rail where there are no visible internal defects. See Figure 4-CC.

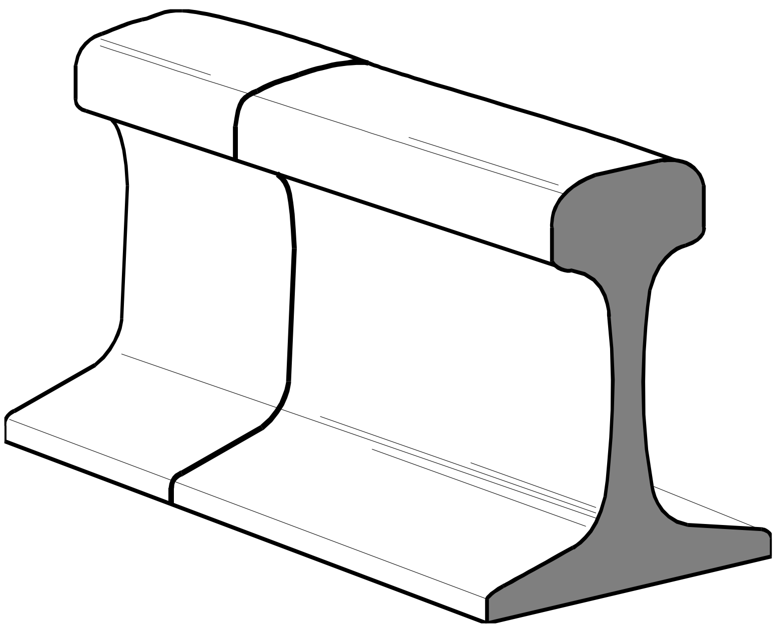


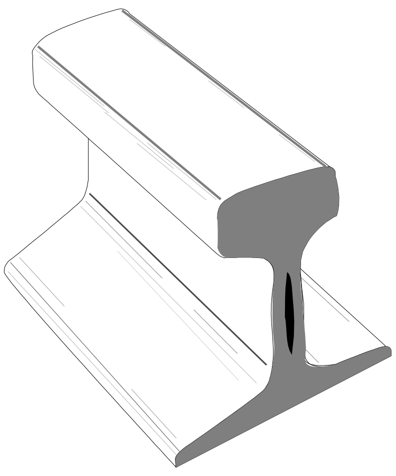
Photo Example

Figure 4-CC **Ordinary Break / Sudden Rupture**

Note: When encountering an ordinary break, not at a weld, trim rail ends square before applying joint bars or welding.

J. Piped Rail (PR)

A piped rail is a vertical split in the web of the rail caused by a manufacturing defect. See Figure 4-DD.



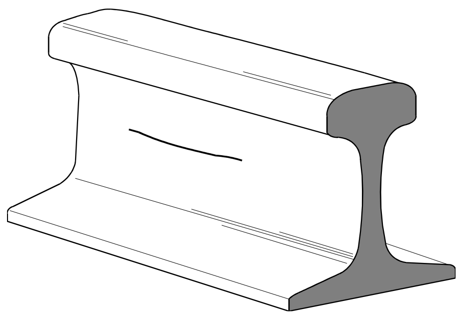
Piped Rail

Figure 4-DD

K. Split Web (SW)

A split web is a lengthwise crack running into and through the side of the web.

See Figure 4-EE.



Split Web

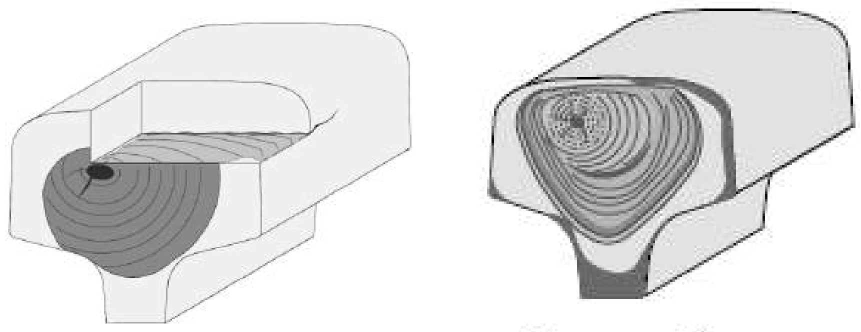
Figure 4-EE

L. Transverse Defects

A transverse defect is a group classification applied to defects found by detector cars, of all types of rail defects that have transverse components, such as transverse fissures (TF), compound fissures (CF) and detail fractures (DF).

A transverse fissure (TF) is a progressive fracture from the center of the head that spreads outward and is identified as a smooth, bright or dark round or oval at a right angle to the length of rail. It has a crystalline center and a nearly smooth surface. See Figure 4-FF.

A compound fissure (CF) is a transverse defect with characteristics similar to the transverse fissure, except that the compound fissure originates in a split in the rail head.
See Figure 4-FF.

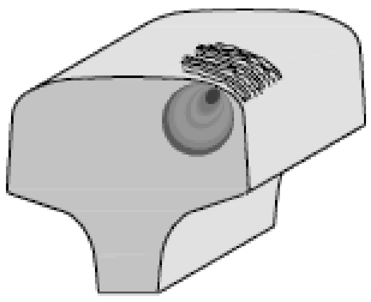


Compound Fissure Transverse Fissure

Figure 4-FF

M. A Detail Fracture (DF)

A detail fracture is a progressive fracture originating at or near the surface of the rail head. See Figure 4-GG.

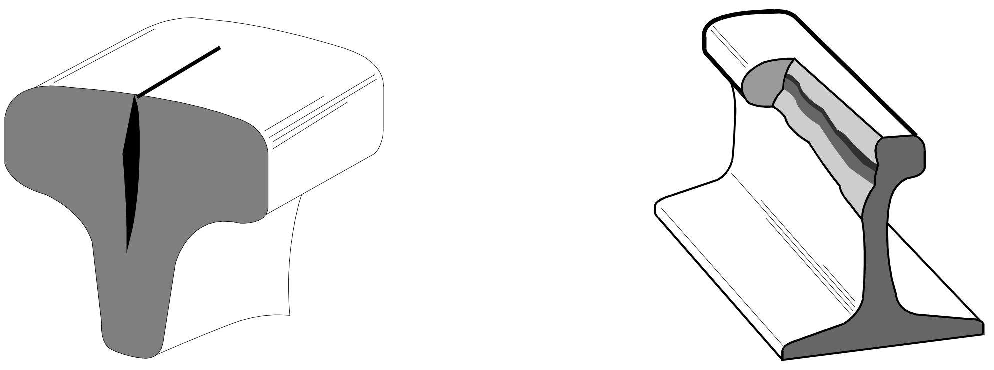


Detail Fracture

Figure 4-GG

N. Vertical Split Head (VSH)

A vertical split head is a vertical split in the head of the rail. It can sometimes be detected by a dark streak that appears on the running surface of the rail head. A rust streak may appear under the head close to the web. See Figure 4-HH.

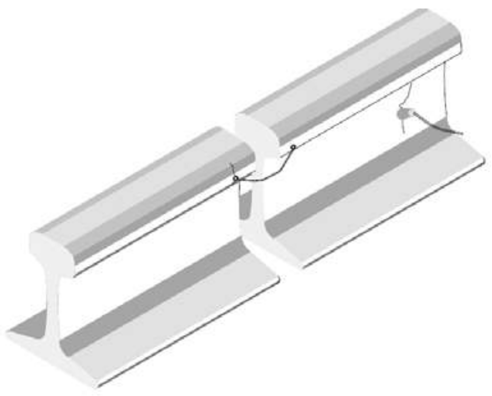


Vertical Split Head

Figure 4-HH

O. Signal Bond Drilled (SBD)

A crack in the rail that developed out of a drilled bond wire. Could be in the rail head or web of the rail. See Figure 4-II.

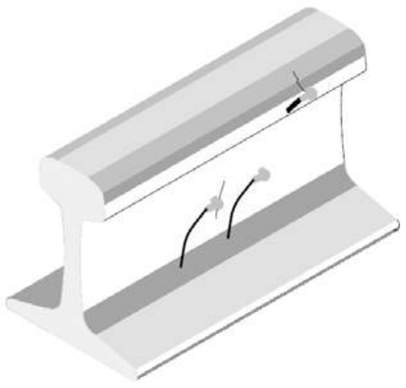


Signal Bond Drilled

Figure 4-II

P. Signal Bond Thermite (SBT)

A crack in the rail that developed out of a bond wire that was welded to the rail. Most common use was the CAD Weld. It could be on the rail head or the web of the rail. See Figure 4-JJ.

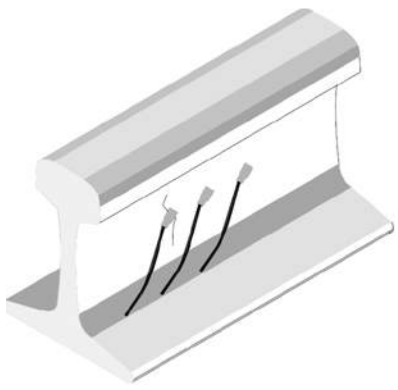


Signal Bond Thermite

Figure 4-JJ

Q. Signal Bond Electric (SBE)

A crack in the rail that developed out of a bond wire that was welded to the rail with electric current. The most commonly used electric bond is the Stanley weld. See Figure 4-KK.



Signal Bond Electric

Figure 4-KK

R. Damaged Rail (DMG-R)

Damaged rail means any rail broken or injured by wrecks, broken, flat, or unbalanced wheels, wheel slipping, or similar causes.



4.18.2 Rail Testing Frequency

Main Line rail will be inspected according to UPRR frequency requirements as specified in the TMP under the Track Assessment tab. In addition to visual inspections, a search for internal defects will be conducted on an established schedule.

The following are the minimum frequencies for internal inspection of rail on sidings, main line crossovers and connection tracks for UPRR. This is in addition to existing FRA requirements of "Inspection of rail" under Track Safety Standards, Part 213.

Rail Testing Minimum Standards 1/19/2015

4.18.2 Default Rail Testing Frequency		
Type of Territory	UPRR Minimum Frequency	Times per Year
Non-signalized main line greater than or equal to 10 MGT annually	120 Days	3
Non-signalized main line less than 10 MGT annually	182 Days	2
All main lines carrying Commuter or Passenger Traffic	90 Days	4
Class 3 and above main lines in Key Route Territories	120 Days	3
Sidings and crossovers in Key Route Territories	Once more annually than FRA requirements. Minimum 182 Days for Sidings	2
Critical Leads	182 Days	2
Connection Run Thru Tracks	182 Days	2
Sidings for C,P,M Routes (bi-directional)	182 Days	2
Sidings for Other Routes/WO Passenger	365 Days	1
Main line crossovers designated as FRA Class 3 or higher*	182 Days	2
* If not otherwise listed above		
Minimum defined as greater than the calculated frequency for the specific track.		

4.18.3 Defect Marking and Minimum Rail Removal

If a defective rail is detected by any means remove the defect. If the rail is left in the track temporarily, UPRR guidelines for Remedial Action must be followed.

Follow these requirements when removing detector car defects from track.

1. Minimum amount of rail to be removed shall be marked by detector car personnel with a metal marker item number 410-4352 on field side of rail head, see Figure 4-LL. In addition, defects shall be marked with car number, defect type, number, size and date detected in 1-inch high letters with white metal marker on web adjacent to defect.
2. Detector car personnel shall mark defects with OSHA Safety Red spray paint on both sides of the web and base in minimum 2-inch widths. Where one side or sides of the web and base are inaccessible because of permanent features, paint and place highly visible marking on or next to the head of the rail. Paint markings on long defects shall be no more than 6 feet apart, to cover defect area. See Figure 4-LL.

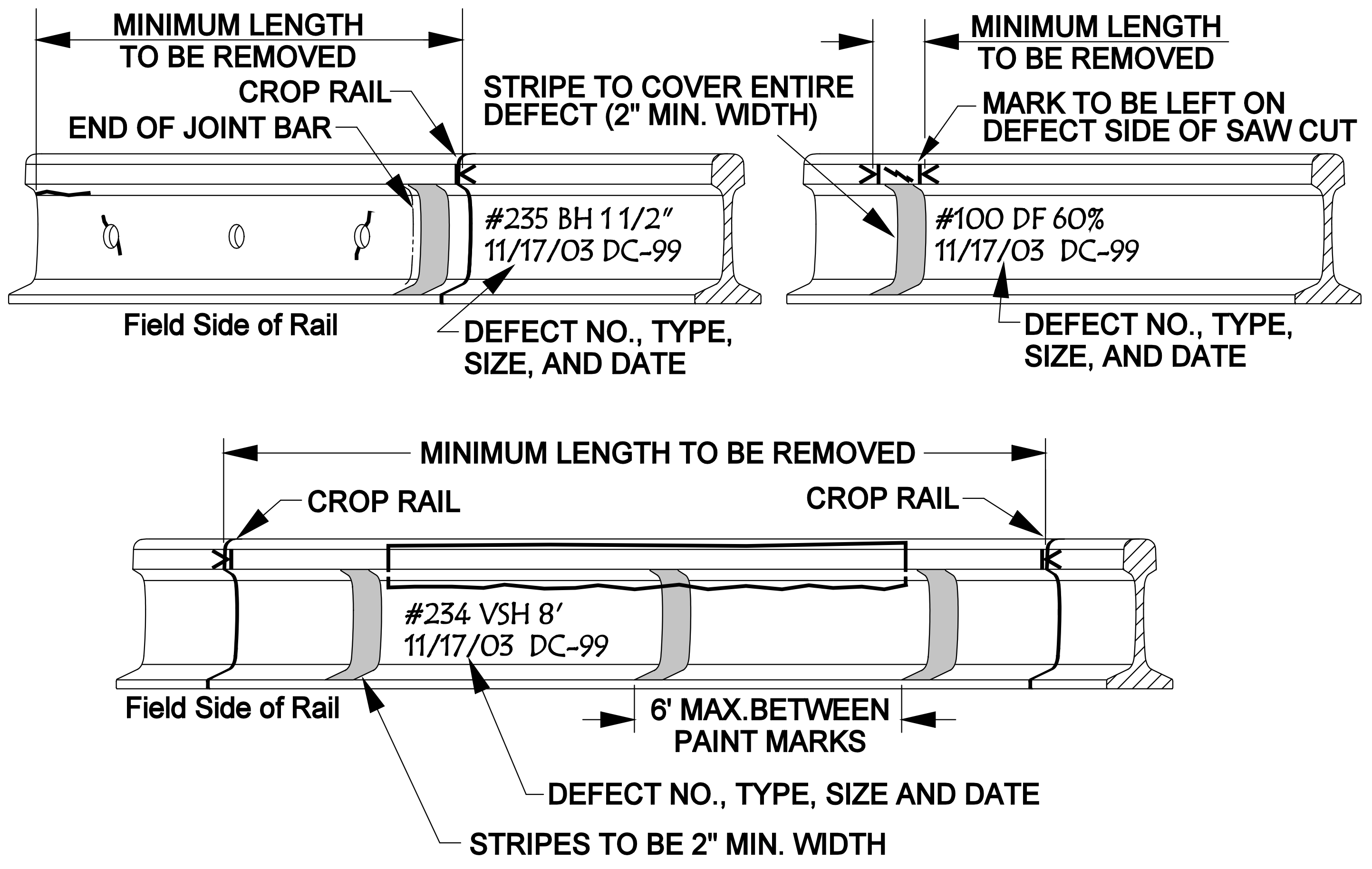


Figure 4-LL

3. Defect area shall be visually inspected after cutting to ensure defect has not grown past marked area.
4. Before removal from site, defect must be cropped from rail and cut into pieces no greater than 14 feet in length to prevent future reuse in track. If not practical to cut rail at site, it must be performed before it is placed in the scrap area to prevent the

possibility of reuse.

5. The entire rail (weld to weld) must be removed and scrapped when:
   a) More than one defect is found within the same length of rail on the same inspection.
   b) When defects are found in replacement plug rails, the entire plug rail must be replaced. (Exception to both a and b) - Bolt hole defects and head and web separations within joint areas do not require entire rail be removed or scrapped).
   c) VSH or Pipe defects are detected in rail ingot letter “A” sections.
   d) Any defect is found in the following rails manufactured by “Algoma, British, Workington, Vilru, or Bethlehem FHT.”
   e) Any defect is found in chrome alloy rails manufactured by "Klockner, Thyssen, Krupp and CFI" or any other manufactured chrome alloy rails.
6. Defective rail(s) are to be scrapped and must not stored with good replacement rails.
7. Red paint or marking must not be removed from defective rails.
8. Rail test operators shall mark defective joint bars with OSHA safety red paint with a minimum 2 inch wide, vertical mark in the center of the bar.
9. Remove/paint over previous UT-Tested or UT Certified stenciling on rail removed from track.

4.18.4 Non-Certified Rail Test

Follow these instructions when unable to make a quality rail test:

1. When a rail test operator determines that, due to rail surface conditions, a valid search for internal defect cannot be made, this section of track cannot is not classified as a certified test.
2. When valid search for internal defects cannot be made, the track, location, limits of the area which a valid test could not be obtained and the date of inspection must be documented. Then the rail test operator will enter this information into the UPRR Laptop Movement Reporting System “Rail Test Quality Database.”
3. Rail test operator will immediately notify local Manager Track Maintenance of any areas entered into the “Rail Test Quality Database.”
4. If a valid search for the internal defects is not completed before the expiration of time or tonnage limits as required by the FRA TSS 213.237, place a 25 MPH slow order on the track until a valid ultrasonic inspection is completed or remove track from service.

4.18.5 Rail Repair and Maintenance Plug Rail Replacement

Use Table 4-Q below to determine defect repair / correction options.

Rail Defect Repair Matrix - For the Reduction of Joints Installed in CWR					
Defect Type	**Cut Out Defect and Weld**		**Cut Out Defect and Wide Gap Weld**		**Cut & weld in a Plug Rail (2-welds)**
Repair Options ==>>	**Option #1**		**Option #2**		**Option #3**
CF - Compound Fracture					**X**
TF* - Transverse Fissure	**X (preferred)**	**or**	**X**	**or**	**X ***
DF* - Detail Fracture	**X (preferred)**	**or**	**X**	**or**	**X ***
DPW* - Defective Plant Weld	**X (preferred)**	**or**	**X**	**or**	**X ***
DIW* - Defective In-Track Weld	**X (preferred)**	**or**	**X**	**or**	**X ***
DIW-H - Defective In-Track <u>Head Repair Weld</u>					**X ***
DFW-B - Defective Field Weld - Boutet			**X (preferred)**	**or**	**X**
DFW-O - Defective Field Weld - Orgothermit			**X (preferred)**	**or**	**X**
DFW-U - Defective Field Weld - Unknown			**X (preferred)**	**or**	**X**
DWG-B - Defective Wide-Gap Field Weld - Boutet					**X**
THW - Thermite <u>Head Repair Weld</u>					**X**
EBF - Engine Burn Fracture					**X**
BH - Bolt Hole Crack					**X**
HW - Head Web Separation					**X**
SW - Split Web					**X**
SBT, SBE or SBD - Signal Bond (Thrmit, Elec, Drill)					**X**
HSH - Horizontal Split Head					**X**
VSH - Vertical Split Head					**X**
PR - Pipe Rail					**X**
CH or FR - Crushed Head or Flattened Rail					**X**
SSC - Shell, Sliver, Corrugation					**X**
SSC-W - Shell, Sliver, Corrugation @ Weld	**X (preferred)**	**or**	**X**	**or**	**X ***
DMG-R - Damaged Rail					**X**
BB - Broken Base (Longitudinal break)					**X**
BB - Broken Base (Transverse break)	**X (preferred)**	**or**	**X**	**or**	**X ***
SR - Ordinary Break/Sudden Rupture	**X (preferred)**	**or**	**X**	**or**	**X ***
All Repairs to be made in option order (Option #1 first and Option #3 last).					

Table 4-Q

Form 7913, “Instructions for Inspecting, Welding and Grinding of Rail and Track Components” applies to all of the above.

* When repairing DF, TF, DIW, DPW or DFW – X, refer to Section 4.13 Field Welding (Thermite) for detailed joint and weld placement information.

<u>Defect Repair</u>

A. Follow these requirements for defects that can be removed without a rail change.

Rail test operator will mark outermost limits and centerline of defect on side of rail head.

- If cutting rail for immediate thermite welding, follow steps B. #1 through #6.
- If not setting up rail ends for immediate welding, but welding is planned, skip to C. #1 through #4.
- If welding out a defect that had been cut and drilled, with joint bar application, skip to D. #1 through #6.

B. Immediate Thermite welding

1. Use reference marks as outlined in Section 7.9.2 Placing Reference Marks.
2. Adjust rail anchors to prevent rail movement.
3. Make saw cuts for weld gap needed. Cuts must be at or beyond the rail test operator’s marks to ensure entire defect is removed.
4. When the rail test operator’s marks are missing, do the following:
   Cut and remove 1-3/8” minimum, on each side of defect or cut centerline.
5. Make a visual inspection of the rail ends to make sure there are no cracks or signs of defect still present. If indication of defect is still present, more rail must be removed until no signs are present.
6. When necessary, use a rail puller to hold rail in position or pull rail back together.
7. Follow CWR adjust policy and welding procedures to weld rail ends together.

C. Cut and Drill for Joint Bar Application – Defect welding out planned

1. Use reference marks as outlined in Section 7.9.2 Placing Reference Marks.
2. Adjust rail anchors tight against ties and make saw cuts needed to remove entire defect marked by the operator. See Figure 4-MM.
3. When necessary, use a rail puller to hold rail in position or pull rail back together.
4. Drill only the outermost 4 bolt holes and apply joint bars. Bolt holes and rail ends to be beveled and slotted per Standard Drawing No. 0745. To de-burr and bevel holes drilled in the field, use abrasive stone (Item Number 411-3867).

D. Welding out a defect where a single cut was made or joint bars only were applied.

1. Use reference marks as outlined in Section 7.9.2 Placing Reference Marks.
2. Adjust rail anchors to prevent rail movement.
3. Two additional saw cuts may be required to remove the defect. Make saw cuts on both sides of the rail gap at or beyond the existing rail test operator’s marks to ensure entire defect is removed. Ensure gap is correct for the type of weld to be used (standard or wide gap thermite weld).
4. When defect was not removed with two saw cuts at an earlier time and the rail test operator’s marks are missing, do the following: Cut and remove 1-3/8” on each side of original saw cut centerline; and install a wide gap weld.
5. When necessary, use a rail puller to hold rail in position or pull rail back together.
6. Follow CWR adjust policy and welding procedures to weld rail ends together.

   See example of rail marking in Figure 4-MM.

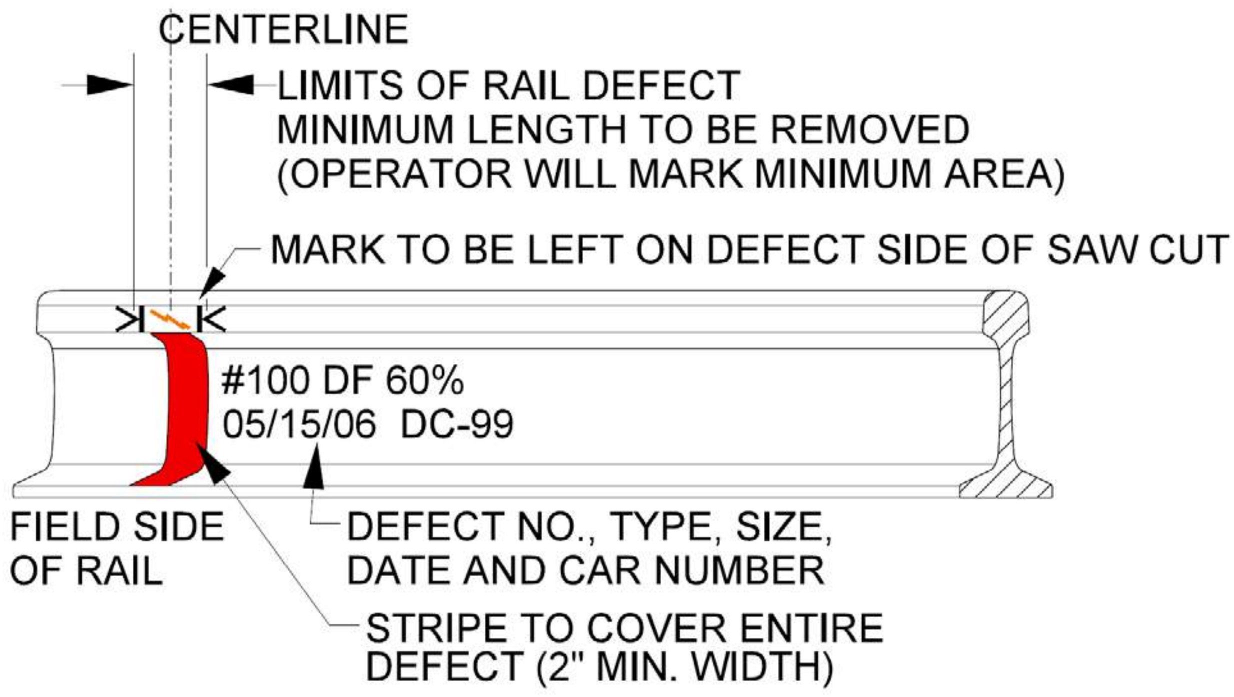


Figure 4-MM

E. Main Line Maintenance Replacement Rails

When defects are found by a detector car or a service failed rail occurs, replace rail with UT Tested or UT Certified rail as follows:

All rails installed are to be consistent with appropriate length, plug rail specification and rail chemistry per existing instructions. (Section 4.3.1 A. through C and Form 7913, “Instructions for Inspecting, Welding and Grinding of Rail and Track Components”. Worn rail must not have more than ¼” vertical mismatch or ¼” horizontal gage face mismatch. Replacement rail surface condition must be equal or better than adjacent rail in track.

Undesirable rail surface conditions include wheel burns, corrugation, shelling, slivers, spalling or heavy head checking, all of which could hide internal defects.

- New rail or rail newer than rail in track is to be used for individual rail replacements in territories where rail is less than three years old. (New rail that has never been installed in track was tested at the manufacturer). When installing a new rail, Write “New Rail” and “Installed – Current date” on rail web with a permanent rail marker

- **All Main Lines and Controlled Sidings -** Use replacement rails with a roll date no older than 1975 for133# and 136# rail sections.

Rail older than 1975 for 133# and 136# rail sections which is released from the mainline may be used as replacement rail **only when All provisions described below are met**: 1. Manufacture date and rail chemistry are the same as or an improvement to the adjacent rail sections where the rail will be installed. *(Refer to: 4.2.4 – Rail Chemistry and 4.3.1, A. Manufacturing Process Restrictions)* 2. Non A-rail AND Control cooled (*Refer to Section 4.2.3 – Hydrogen Elimination)* 3. Rail is UT Certified / Tested and properly marked on each side of the rail web.

- **Other Tracks –** Use controlled cooled rails.
- **Restricted Use Maintenance Rail —** A-rails and non-controlled cooled rails are to be used in yard, back or industry tracks only. These rails must be separated in inventory upon inspection and identification. Non-controlled cooled rails (pre-1937) are not to be used in welded strings. When rail cannot be identified because of corrosion, rust scaling or otherwise, assume that the rail is an "A-rail" and inventory as such. Under current policy, no A-rails or non-controlled cooled rails may be purchased. A-rail is limited to secondhand rail relay, Class 3 usage. Rail manufactures after 1938 identified controlled cooled rail by "CC", "VT" or "OP" on Brand side of rail. * *Note: All rail manufactured in the United States after 1937 is controlled cooled rail, although "CC" may be not present on the Brand side.* A-rail is identified on stamp side of rail following heat number. See Sections 4.2.1 Rail Branding and 4.2.2 Rail Stamping.

4.18.6 Remedial Action Required

Use Table 4-R to determine the required action for rail defects.

NOTE: In the following table, the symbol > means greater than.

The table below outlines major changes from the previous Rail Defect Remediation Matrix

Defect Type	Change (NEW)	*Previous Matrix*
Compound Fissure (CF) & (CF-G)	Only one Repair option - This requires the rail to be replaced. Joint bars are applied to reduce risk until the rail is replaced.	*No change*
Transverse Fissure (TF)	Now Requires the Same Remediation as a Detail Fracture (DF)	*Was the same as CF*
DF, EBF, and Weld Defects Less than 25%	Requires joint bars to be applied within **10 Days** When not applied within 10 days, track speed must not exceed **10 MPH**	*Was 20 days, then Out-of-Service*
DF, EBF, and Weld Defects 25% or greater, but **less than 60%**	Requires joint bars to be applied within **7 Days** When not applied within 7 days, track speed must not exceed **10 MPH**	*Was 10 days and >80%, then Out-of-Service*
DF, EBF, and Weld Defects **60% or greater**	**10 MPH** until Joint Bars are applied AND Joint bars must be applied within **7 Days**	*Was 10 days to 80% then Out-of Service*
Longitudinal Weld Defects (Visual or found with UT)	Horizontal Defects found in Welds - Apply Remediation per Split Web (SW) according to length of defect. When there is any transverse component to the defect, Apply the most restrictive remediation	*New FRA classification for weld defects*
BH, HW, HSH, VSH & Pipe	Reinspect Option starts over with each reinspection. When found with anything other than visual, reinspect must include the ability to resize the defect. (Found with UT, reinspect with UT)	*Reinspection was only defined in the FRA Compliance Manual*
Crushed Head (CH)	Depth ≥3/8" and length ≥8" or deformation under the rail head. *This also applies to Flattened Rail (FR)*	*Was not classified by FRA*

Table 4-R

Defect Type	Applies to Main Tracks on: > Critical, Premium and Major Service Routes > All Passenger Train Routes > Main Lines Greater than 20 MGT Annually			Applies to All Other Tracks Tested			Minimum Remedial Code, When not removed ahead of trains
	Percent of existing rail head cross-sectional area weakened by defect		Required Action	Percent of existing rail head cross-sectional area weakened by defect		Required Action	
	Less Than	But Not Less Than	If defective rail is not replaced or repaired, take the remedial action prescribed in note	Less Than	But Not Less Than	If defective rail is not replaced or repaired, take the remedial action prescribed in note	
Compound fissure (CF) & (CF-G)	25%	1%	Limit operating speed over defect to 30 MPH. Apply joint barswithin 48 hours.	70%	1%	limit operating speed, not to exceed 30 MPH over defect. Apply joint bars within 10 days in class 1 & higher.	B
	70%	25%	Limit operating speed over defect to 10 MPH until joint bars are applied, thereafter 30 MPH. Apply joint bars within 48 hours				
	100%	70%	After visual inspection, limit operating speed over defect to 10 MPH or less. If not replaced the same day, apply joint bars. Replace or repair rail within 24 hours.	100%	70%	After visual inspection, limit operating speed, not to exceed 10 MPH over defect. Visually inspect within each 24 hour period or replace rail. Apply joint bars within 5 days in class 3 & higher and within 7 days in class 1 & 2 track.	A2
		100% (CO)	Visually supervise each movement over defective railm not to exceed 10 MPH. Replace or repair rail within 24 hours.		100% (CO)	Visually supervise each movement over defective rail, not to exceed 10 MPH. Apply joint bars within 5 days in calss 3 & higher and within 7 days in calss 1 & 2 track.	A
	(CO) " Crack Out" is a visual crack in rail head						

Table 4-R (cont.)

Defect Type	Applies to Main Tracks on: > Critical, Premium and Major Service Routes > All Passenger Train Routes > Main Lines Greater than 20 MGT Annually			Applies to All Other Tracks Tested			Minimum Remedial Code, When not removed ahead of trains
	Percent of existing rail head cross-sectional area weakened by defect		Required Action	Percent of existing rail head cross-sectional area weakened by defect		Required Action	
	Less Than	But Not Less Than	If defective rail is not replaced or repaired, take the remedial action prescribed in note	Less Than	But Not Less Than	If defective rail is not replaced or repaired, take the remedial action prescribed in note	
Transverse Fissure (TF) - Detail Fracture (DF) & (DF-G) - Engine Burn Fracture (EBF) - Defective Field Weld Boutet (DFW-B) ' - Defective Field Weld Orgothermit (DFW-O) ' - Defective Field Weld Unknown Mfg. (DFW-U) ' - Defective Wide Gap Weld (DWG-B) ' - Defective Plant Weld (DPW) - Defective In-Track Weld (DIW) - Defective Head Repair Weld (DSW or THW)) - Signal Bond (SBT, SBE & SBD) in head of rail	25%	1%	Limit operating speed to 50 MPH and replace or repair rail within 4 days. If rail not replaced or repaired, restrict to 30 MPH until joint bars are applied and 50 MPH thereafter. Apply bars within 10 days in class 1 & higher. When joint bars have not been applied within 10 days, limit operating speed to 10 MPH	25%	1%	Limit operating speed to 50 MPH and replace rail within 4 days. If rail not replaced, restrict to 30 MPH until bars are applied and 50 MPH thereafter. Apply joint bars within 10 days in class 1 & higher. When joint bars have not been applied within 10 days, limit operating speed to 10 MPH	C
	60%	25%	Limit operating speed over defect to 30 MPH Until joint bars are applied, thereafter 50 MPH. Joint bars must be applied within 5 days in class 1 & higher. When joint bars have not been applied within 7 days, limit operating speed to 10 MPH	60%	25%	Limit operating speed over defect to 30 MPH Until Joint Bars are applied, there after 50 MPH. Apply joint bars within 5 days in class 3 & higher and within 7 days in class 1 & 2 track. When joint bars have not been applied within 7 days, limit operating speed to 10 MPH	D
	100%	60%	After visual inspection, limit operating speed over defect to 10 MPH joint bars are applied, thereafter limit operating speed to 50 MPH. Apply joint bars within 24 hours. Make a Visual inspection within each 24 hours util joint bars are applied; rail is replaced or repaired.	100%	60%	After visual inspection, limit operating speed over defect to 10 MPH and make a visual inspection within each 24 hours period OR Apply joint bars, thereafter limit operating speed to 50 MPH. Apply joint bars within 5 days in class 3 & higher and within 7 days in class 1 & 2 track.	A2 or (E and H)
		100% (CO)	Visually supervise each operation over the defect & limit operating speed over defect to 10 MPH until joint bars are applied, thereafter limit operating speed to 50 MPH. Apply joint bars within 24 hours.		100% (CO)	Visually supervise each operation over the defect & limit operating speed over defect to 10 MPH. OR Apply joint bars and limit operating speed to 50 MPH. Apply joint bars within 5 days in class 3 & higher and within 7 days in class 1 & 2 track.	A or (E and H)
See "Repair" definition below.	(CO) " Crack Out" is a visual crack in rail head						

Table 4-R (cont.)

Defect Type	Applies to Main Tracks on: > Critical, Premium and Major Service Routes > All Passenger Train Routes > Main Lines Greater than 20 MGT Annually — Length of Defect: More Than	Length of Defect: But Not More Than	Required Action — If defective rail is not replaced or repaired, take the remedial action prescribed in note	Applies to All Other Tracks Tested — Length of Defect: More Than	Length of Defect: But Not More Than	Required Action — If defective rail is not replaced, take the remedial action prescribed in note	Minimum Remedial Code, When not removed ahead of trains
Horizontal Split Head (HSH) - Vertical Split Head (VSH) - Split Web (SW) - Signal Bond (SBT, SBE & SBD) in web of rail - Pipe Rail (PR) - Head & Web Separation (HW) ----- (HW - within joint bars or spring rail frog See notes below)	0"	1"	Replace rail within 14 days.	0"	1"	No Requirement	NRA
	1"	2"	Limit operating speed over defect to 50 MPH & Replace rail within 14 days.	1"	2"	Limit operating speed to 50 MPH or maximum allowable speed for class of track. If rail not replaced, inspect rail [3] in 90 days.	H and F
	2"	4"	Limit operating speed over defect to 30 MPH & Replace rail within 14 days.	2"	4"	Limit operating speed, not to exceed 30 MPH over defect. If rail not replaced, inspect rail [3] in 30 days .	I and G
	4"		Visually inspect and determine if safe to continue operation over the defect & limit operating speed over defect to 30 MPH. Replace Rail within 24-hours.	4"		Limit operating speed, not to exceed 30 MPH over defect. If rail not replaced, inspect rail [3] in 15 days.	B
	Break out in rail head		Visually supervise each operation over the defect & limit operating speed over defect to 10 MPH until rail is replaced.	Break out in rail head		Visually supervise each movement over defective rail, not to exceed 10 MPH.	A
Additional Required Actions HW within Joint Area	1/2"	1"	Replace rail within 48 hrs.	1/2"	1"	Replace rail within 14 days	NRA
	1"		Replace rail within 24 hours.	1"		Replace rail within 7 days.	Use above sizes for remedial
HW in Spring rail frog	0"	NA	Replace per FRA Track Safety Standards Part 213.139 (c)	NA	NA	Replace per FRA Track Safety Standards Part 213.139 (c)	213

Table 4-R (cont.)

Defect Type	Applies to Main Tracks on: > Critical, Premium and Major Service Routes > All Passenger Train Routes > Main Lines Greater than 20 MGT Annually			Applies to All Other Tracks Tested			Minimum Remedial Code, When not removed ahead of trains
	Length of Defect		Required Action	Length of Defect		Required Action	
	More Than	But Not More Than	If defective rail is not replaced or repaired, take the remedial action prescribed in note	More Than	But Not More Than	If defective rail is not replaced, take the remedial action prescribed in note	
Bolt Hole Crack (BH) Note: BH defect found in spring rail frog *See below*	* 0"	1/2"	Replace rail within 30 days.	0"	1/2"	No Requirement	NRA
	1/2"	1"	Limit operating speed over defect to 30 MPH & Replace rail within 7 Days	1/2"	1"	Limit operating speed, not to exceed to 50 MPH over defect. If rail not replaced, inspect rail [3] in 90 days.	H and F
	1"	1 1/2"	Limit operating speed over defect to 30 MPH & Replace rail within 7 Days	1"	1 1/2"	Limit operating speed not to exceed 50 MPH over defect. If rail not replaced, inspect rail [3] in 30 days.	H and G
	1-1/2"		Limit operating speed over defect to 10 MPH & Replace rail within 14 days.	1 1/2"		Limit operating speed, not to exceed 30 MPH over defect.	B
	Break out in rail head		Visually supervise each operation over the defect & limit operating speed over defect to 10 MPH until rail is replaced.	Break out in rail head		Visually supervise each movement over defective rail, not to exceed 10 MPH.	A
BH in Spring rail frog	0"	NA	Replace per FRA Track Safety Standards Part 213.139 (c)	NA	NA	Replace per FRA Track Safety Standards Part 213.139 (c)	213
	* No remedial action is required for Bolt Hole defects under the following conditions: > Defects less than 1/4" in size that cannot be visually verified after bars are removed. Note: BH defect found in spring rail frog shall be replaced regardless of size – Reference FRA, Track Safety Standards, Part 213.139 (c)						
Broken Base (BB) - Signal Bond (SBT, SBE & SBD) attached to base of rail	0"	2"	Limit operating speed over defect to 30 MPH until Joint Bars are applied, there after 50 MPH. Replace Rail within 48 hours.	0"	6"	Limit operating speed over defect to 30 MPH until joint bars are applied, there after 50 MPH. Apply joint bars within 5 days in class 3 & higher and within 10 days in class 1 & 2 track.	D
	2"		After visual inspection and determined safe to continue in operation, limit operating speed to 10 MPH and supervise each movement over defect until joint bars are applied, thereafter 30 MPH. Replace Rail within 48 hours.	6"		Visually supervise each movement over defective rail, not to exceed 10 MPH OR Apply joint bars, thereafter limit operating speed to 30 MPH. Apply joint bars within 5 days in class 3 & higher and within 10 days in class 1 & 2 track	A or (E and I)

Table 4-R (cont.)

4.0 RAIL & JOINTS

Defect Type	Applies to Main Tracks on: > Critical, Premium and Major Service Routes > All Passenger Train Routes > Main Lines Greater than 20 MGT Annually			Applies to All Other Tracks Tested			Minimum Remedial Code, When not removed ahead of trains
	Length of Defect		Required Action	Length of Defect		Required Action	
	More Than	But Not More Than	If defective rail is not replaced or repaired, take the remedial action prescribed in note	More Than	But Not More Than	If defective rail is not replaced, take the remedial action prescribed in note	
Ordinary Break	N/A		Visually supervise each operation over the defect & limit operating speed over defect to 10 MPH or less, until application of joint bars. Apply joint bars within 24 hours.	N/A		Visually supervise each operation over the defect & limit operating speed over defect to 10 MPH or less, until application of joint bars. Apply joint bars within 24 hours.	A or E
Shell, Sliver, Corrugation (SSC) & (SSC-W) *	N/A		Replace rail or repair within required days per SSC Route Class Remediation Table below [2]. Maintenance officer designated under FRA 213.9 is required to visually inspect within 7-days [4]	N/A		Replace rail or repair within required days per SSC Route Class Remediation Table below [2]. Maintenance officer designated under FRA 213.9 is required to visually inspect within 14-days [4]	NRA
	On or within 500 feet of bridge[5]		Limit operating speed to 30 MPH. Replace rail within 30 days [2]. Maintenance officer designated under FRA 213.9 is required to visually inspect within 7-days [4]	On or within 500 feet of bridge[5]		Limit operating speed to 30 MPH. Replace rail within 30 days [2]. Maintenance officer designated under FRA 213.9 is required to visually inspect within 7-days [4]	NRA
Flattened Rail (FR) - Crushed Head (CH)	Depth ≥ 3/8" and length ≥ 8" or deformation under the rail head		Replace rail or repair within required days per SSC Route Class Remediation Table below [2]. Maintenance officer designated under FRA 213.9 is required to visually inspect within 7-days [4]	Depth ≥ 3/8" and length ≥ 8" or deformation under the rail head		Replace rail or repair within required days per SSC Route Class Remediation Table below [2]. Maintenance officer designated under FRA 213.9 is required to visually inspect within 7-days [4]	H
Damaged Rail (DMG-R)	N/A		Limit operating speed over defect to 30 MPH until joint bars are applied, there after 50 MPH. Apply joint bars within 5 days	N/A		Limit operating speed over defect to 30 MPH until joint bars are applied, there after 50 MPH. Apply joint bars within 5 days in class 3 & higher and within 10 days in class 1 & 2 track.	C
All Inspections, restrictions or remedial actions will be performed by Supervisor / person qualified & designated under U.S. DOT Track Safety Standards 213.7(a) in Track Class 1 - 5 and 213.305 in Track Class 6 & higher. Supervisor may apply more restrictive remedial action to insure safe train operation over defect.							

Table 4-R (cont.)

SSC Route Class Remediation Table							
	Route Class:	Critical		Premium		Major	Other
	Applies to Main Tracks with the following Annual MGT:	Less than 50 MGT	50 MGT or Greater	Less than 50 MGT	50 MGT or Greater	No MGT Requirement	No MGT Requirement
Defect Type	Length of Defect						
Shell, Sliver, Corrugation (SSC) & (SSC-W) * - Flattened Rail (FR) - Crushed Head (CH)	Less than 3 feet	40 Days	35 Days	40 Days	35 Days	50 Days	60 Days
	3 to 10 feet	40 Days	30 Days	40 Days	35 Days	50 Days	60 Days
	Greater than 10 feet	40 Days	20 Days	40 Days	30 Days	40 Days	60 Days
	When defect is not corrected within the day requirement above, limit operating speed over defect to 30 MPH for Freight trains or 40 MPH for Passenger trains [2].						
	On or within 500 feet of bridge[5]	Limit operating speed to 30 MPH. Replace rail within 30 days [2].					

Table 4-R (cont.)

Definitions and Notes
* Definition: Shell, Sliver, Corrugation are locations where, rail defects may originate or may be hidden under surface conditions. These defects are at risk of not being detected by ultrasonic test systems. SSC defects are usually localized surface conditions between 8-inches and one rail length. SSC-W (Battered Welds SSC) defects usually begin within 6" of welds.
[1] Note: Thermite Field Weld Defects – Standard joint bars may not be applied without excessive grinding and risk of failure. For these reasons, weld or rail must be replaced prior to expiration of days required by UPRR and FRA TSS § 213.113 or § 213.337 to apply joint bars. Field weld straps are <u>not</u> joint bars.
[2] Note: If not removed or repaired within the days required, a variance must be requested and given by the Region Chief Engineer, General Director or higher company officer.
Clarification: [2] Note above applies to <u>All</u> defects not removed or repaired within the required days
[3] Note: "Inspect rail" means: Inspect rail within "required" days after it is determined to continue the track in use. If the rail remains in track and is not replaced or repaired, the reinspection cycle starts over with each successive reinspection unless the reinspection reveals the rail defect to have increased in size and has therefore become subject to a more restrictive remedial action. This process continues indefinitely until the rail is removed from track or repaired. If not inspected within "required" days, limit speed to Class 2 or the maximum allowable speed under 213.9 for the class of track concerned, whichever is lower, until inspected.
[4] Note: Maintenance officer's inspection will be performed by MTM, designated region officer or ARASA qualified under FRA, TSS §213.7. This is an on the ground, visual inspection of the rail to determine if track is to remain in service and /or determine if a more restrictive speed is needed.
[5] Bridge means: Any structure with a deck or undergrade structure with spans 10 feet or greater in length, which supports one or more railroad tracks.
"Repair" means Remove Entire Defect or Defective Weld as marked, adjust rail as required and Apply joint bars or Weld rail.
Application of joint bars associated with remediation of CF and CF-G defects are UP requirements to reduce risk until defect is repaired or rail is replaced. Remediation requires removing the entire defect in all FRA Track Classes.
Apply joint bars, means: Drill the outermost four holes, two on either side of defect and securely bolt a joint bar to each side of rail. Rail weights greater than 112 LB require 36" or longer joint bars.
Limit Operating Speed, means the same as "Speed is Not to Exceed"
New Defect Classifications - 8/2006 added: Signal Bond (SBT, SBE & SBD) are defects originating in signal bond process or application. SBT = Signal Bond Thermite (CAD WELD), SBE = Signal Bond Electric and SBD = Signal Bond Drilled. Defective Slot Weld (DSW) is a defect originating from slot welding process used to repair some head defects. 10/2008 added: DF-G = Detail Fracture found with D-car gage ultrasonic Wheel. CF-G = Compound Fracture found with D-car gage ultrasonic wheel
Inspect rail means: Inspect rail within "*required*" days after it is determined to continue the track in use. If the rail remains in track and is not replaced or repaired, the reinspection cycle starts over with each successive reinspection unless the reinspection reveals the rail defect to have increased in size and has therefore become subject to a more restrictive remedial action. This process continues indefinitely until the rail is removed from track or repaired. If not inspected within "required" days, limit speed to Class 2 or the maximum allowable speed under 213.9 for the class of track concerned, whichever is lower, until inspected.
Longitudinal Defects found in Welds - Apply Remediation per Split Web (SW) according to length of defect. When there is any transverse component to the defect, Apply the most restrictive weld defect remediation.

Table 4-R (cont.)

DPW and DIW Remediation:

When joint bars are applied to a defective flash butt weld (Plant Weld or In-Track Weld) as part of temporary remediation, do the following:

- Overflow metal must be completely ground off to rail profile, ensuring complete removal of the overflow metal from the Fishing area under the head and base of the rail. *Failure to completely remove the metal overflow will cause the joint bar to bind on the upset metal and prevents contact with the rail, resulting in a service failure.*

When overflow metal cannot be completely removed by grinding, standard joint bars must not be applied. In an emergency, as a temporary repair to pass trains over a broken rail, apply field welds straps and a maximum 10 MPH Slow Order. Field weld straps are **not** joint bars and must not be used in place of standard joint bars.

Insulated Joint:

Requirements for inspection and remedial actions for defective insulated joints are located in Section 8.6.15 Insulated Joint Bar Inspections.

4.18.7 Maintenance Replacement Rail Certification

All maintenance rail installed in the following tracks shall be ultrasonically tested for internal rail defects and be certified defect free:

- All track referenced in Section 4.18.2 Rail Testing Frequency.
- All other tracks as designated by the Chief Engineer.

All maintenance rails shall be marked with the following information:

- Method of certification (UT TESTED or UT CERT) stenciled on the rail web in yellow.
- Employee ID or Vendor Number certifying rail.
- **Date Last Tested.**
- **MGT Since Last Test for UT CERT rail.**

If rail is installed and no certification markings are on the rail:

- Limit operating speed to 25 mph until ultrasonic inspection is complete. Use slow order code T-20.

Replacement rails shall be certified in one of these three methods prior to installation.

A. Rails certified by field maintenance personnel

This method involves field personnel certifying rail, provided that they have a personal knowledge of the last ultrasonic test prior to being removed from service. This method will be used in the following situations:

1. Rail is removed from main track and either re-installed or stock piled for later installation at designated locations.

Note: Replacement plug rail must not contain head repair welds or thermite welds of any kind. All bond pin holes shall be no closer than 18 inches to either end of plug. Plant or In-Track Welds must be no closer than 30 inches from either end.

2. If a certified plug rail is cropped into smaller sections, employee shall copy certification information to rail web of all sections that meet UPRR length requirements and include their employee ID#.

Note: When removing rail from main line tracks, obtain the date last tested and accumulated tonnage since last test found in the TMP under the Track Assessment > Rail Certification.

3. Rail must have been removed from main track within 10 MGT of last full ultrasonic inspection for internal defects.
4. Rails not removed within 10 MGT of the last ultrasonic inspection shall be UT tested prior to reinstallation in applicable trackage.
5. Rail removed from sidings where current tonnage is not available, may be certified for reuse if ultrasonic inspection is within the last 90 days AND less than 10 MGT.
   Use adjacent mainline tonnage to calculate MGT since last test.
   MGT Since Last Test Calculation:
   ("Annual MGT" / 365 days) X "Days Since Test" = MGT Since Test
   Example: Annual MGT for Sub "A" = 183 MGT and it's been 10 days since the detector car tested this rail, then:
   183/365 = .5 MGT/day
   .5 MGT multiplied by 10 days = 5 MGT Since Last Test
6. Write last test date and MGT since last test on rail web. See Figure 4-NN below.

Note: Revision to FRA rule 213.237 (c) – Inspection of Rail

Internal rail inspections on Class 4 and 5 Track, or Class 3 Track with regularly-scheduled passenger trains or that is a hazardous material route, shall not exceed a time interval of 370 days between inspections or a tonnage interval of 30 mgt between inspections, whichever is shorter. Internal rail inspections on Class 3 Track that is without regularly-scheduled passenger trains and not a hazardous material route must be inspected at least once each calendar year, with no more than 18 months between inspections, or at least once every 30 mgt, whichever interval is longer, but in no case may inspections be more than 5 years apart.

(1) Any rail used as replacement plug rail in track that is required to be tested in accordance with this section must have been tested for internal rail flaws.

(2) The track owner must verify that any plug rail installed after March 25, 2014 has not accumulated more than a total of 30 mgt in previous and new locations since it's last internal rail flaw test, before the next test on the rail required by this section is performed.

(3) If plug rail not in compliance with this paragraph (c) is in use after March 25, 2014, trains over that rail must not exceed Class 2 speeds until the rail is tested in accordance with this section.

B. Maintenance rail is certified in the field at designated locations

This method involves a contractor or a railroad employee to ultrasonically test, certify and mark rail for reuse.

1. Rail shall be collected and prepared for inspection by local forces. Rail surface may require wire brushing for proper testing by local forces.
2. Railroad employees or contractors will periodically test rails laid out for inspection. This testing is to be performed by joint test cars with existing equipment modified for single rail traversing or by a contractor with special equipment.
3. Rails shall have a complete ultrasonic inspection with a portable unit.
4. Rail ends shall be hand tested in areas not accessible to portable test unit.
5. Rails will be certified and marked with employee ID/vendor number, date tested and UT TESTED stenciled on web of rail.

C. Certified plug rail purchased from outside parties

This method involves an outside vendor-purchasing rail removed from UPRR track, sorting and/or testing rail and selling it back to UPRR as UT certified rail.

1. Vendor purchases and removes rail from right-of-way.
2. Vendor sorts, ultrasonically tests and certifies rails.
3. Rail is marked per these instructions.
4. Rail is furnished to the field through the regional track stores.

Table 4-S shows plug rails to be made available.

Designation	Rail Sections	Application	Vertical Wear	Horizontal Wear
PT-0 (New)	133, 136, 141	Tangent/Low Rail	0	0
PT-1	115, 119, 133, 136, 141	Tangent/Low Rail	3/32" Max	1/32" Max
PT-2	133, 136, 141	Tangent/Low Rail	5/16"	1/16"
PT-3	133, 136, 141	Tangent/Low Rail	1/2"	1/16"
PT-4	115, 119, 133, 136, 141	Tangent/Low Rail	11/16"	1/16"
PT-5	133, 136, 141	High Rail	1/8"	1/4"
PT-6	115, 119, 133, 136, 141	High Rail	1/4"	1/2"

Table 4-S

D. Marking

All replacement rails that have been certified UT Tested or UT Certified shall be marked and stenciled as follows:

1. Employee is certifying rail that has been tested within the last 10 MGT of service shall mark and stencil UT CERT, (Item Number PC-00600), 3 feet from rail end, on rail web. Stencil using Safety Yellow enamel paint. See Figure 4-NN.
2. Mark each rail 3 feet from rail end with their employee ID# or vendor identification. When using UT CERT process, mark last test UT date and MGT since last test. Markings shall be placed on web in 1-inch letters and numbers using metal marker item number 410-4352.

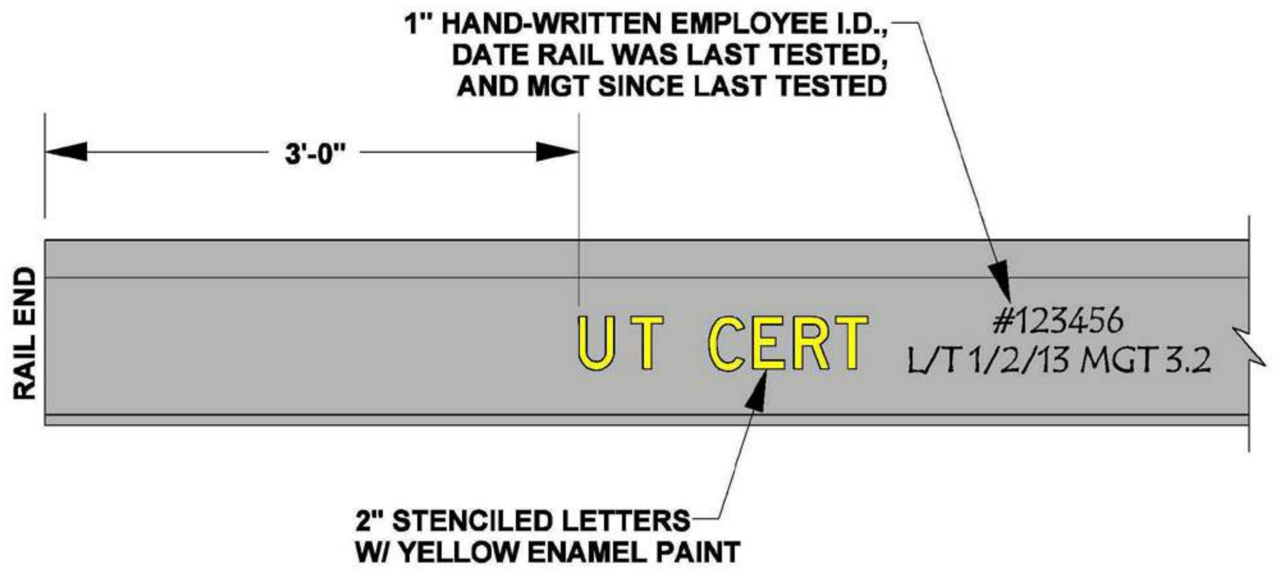


Figure 4-NN

3. **Rails with a roll date no older than 1975 for 133# and 136# rail sections.**

   Rails found to be free of internal defects via full ultrasonic inspection in a facility or with portable unit will be marked and stenciled with the following: Stencil UT TESTED, 3 feet from each rail end and a minimum of every 15 feet thereafter for rails greater than 30 feet in length, using Safety Yellow enamel paint. See Figure 4-OO-1.

4. **Rail older than 1975 for 133# and 136# rail sections. - (Limited Use)**

   Rails found to be free of internal defects via full ultrasonic inspection in a facility or with portable unit will be marked and stenciled with the following: Stencil UT LTD USE, 3 feet from each rail end and a minimum of every 15 feet thereafter for rails greater than 30 feet in length, using Safety Yellow enamel paint. See Figure 4-OO-2. Use of this rail is limited to only locations where all three provisions in Section 4.18.5, E are met. *Refer to the second bullet and the text within the boxed area.*

5. Mark rail with employee ID# or vendor identification and date inspected. When rail found to be defect free of defects via full ultrasonic inspection, employee ID# or Vendor Identification must be placed 3 feet from each rail end and a minimum of every 15 feet thereafter for rails greater than 30 feet in length. Markings shall be placed on the web in 1-inch letters and numbers using metal marker item number 410-4352.

6. To enable rail test personnel or vendor to ultrasonically test rail at field locations, then properly mark and stencil rail, field personnel must do the following:

   - Place rail on a flat surface with access for walking with portable equipment.
   - Place rail to allow full access to the rail head.
   - Space rail far enough apart to allow application of Stenciling and marking on rail web.
   - Prepare rail head by removing dirt, debris and heavy rust.
   - Inspect rail branding and heat numbers, then remove rail that does not meet requirements outlined in Section 4.18.5, E, for applicable trackage.

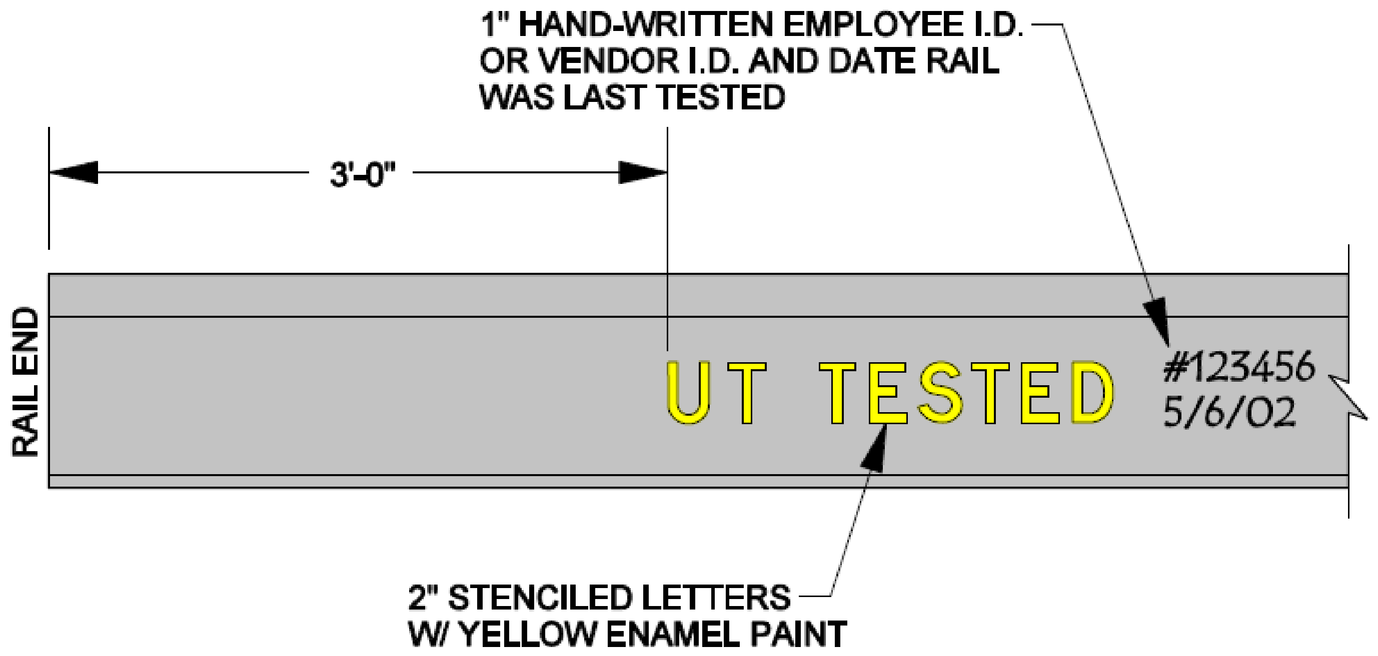


Figure 4-OO-1

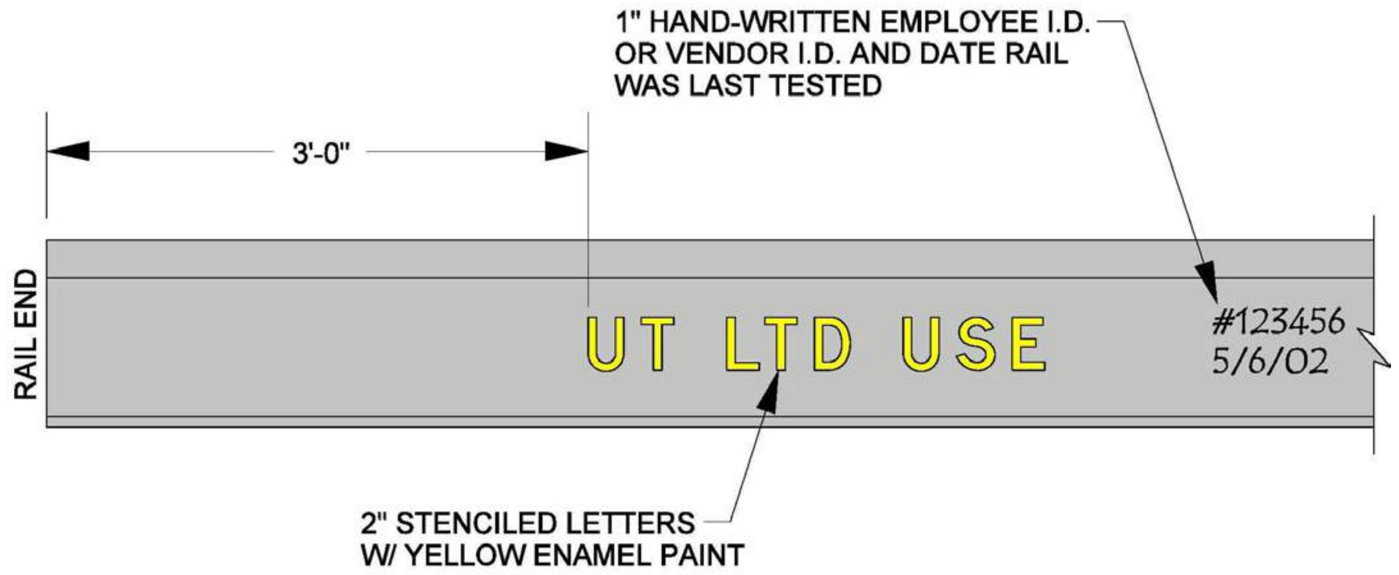


Figure 4-OO-2

7. Designated Non Main Line rail – Rail which does not meet criteria for Mainline use as defined in Section 4.18.5, E, may be acceptable for use as maintenance replacement plug rail in Yard or Industry tracks. To designate this usage, rails found to be free of internal defects via full ultrasonic inspection in a facility or with portable unit will be marked and stenciled with the following: Stencil UT Y / I, 3 feet from each rail end and a minimum of every 15 feet thereafter for rails greater than 30 feet in length, using

Safety Yellow enamel paint. See Figure 4-OO-3. Certified rail should be used as replacement maintenance rail in all critical Yard and Industry leads or tracks, when available.

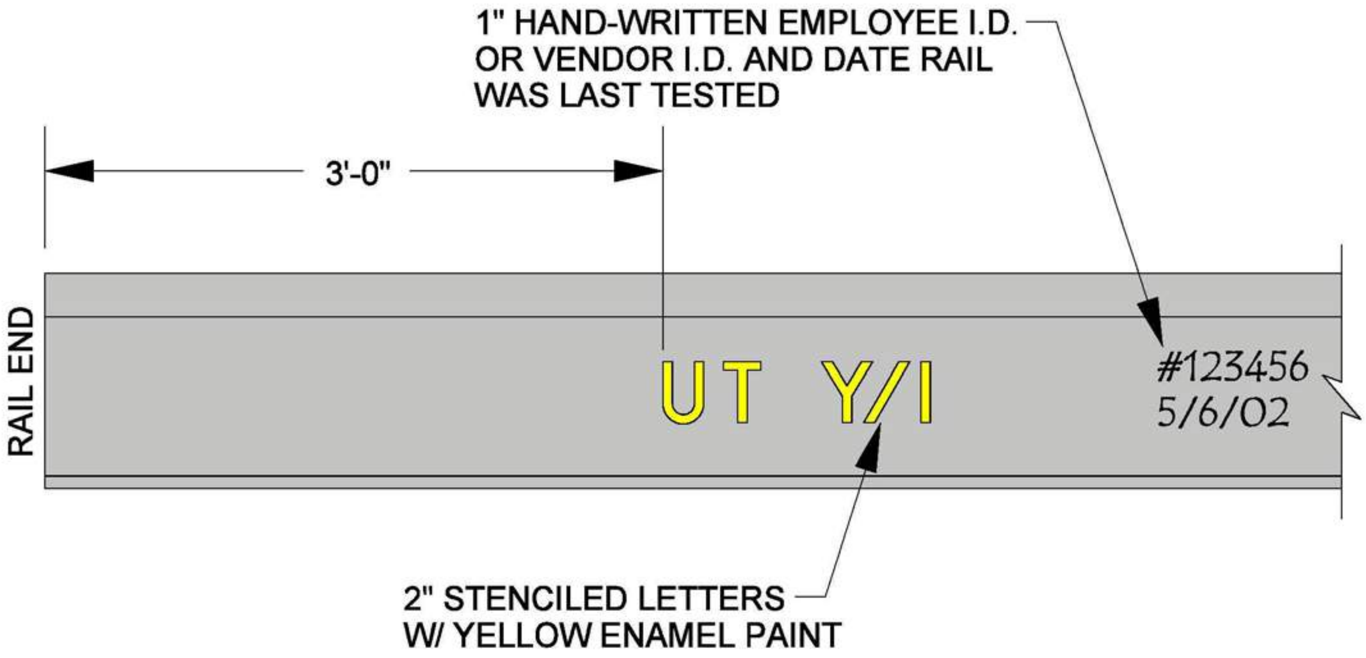


Figure 4-OO-3

8. Scrap Rail - When internal defects are found in replacement plug rail through a full ultrasonic inspection, or when the inspector finds evidence of internal defects found during a previous test, then entire rail (weld to weld) is to be scrapped. * Exception: - Bolt hole defects and head and web separations within joint areas do not require entire rail be scrapped. Refer to Section 4.18.3, Number 5, for additional rail to be scrapped. Stencil SCRAP, 3 feet from each rail end and a minimum of every 10 feet thereafter for the entire rail length, using Safety Red enamel paint. See Figure 4-PP. The SCRAP stencil is item number PC-00608.

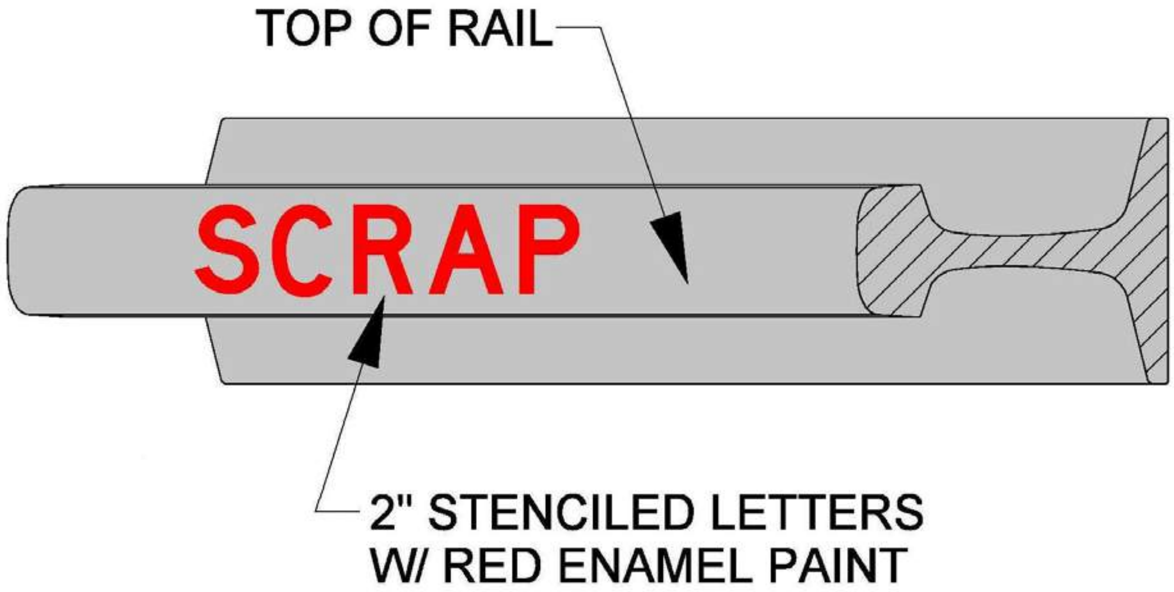


Figure 4-PP

E. New or Service Failed Rail

1. Old or previous UT TESTED or UT CERTIF. certification markings shall be removed/painted over when rails are removed on account of a Service Failure, detector car defect or during other normal maintenance rail changes and scrapped.
2. New rail is certified defect free at steel mill and does not need marked to be stenciled, if it has not been in service.
    - When new rail is used as replacement plug rail write: "NEW RAIL", date installed and employee ID, in 1-inch letters (Refer to Section 4.18.6, D. Marking, and Figure 4-NN).
3. When a rail is removed because of a service failure defect, rail must not be reused until it is ultrasonically tested.

Exception: Service failed rails with Bolt Hole, Weld or Head and Web-joint defects may be reused after cropping, provided that it meets MGT and elapsed time requirements for tested rail. These rails shall be tested or re-certified and marked per instructions.

4.18.8 Relaying Second Hand Rail Cascaded via Rail Trains

All secondhand CWR strings cascaded via rail trains for relaying main line tracks shall have 25 mph slow order until it has been ultrasonically inspected at the new location.

4.18.9 Passing Trains over Broken Rails or Pull-Aparts

Any trackman or signalman with at least one year of maintenance-of-way or signal experience may pass trains over broken rails provided that they meet the minimum qualifications as set forth under rule 213.7 of the FRA Track Safety Standards, which include all of the following:

1. Has been trained and passed examination within the last two years in the movement of trains over broken rails and pull-aparts.
2. Train speeds are limited to a maximum of 10 MPH over the broken rail or pull-apart.
3. The qualified employee must visually supervise all train movement over the broken rail and be able to communicate with the engineer so that he can stop the train if necessary.
4. Someone is notified and dispatched who is fully qualified under FRA rule 213.7 (a) or (b) to relieve them for the purpose of authorizing movements and effecting repairs.
5. Do not operate over any break on a curve (regardless of length of gap) until temporary

4.0 RAIL & JOINTS

repairs have been made.

6. Do not operate over any gap in the rail (from a broken rail or pull-apart) greater than 3 inches until a 213.7 a or b qualified trackman has taken charge.
7. Do not operate over a break or pull-apart with a gap greater than 4 inches until temporary repairs have been made.
8. Do not operate over any break or pull-apart with a gap greater than 7 inches until permanent repairs have been made.

Note: Safe train movement is of the first importance. The final determination whether it is safe to pass a train over a broken rail or pull-apart is left to the employee on the ground watching the train over the defect. Other factors that must be considered when making this determination are:

- **Condition of the ties under the break or pull-apart.**
- **Alignment of the gage and running surface of the rail ends.**
- **For a broken rail, the type of break (vertical or angular).**
- **General surface and alignment of the track.**

Use the summary matrix in Table 4-T to determine requirements for passing trains over broken rails or pull-aparts.

Passing Trains over Broken Rails and Pull-Aparts	
Gap of Rail Ends	**Required Authorization**
3 inches or less	Trackman or Signalman 213.7 (A, B or C)
4 inches or less	Trackman 213.7 (A or B)
4 to 7 inches	Trackman 213.7 (A or B)
More than 7 inches	N/A

Table 4-T

4.18.10 Temporary Repairs to Broken Rails and Pull-Aparts to Pass Trains

Temporary repairs of a broken rail may consist of one of the following:

1. If the gap in the break is less than 4 inches, apply joint bars with one bolt through the break and one of the center pair of joint bar holes.
2. If the gap in the break is between 4 and 7 inches, apply a 4-inch “dutchman” with a bolt hole through the center with a pair of joint bars. Secure the “dutchman” with a bolt inserted through the hole in the “dutchman” and one of the center pair of joint bar holes.
3. Issue a Form A slow order over the temporary repair not to exceed 10 mph. Consider walking speed if the break is in a curve.
4. Supervise every train movement over the temporary repair. Ensure that you have a means of radio communication with the train crew to:
   a. To advise the train crew when the rear car has cleared the temporary repair.
   b. Stop the train if necessary.

   The employee must be qualified under FRA 213.7 A or B.

Temporary repairs of pull-aparts may consist of one of the following:

1. If the gap is less than 4 inches, secure the joint bars by tightening all bolts in one of the rail ends.
2. If the gap in the break is between 4 and 7 inches, apply a 4-inch “dutchman” with a bolt hole through the center with a pair of joint bars. Secure the “dutchman” per Figure 4-QQ with a bolt inserted through the hole of the “dutchman” and one of the center holes of the joint bars.

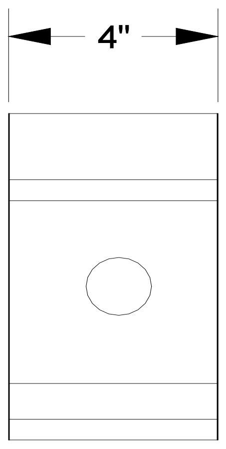


Figure 4-QQ

4.18.11 Broken Rail and Derailment Reporting

A. Service Failure Broken Rail Reporting

Definition: A service failed broken rail is defined as an unexpected break in the rail, usually in two or more pieces with separation **OR** rail with a substantial portion of the rail head, web or base missing.

When service failed broken rails occur, collect information contained in Engineering OE Production Log ***(Form: PB-24021)***. Following repair or replacement of the broken rail, report the service failure by one of the following means:

1. **TEP (Time Entry Portal) – OE Production Reporting** using the correct Work Codes for each failure type.

2. **Track Maintenance Planner (TMP)**, – Web base reporting, From the UPRR Employee home page *Go to: **Departments** > **Engineering** > **Track Maintenance** > **Manage** > **Service Failure (Broken Rail)***

Using a digital camera, capture pictures of the rail while still in track and pictures of each full rail end. Email photos to: sfdesk@up.com. When sending pictures, include: Fail date, Subdivision, track, milepost (including decimal) and rail side (Left or Right). Provide a contact with phone number for follow-up questions.

When broken rail failures occur within 30 days or within 1 MGT of the last detector car test, secure and store fractured rail ends. Using a permanent metal marker, write the following information on the rail: Fail date, subdivision, track, milepost (including decimal) and rail side (Left or Right). Store rail at a location designated by Manager Track Maintenance until inspected by Rail Assessment Group manager, or Rail Test Operator.

B. Broken Rail Derailment Reporting

When a derailment is being investigated and the cause is not readily apparent and a broken rail cannot be ruled out immediately, collect and include the following information in derailment reporting.

Rail section (weight), Manufacture, Year/Month rolled, Standard/Premium, and rail heat number (including ingot number, "A" rail etc.).

1. Rail profile, head width and height. (Approximate gage face loss and height loss).
2. Rail condition, running surface. (shell, head checks, slivers, grease, rust or recently ground).

If broken rail is entered as the cause of the derailment, rail shall be sent to the: R & D Lab; 5697 N. 13th St.; Omaha, NE 68110. In addition, a SERVICE FAILURE report must be completed in the TMP, within 7 days, *Go to: **Engineering** > **Track Maintenance** > **Manage** > **Service Failure (Broken Rail)*** to find report form.

4.19 Rail Lubrication

For questions regarding wayside lubrication including product, parts, maintenance, placement, or projects please contact the Manager of Rail Life Extension at 402-544-4701.

Apply rail lubrication when:

- The rail shows excessive wear.
- Noise levels are high from squealing wheels.
- Reducing lateral forces is desirable.
- Operating conditions warrant its use.

4.19.1 Methods of Lubrication

When lubricating rails, apply track lubrication through:

- Wayside systems.
- In-train systems.
- Manual applications with a brush or spray.
- When applying lubricant to the track it is important that both rails be lubricated. This is especially important in curves, as excessive lubrication of the high rail and poor lubrication on the low rail can result in a low rail rollover condition leading to a derailment.

4.19.2 Lubricants

Follow these requirements for using lubricants:

1. Use only company-approved products for lubricants.
2. Dispose of used containers or contaminated materials according to company policy and local, state, and federal guidelines.

4.19.3 Locations for Rail Lubrication Application

Follow these recommendations for applying lubrication to main and branch lines:

1. Apply lubrication to track when any of the following conditions exists:
   - **Curvature is 1 degree 30 minutes or greater, and tonnage exceeds 50 MGT per year.**
   - **Curvature is 2 degrees or greater on concrete ties.**
   - **Curvature is 3 degrees or greater.**
   - **Curvature where wide gage is present due to excessive rail wear.**
2. Lubricate other tracks such as wyes and frequently used industrial leads where conditions warrant.
3. When possible, try to avoid installing gauge face lubricators closer than 500 feet from the start of an approach to an automatic crossing warning device.

If unclear as to where the start of the approach is located, contact the appropriate Signal representative.

4. Refer to Standard Drawing No. 6040 for wayside lubrication installation.

4.0 RAIL & JOINTS

4.19.4 Suspension of Lubrication for Maintenance Work and Grinding

During service unit and program maintenance work remove all wayside lubricators in a timely manner. Maintenance work includes but is not limited to the following: plug rail change outs, thermite welds, surface and lining, rail relay, tie gangs, undercutters, TRT, CAT gangs and rail grinding projects.

During rail grinding operations, when possible remove the plunger block or ramp assembly, wheel sensor and all distribution bars on wayside systems to allow for grinding through the lubricator site.

Resume lubrication immediately after the scheduled work is completed.

4.20 Rail Grinding

4.20.1 General

Production and Switch rail grinding prolongs rail life by reducing rail surface corrugations, spalling, head checks, surface cracking, and flow. Grinding reshapes the rail head to a profile that provides improved wheel contact. If rail is allowed to deteriorate as corrugations, shelling, and rail batter increase, the following conditions will result:

- Decreased rail life due to internal rail defects
- Poor riding surface
- Spike lift
- Tie and ballast breakdown
- Damage to rolling stock
- Gage widening

Rail/curve relay areas will not be ground if designated to be replaced within 3 months.

- Exception: Can’t test/difficult to test rail.

4.20.2 Corrective, Maintenance, and Preventive Grinding

The three types of rail grinding practices are corrective grinding, maintenance grinding, and preventive grinding.

Follow these requirements:

- **Corrective Grinding:** Remove visible rail damage as required by grinding the rail head heavily. This practice usually requires 5 to 7 passes. Curves every 90 MGT. Tangent every 120 MGT.
- **Maintenance Grinding:** Perform scheduled out-of-face grinding at an increased speed on a frequent cycle based on tonnage and track geometry. Maintenance grinding removes surface defects and cracks before they are allowed to propagate. This practice requires 3 to 5 passes. Curves every 60 MGT. Tangent every 90 MGT.
- **Preventive Grinding:** Perform high-speed out-of-face grinding on a regular schedule based on tonnage and curvature. This practice requires 1 to 3 passes. Curves every 30 MGT. Tangent every 60 MGT.

Table 4-W below shows the preventative grinding cycles.

Preventive Grinding Cycles		
Track Geometry	**Concrete Ties Rail**	**Wood Ties Rail**
Sharp Curves (> 3°)	Premium	Premium
	15 to 30 MGT	15 to 30 MGT
	Standard	Standard
	15 to 25 MGT	15 to 25 MGT
Mild Curves (> 0° < 3°)	Premium	Premium
	45 to 70 MGT	45 to 60 MGT
	Standard	Standard
	30 to 45 MGT	30 to 50 MGT
Tangent Track	Premium	Premium
	90 to 100 MGT	90 to 100 MGT
	Standard	Standard
	60 to 75 MGT	60 to 75 MGT

Table 4-W

4.20.3 When to Grind and Type of Grinding

Use Section 4.20.2 as a guide for type of grinding to use. In addition, the following will also be used as a guide to the type and timing of grinding to be done.

1. Hy-rail inspection by grinding supervisor and/or Manager of Rail Life Extension.
2. Surface defects, number, length and depth.
3. Quality of detector car tests.
4. New rail will be ground at the first opportunity.
5. Grinding will be limited to a maximum of 5 passes but no more than 7 in one grid cycle. This is performed to avoid development of vertical split heads due to a sudden change in wheel loading on the railhead.

6. Rail defect history.

4.20.4 Grinding Requirements

Determine grinding requirements by:

- MGT of traffic.
- Recorded measurements of growth rate of corrugations. Take measurements manually using a 24-inch straightedge and a Starrett taper gauge graduated in thousandths of an inch.
- Measurements taken electronically by a track evaluation car.

4.20.5 Classification of Rail Condition for Grinding

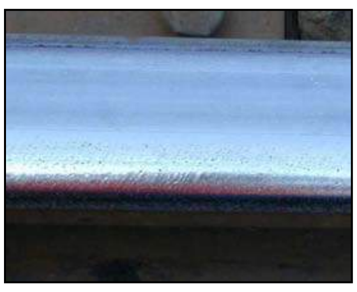
Rolling Contact Fatigue (RCF)

Visible and undesirable rail surface conditions that require treatment by rail grinding to prevent loss of rail life.

Examples are shown below (AREMA, Committee 4).

A. Head Checking:

Hair line cracks which appear in the gage corner of the rail head, at any angle with the length of the rail. When not readily visible the presence of the checks may often be detected by the raspy feeling of their sharp edges.



Light Checking

Severe Checking with Spalling

Head Checking with Flaking

B. Flaking:

A surface condition consisting of the gouging of metal on the rail head. It is indicated by small chipping and cavities. It is a progressive horizontal separation on the running surface of rail near the gage corner, with scaling or chipping of small slivers. Flaking should not be confused with shelling, as the flaking takes place only on the running surface usually near the gage corner of the rail and is not as deep as shelling.

Severe Flaking with Head Checking

Close Up of Flaking on Gauge

C. Shelling:

Pieces of rail metal that crack or break away from the gage corner of the rail, due to repeated cycles of high contact stress on the gage corner. This condition consists of progressive subsurface horizontal separations that may crack out on the gage side of the rail head. Shelling normally occurs on the upper gage face of the rail head, and extends longitudinally. Shells originate under the surface of the rail head.

Shelling (Light)

Severe Shelling on Gage Corner

D. Spalling:

Cracking and shipping of the rail surface. This condition is a direct result in high horizontal wheel-rail creeping forces, transverse friction forces and extreme wheel-rail contact stresses resulting in micro-cracking, head checking or chipping. Crack progression may be in any plan.

Light Spalling

Mild Spalling

Severe Rail Center Spalling

E. Corrugation:

Definition: Repetitive longitudinal pattern of shallow wavelike depressions along the rail surface. There is short wave (2 to 3 inches) and long wave (10 to 12 inches or more) corrugation. Corrugation is sometimes called “washboard rail”.

Corrugation (Light)

Corrugation – Low Rail (Mild)

Corrugation with Crushing (Severe)

F. Mill Scale and Corrosion:

Mill scale is an oily scaly layer on the surface of the rail. The purpose of removing mill scale is to enhance shunting capability and prevent corrugations from developing due to the irregular surface. The de-carbonized layer is very soft and may produce surface cracks. Corrosion is disintegration starting at the surface, from chemical decay, mainly oxidation (rusting). As it progresses, it often forms irregular pits, cavities, or develops cracks in the rail web or base.

Before

After

4.20.6 Preparation For Grinding

Before grinding, prepare as follows:

1. Pre-inspection of subdivision(s) is completed by grinding supervisor including all grinding operation details such as metal removal plan, number of passes, can’t test locations and upcoming rail program work.
2. Ensure the service unit has provided a qualified EIC who has completed both Rail Grinding Courses (Video: ESRGEE; Exam: MWRGEE).
3. When possible, remove crossing planks, rail lubricators, wheel sensors at hot box detectors, and AEI sites.
4. Inform the Dispatch Center of the daily/weekly/monthly plan before grinding to maximize track time and coordinate train movement including grinding train tie up locations.
5. Update any schedule changes immediately into the car scheduler and inform all service unit, HDC and Centralized personnel.
6. At all times, and especially in areas where fire risk is high, current instructions for the Union Pacific Railroad Engineering Department’s Fire Prevention Plan must be complied with. See Section 6.3 Fire Protection.

4.20.7 Switch Grinder Responsibilities

1. Switch rail grinding will fill in the areas at switches, road crossings, rail lubricators and hot box detectors that the production rail grinder are unable to grind.
2. Curves and mainline rail marked as difficult to test due to rail conditions will be ground if production rail grinder will not be on the subdivision within 3 months.
3. Sidings marked as difficult to test due to rail conditions will be ground if track time allows.
4. An 8-inch radius shall be ground on the running rails of the switch.
5. Component grinding by local support forces shall be performed at the time of the switch grinding, whenever possible.

6. When grinding road crossings, only UP employees will provide the flagging protection. The EIC may be required to assist on providing this flagging protection and must also give grinder operator permission to make change in direction movements.
7. When grinding rail lubricators, ensure that lubricator bars, wheel sensors and plungers are removed.
8. When grinding hot box detectors, a protective piece of material will be placed over each lens of detector to prevent grinding dust contamination. Once grinding is complete the protective material will be removed for proper hot box operation.
9. When grinding turnouts, in heavily used sidings, industrial leads, set out or yard tracks, all areas of turnout will be ground (A-G). For all other turnouts, only Section F-G (Switch Point and Stock Rail) will be ground.

Turnout Areas To Be Ground:

The straight and turnout sides of the switch beginning 100 feet ahead of the switch points and 100 feet behind the frog joint/weld area or to tie into where the production rail grinder ended. On sidings and cross-overs, turnout curves will be ground up to 10 feet prior to insulated joint.

Areas to grind will include:

A – B = Straight side of switch

F – C = Turnout side of switch

C – D = Turnout curve

E = Frog/guard rail area (Do not grind closer than 6 inches either side of frog point)

F – G = Switch Point and Stock Rail: 1) Begin grinding switch points when the switch point is ½ the rail head width or when the switch point is higher than the stock rail, 2) Inspect Stock Rail in the wheel transfer area to determine specific grind needed.

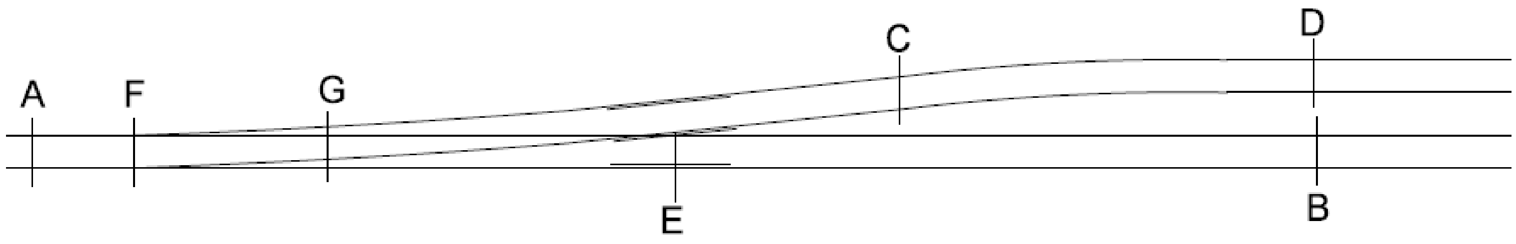


Figure 4-RR

Switch Points:

When grinding switch points, begin grinding 10 feet ahead of switch points and raise grinding wheels before making contact with switch point tip. Lower grinding wheels when the switch point is ½ the rail head width or when the switch point is higher than the stock rail.

Turnout Stock Rails:

When grinding the turnout stock rail, effort must be made to correct surface condition where worn wheels with a false flange ride on the stock rail while making the transfer from switch point to stock rail.

Frogs:

- Rail Bound Manganese: Grind within 6 inches of frog point on either end of frog.
- Spring Rail: Grind to within 6 inches of frog point on either end of frog.
- Moveable Point: Effort must be made to correct surface condition where worn wheels with a false flange create a low surface condition.
  - Mainline frog point – grind up to area where tip of short point begins
  - Turnout frog point – grind up to and including the short point
  - Wing rails – care must be taken when grinding the wing rail in area where the frog point fits up against the wing rail
- Jump Frog: This type of frog will not be ground
- Standard Crossing Frogs (Diamonds): Grind up to 10 feet prior to the insulated joints on either end of the frog
- One Way Low Sped (OWLS) Crossing Frog: Grind up to the insulated joints on either end of the frog.

4.20.8 Grinding on Bridges

1. All concrete and steel ballast deck bridges in scheduled grinding limits will be ground.
2. Bridges with wood ties on steel girders (and no other wood on bridge except timber guard rails and walkways) and timber ballast deck bridges will be ground when the bridge is part of a curve or tangent scheduled for grinding.
   a. Grinder will operate all side sprays and cannons, front and rear.
   b. Grinder will operate front and rear tie sprays with at least a .03% foam mix. If front tie sprays are not operable, grinder will pre-wet the bridge before grinding, with the

4.0 RAIL & JOINTS

remaining tie spray and front and rear water cannons (one time only).

c. The Contractor's hy-rail water truck which is following the grinder operation will manually or automatically scan the entire bridge deck, sides and areas below the bridge with an infra-red heat sensing device to detect any hot spots. The water truck will not leave the bridge area until the entire bridge and surrounding area is shown to be negative with the scanning device.

d. Service Unit B&B forces must follow Fire Prevention Plan. See Section 6.3 Fire Protection.

3. Open deck timber stringer bridges will be ground when falling in the scheduled grinding limits, but only after the following is completed:
   a. Grinding Supervisor or Service Unit manager determines rail on bridge requires grinding.
   b. Grinding Supervisor or Service Unit Manager has contacted the local B&B forces, notified them of the bridge(s) to be ground on their territory and ascertained from them that they will be on site for the grinding at the time of grinding and will protect the bridge for four hours after the last grinding pass has been made.
4. The following applies to the LORAM 400 series production rail grinders only.
   a. No open deck timber stringer bridges, open deck wood ties on steel girders or timber ballast deck bridges will be ground except as identified in curves. Additional support will be provided by a second contractor water truck equipped with infrared cameras to inspect bridges in curves.
      i. When one water truck is not functioning properly, rail grinding operations will continue but, no grinding will be done on any bridge structure. If both water trucks cease to function properly, rail grinding operations will be suspended.

4.20.9 Service Unit Requirements for Assisting Production Rail Grinding

A minimum of **two** Service Unit (SU) employees are required for the production rail grinding operation. **One** employee must be familiar with the territory, be a qualified EIC, and has completed the Rail Grinding EIC courses (Video: ESRGEE; Exam: MWRGEE). Refer to Rail Grinding EIC guide. This EIC will be riding on the grinder and directing all movements. <u>The EIC must be on the leading end of the grinder while moving.</u>

This employee must have current:

- System General Orders
- Subdivison General Orders
- Timetable
- Emergency Response Plan
- Fire Prevention Plan
- Track Profile
- All bulletins that may affect the grinder during shift

The second employee is required to <u>protect the contractor's hy-rail water truck</u>. An additional vehicle will be used when available to patrol right of way and bridges for fires.

<u>EIC must ensure that another UP employee is protecting contract water trucks either by hy-railing behind them, or riding in the rear contract water truck. This employee must provide shoving protection when making a reverse move.</u>

Service Unit personnel are responsible for protecting the Contractor's grinding equipment at the daily tie-up location per current UPRR rules. Provide a track at least 700' long to tie-up grinder at the end of shift. This track should be at least 25' from the mainline when possible and must have access on one side or the other to have the ability to allow fuel and water tanker to approach the grinder. If at all possible, a fire hydrant should be close to this tie up location. Contractors will provide private locks for locking switches, derails, etc.

Service Unit EIC will not leave the grinder until the grinder is done moving for the day, protection is provided and de-briefing with Contractor Superintendent has been completed. The grinder cannot be moved from tie up location after being released from service until the next work day's agreed starting time.

4.20.10 Service Unit Requirements for Assisting Switch Rail Grinding

A minimum of **two** Service Unit (SU) employees are required for the switch rail grinding operation. **One** employee must be familiar with the territory, be a qualified EIC, and has completed the Rail Grinding EIC courses (Video: ESRGEE; Exam: MWRGEE). Refer to Rail Grinding EIC guide. This EIC will be riding on the grinder and directing all movements. <u>The EIC must be on the leading end of the grinder while moving.</u>

This employee must have current:

- System General Orders
- Subdivison General Orders
- Timetable
- Emergency Response Plan
- Fire Prevention Plan

- Track Profile
- All bulletins that may affect the grinder during shift

The second employee must be in a vehicle with at least 50 gallons of water with foam, as required by the Fire Prevention Plan.

Service Unit personnel are responsible for protecting the Contractor's grinding equipment at the daily tie-up location per current UPRR rules. Provide a track at least 300' long to tie-up switch grinder at the end of shift. This track should be at least 25' from the mainline when possible and must have access on one side or the other to have the ability to allow fuel and water tanker to approach the grinder. If at all possible, a fire hydrant should be close to this tie up location. Contractors will provide private locks for locking switches, derails, etc.

Service Unit EIC will not leave the grinder until the grinder is done moving for the day, protection is provided and de-briefing with Contractor Superintendent has been completed. The grinder cannot be moved from tie up location after being released from service until the next work day's agreed starting time.

GENERAL INFORMATION

Contractors pay for their own fuel and water. Railroad employees need to assist them whenever possible in procuring these supplies

Normal workweek for the production and Switch Grinder is five, ten to twelve hour days, Monday through Friday. Start time can vary with Service Unit requirements and track time opportunities. Allow at least one-half hour at starting time for a job briefing before requesting track time. Service Unit support personnel should be on the grinder at the agreed upon starting time.

5.0 TURNOUTS

5.0 Turnouts

5.1 Turnout Identification

5.1.1 General

Follow these general requirements for turnouts:

1. Identify turnouts by their frog number. Refer to Standard Drawing No. 0080 for recommended turnout applications.
2. Determine if a turnout is a left- or right-hand turnout by determining the direction of the diverging track. To do this, stand in the track ahead of the switch and face the frog.
   - If the diverging track is on the left, it is a left-hand turnout. See Figure 5-A.

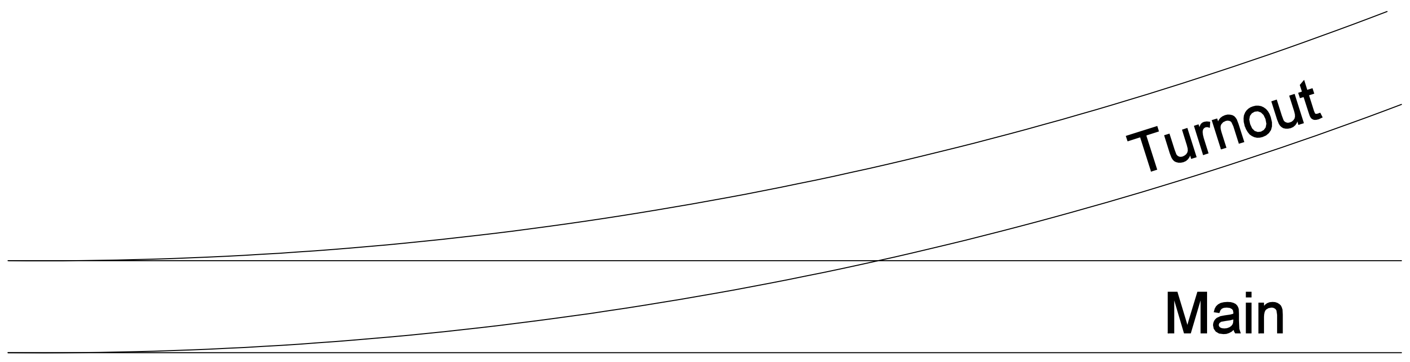


Figure 5-A

   - If the diverging track is on the right, it is a right-hand turnout. See Figure 5-B.

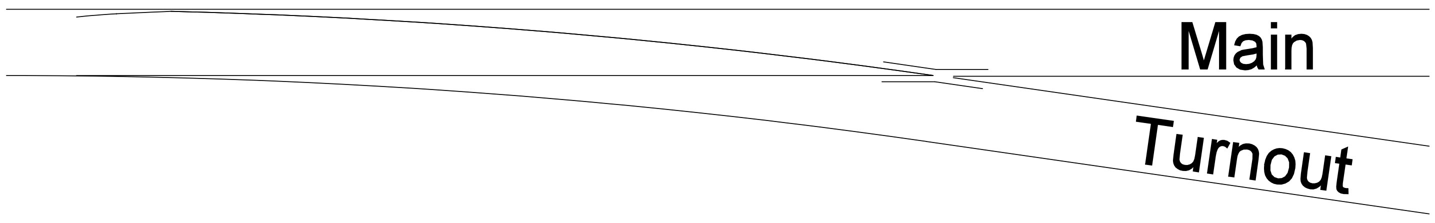


Figure 5-B

   - If both tracks diverge an equal amount, it is an equilateral turnout. See Figure 5-C.

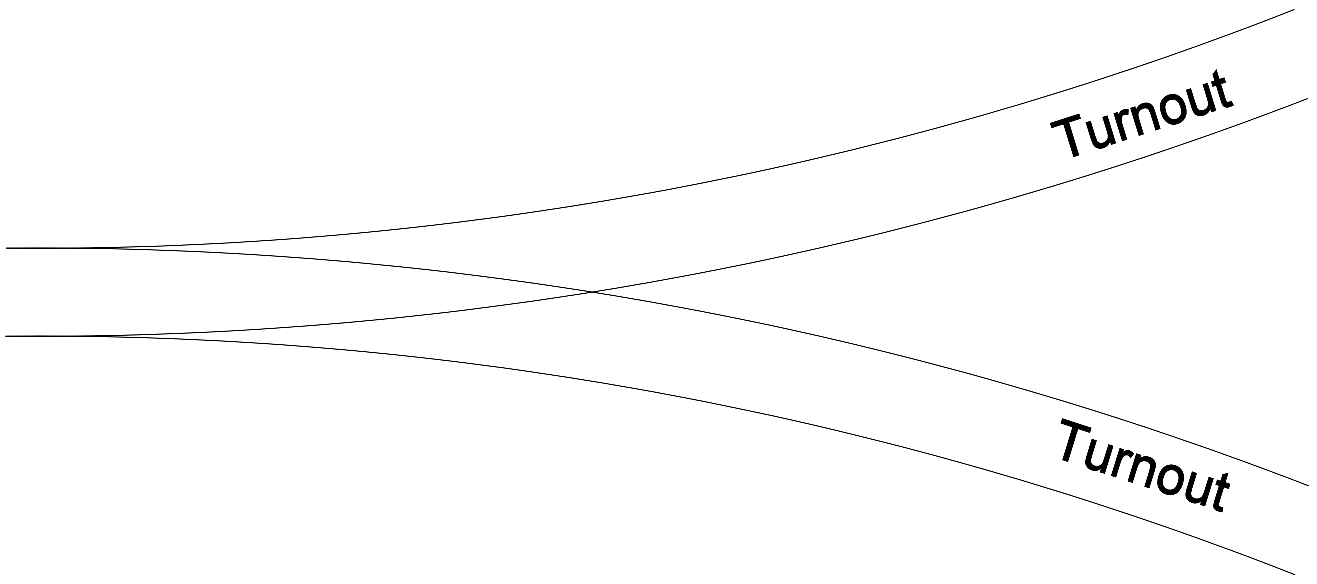


Figure 5-C

3. Some general turnout terms are identified in Figure 5-D.

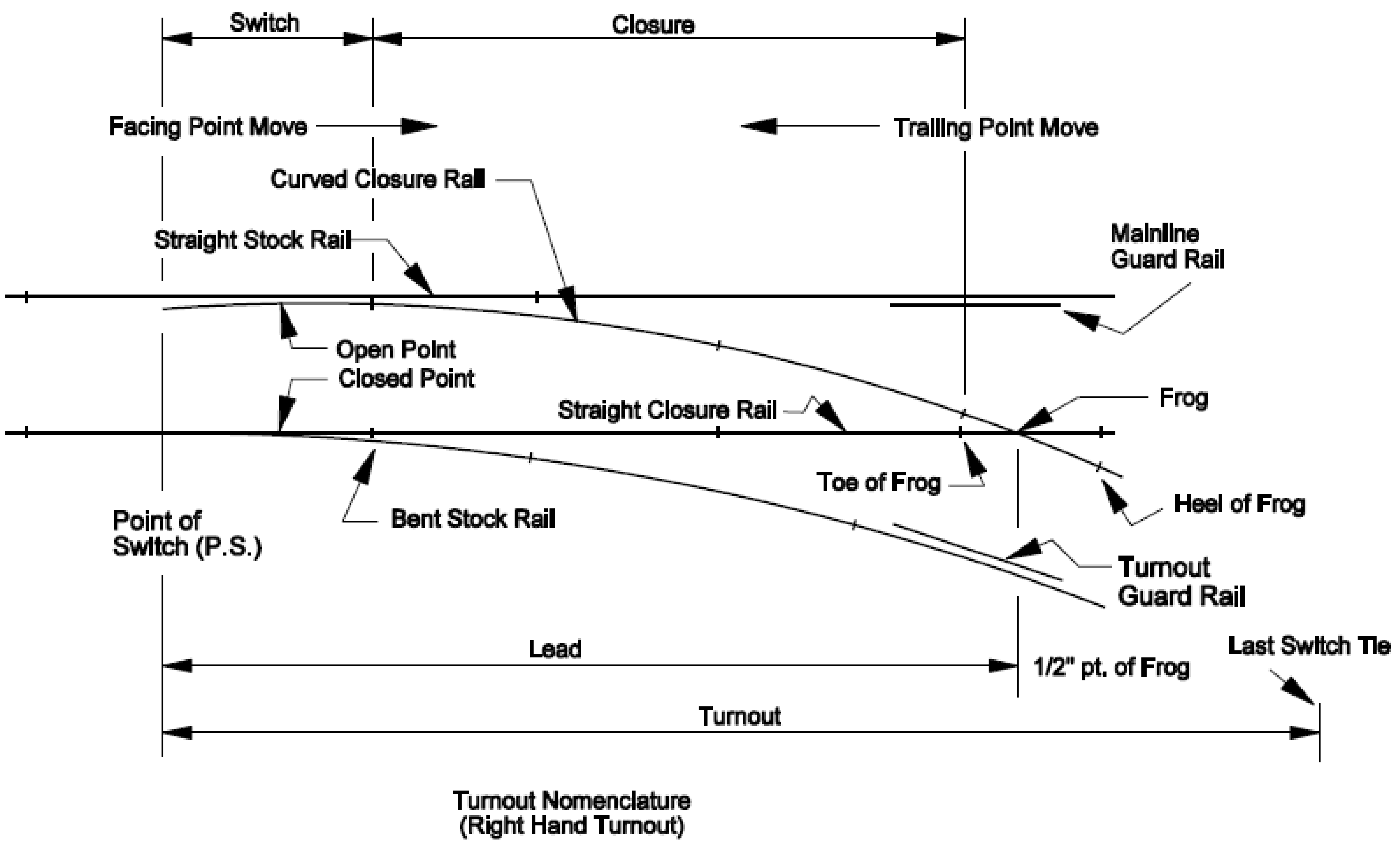


Figure 5-D

5.1.2 Turnout Types

Subsections A, B, and C describe turnout types.

A. Standard Wood

Standard wood turnouts have these characteristics:

- They consist of wood ties, conventional cut spike fasteners, and rolled steel tie plates.
- The switch and frog portion of the turnout uses plates with elastic fastenings.
- Switch points and stock rails are Samson design.

B. Premium Wood

Premium wood turnouts have these characteristics:

- They consist of hardwood ties, elastic type fasteners, and wood screw lags.
- Switch points and stock rails are Samson design.

C. Concrete

Concrete turnouts have these characteristics:

- They consist of concrete ties, tie pads, elastic type fasteners, and coach screws for special plating.
- Switch points and stock rails are Samson design.

5.1.3 Turnout Construction

Follow these requirements for constructing turnouts:

1. Construct turnouts as prescribed in the UPRR Track Standards.
2. Construct turnouts using head hardened rail. Intermediate strength head hardened rail may be used where authorized by UPRR standards.
3. Do not use rails of different sizes in the same turnout except in case of emergency where transition rails are utilized.
4. Spike turnouts according to Standard Drawing No. 0453.
5. Box anchor all switch ties to the extent that the anchors will not interfere with the proper operation of the turnout. Refer to Standard Drawing No. 0460 and Section 4.17 Rail Anchors for further information.

5.1.4 Speeds through Turnouts

Unless otherwise approved by the AVP Engineering Design, the maximum allowable speeds through the diverging route of a lateral turnout installed in tangent track are shown in Table 5-A.

NOTE: Any conflicting Special Instructions or General Orders will supersede any speed posted in Table 5-A.

Turnout Size	Switch Point Length	Point Type	Recommended Speed (MPH)*
Less than 7	11'	Straight	5
7 to 8-1/2	15' or 16' 6"	Straight	10
9 to 10	16' 6"	Straight	15
10	19' 6"	Curved	15
11 to 12	22'	Straight	15
11 to 12	19’ 6”	Curved	20
14	24'	Straight	30
15	26'	Curved	30
16	30'	Straight	35
20	30'	Straight	35
20	39'	Curved	40
24	39'	Curved	50
30	115' 6"	Curved	60

Table 5-A

* The recommendations in Table 5-A are for general informational purposes only. The geometry, and ultimately the speed, through identical size turnouts can vary between manufacturer’s designs. If you have any questions concerning the allowable speed through a turnout, consult with the office of the AVP Engineering Design before making any changes.

5.2 Switches

The switch is the portion of the turnout that consists of the switch points, stock rails and all related OTM in the area from the point of the switch to the heel.

5.2.1 Switch Types

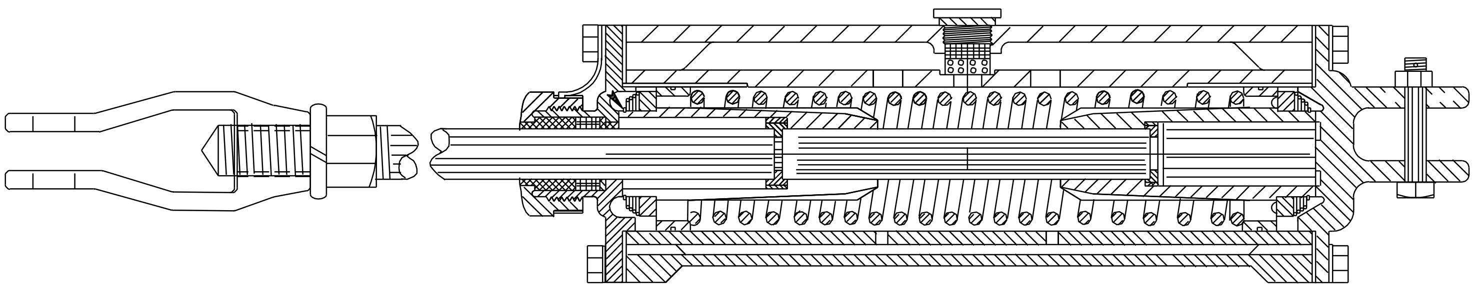
Subsections A through D describe the different switch types.

A. Hand-Operated

A hand-operated switch uses a manually operated switch stand to control the movement of the switch points.

B. Spring-Operated

A spring switch is a hand-operated switch that uses a special buffered connecting rod. The buffered connecting rod incorporates a special spring mechanism designed to permit trailing movements through the switch without throwing the switch. The buffered connecting rod automatically returns the switch points to the original position after they have been displaced by passing wheels in a trailing point movement. See Figure 5-E and Standard Drawing No. 2200. Spring switch points require extra reinforcing to account for the trailing move.



Spring buffered connecting rod

Figure 5-E

Note: Spring Switches must have a facing point signal unless the point is spiked or clamped.

C. Electric Lock

An electric lock is a type of hand-operated switch with an electrically controlled device that mechanically locks the switch. The release of the electric lock is usually controlled by the dispatcher or set on a preset time delay. Refer to Standard Drawing No. 2135.

D. Dual Control

A dual control switch can be controlled manually by means of a hand throw lever or from a remote location (i.e., dispatching center or control tower).

5.2.2 Switch Targets

Use switch targets as follows:

- Ten-inch-diameter switch targets should be used on low mast stands, and 18-inch-diameter targets should be used on high mast stands.
- Switch targets should show red when lined for other than normal movement. Where required by law, green targets will indicate when a switch is lined for normal movement.
- In dark TWC territory a green banner target is required on all main line switch stands.
- Switch targets are not required on dual control switches.
- Standard Drawing No. 2020 shows standard target types.

5.2.3 Switch Stands

Each hand operated switch includes a switch stand that must meet the following requirements:

- It should be set tightly against and attached securely to head block ties.
- It should be placed on the closed point side of the track when the switch is lined for the main track.
  - Some crossover applications may require the stand to be on the open point side of the switch.
- When conditions permit, ground throw type stands should be installed with the handle pointing toward the frog when lined for the main track. See Standard Drawing No. 2101.

1. Refer to the UPRR Track Standards for drawings for standard types of switch stands. Table 5-B lists recommended uses for switch stands.

Switch Stand Model	Features			
	Mast Height	**Operating Control**	**Trailable**	**In-Track Application**
36-EH	High	Raised tri-handle	No	Main and sidings
1008ARS	High	Raised straight handle	No	Main and sidings
112-E	High	Column handle	No	Main and sidings
1004ARS	Low	Raised straight handle	No	Main and sidings
1003ARS	Low	Raised straight handle	Yes	Other than main and sidings
22-E	Low	Raised tri-handle	Yes	Other than main and sidings
Hydra Switch 3000	Low	Push button	Yes	Other than main and sidings

Table 5-B

2. Switch stands recommended for main and sidings may be used on other than main and siding tracks. Switch stands designated for other than main and sidings may only be used for those applications.
3. The Track Department maintains manually operated switch stands. The Signal Department maintains remote control switch machines.
4. Many switch stands recommend annual lubrication and feature external lube holes. It is recommended that oil (Summer-SAE 60, Winter – SAE 40) be utilized as grease may gum up over time.
5. If switch stand is disassembled for repair it is recommended that grease be applied to all internal bushings, slots and bearing surfaces before placing back into service.

NOTE: Do not install trailable automatic type switch stands on main tracks or sidings.

5.2.4 Switch Stand Adjustment

Follow these requirements when adjusting switch stands:

1. To adjust switch stands with adjustable crank eyes and connecting rods, refer to Table 5-C depending on the existing fit of the switch point against the stock rail.

Condition of Points		Action Needed	
Near Point	**Far Point**	**Crank eye on Stand**	**Clevis on Connecting Rod**
Fits properly	Too tight	Screw in	Screw in
Fits properly	Too loose	Screw out	Screw out
Too tight	Fits properly	Screw in	Screw out
Too loose	Fits properly	Screw out	Screw in
Too tight	Too tight	Screw in	None
Too loose	Too loose	Screw out	None
Too tight	Too loose	None	Screw out
Too loose	Too tight	None	Screw in

Table 5-C

NOTE: One complete turn of the crank eye or clevis adjusts the switch point approximately 1/8 inch.

2. Adjust the hand lever of a ground-throw switch stand to allow 1-1/2 to 2 inches above the final resting place in the foot latch when the point contacts the stock rail. See Figure 5-F.

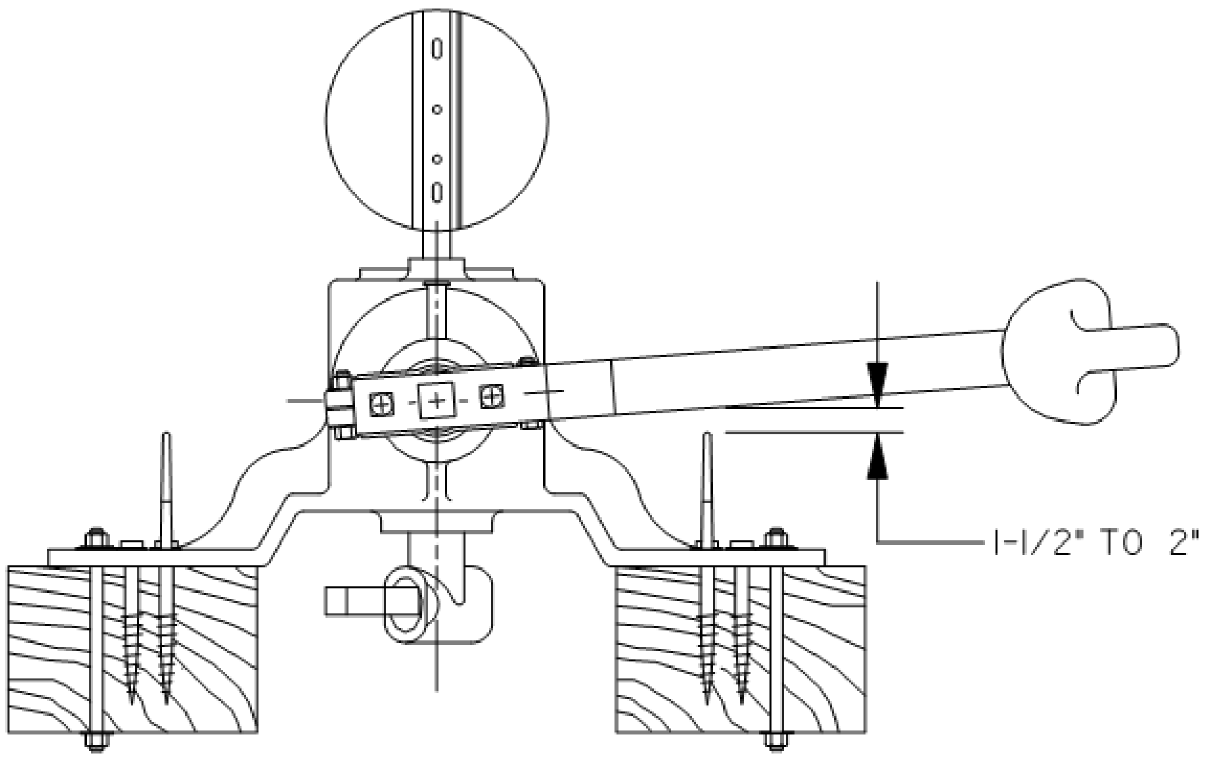


Figure 5-F

3. Keep the hand lever of a column throw switch stand 1/4 inch from the locked position when the point contacts the stock rail. See Figure 5-G.

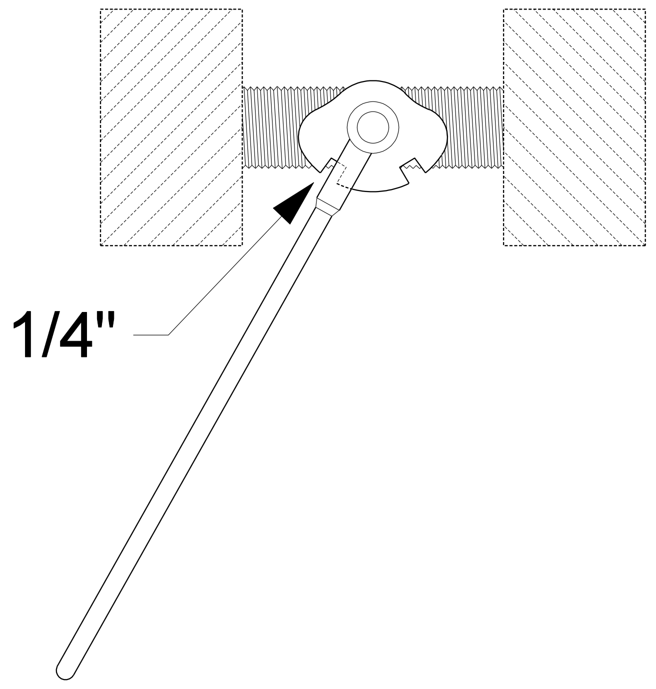


Figure 5-G

4. When adjusting switch stands on spring switches, ensure that the hand lever is **not** in the locked position when the switch points contact the stock rail. The piston travel into and out of the housing of the mechanical switchman should be 1/4 to 1/2 inch when the handle is put into the locked position. See Figure 5-H.

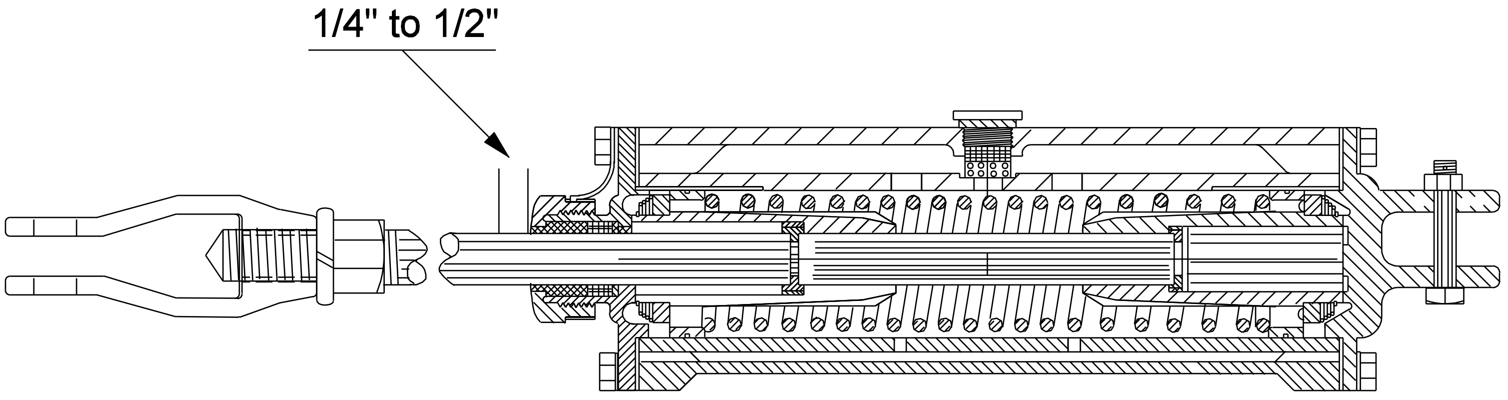


Figure 5-H

5. Do not place high stands closer than 8 feet 6 inches from the center of any track to any part of the stand or target in its most restrictive position.

5.2.5 Switch Machines and Hollow Steel Ties

When installing new switches the general rules are as follows:

1. Switch machine should be configured as follows, see Standard Drawing No. 5002:
   - On all wood turnouts switch machine should be on the turnout side, except where clearance does not permit.
   - On all concrete turnouts less than #20, switch machine should be on the turnout side, except where clearance does not permit.
   - On all concrete turnouts #20 and larger, switch machine should be placed on mainline side, except where clearance does not permit.
   - On all crossovers switch machine should be placed on mainline side, except where clearance does not permit.
2. Hollow steel ties can be utilized to allow for better surfacing capability through the point section of a switch. Hollow steel ties will be utilized on all power operated turnouts #11 and larger where:
   - Turnout is installed in a mainline application with annual tonnage in excess of 40 MGT.

   and/or

   - Concrete Tie Turnouts.
3. Where hollow steel ties are installed:
   - Cover plates should be kept on at all times to prevent ballast from getting into the ties.
   - Ties should be inspected during monthly switch inspections to look for signs of loose or worn insulation between plates and bolts. If loose or worn insulation is found contact Engineering Methods and Research (402) 544-5447 for assistance with replacing.

5.2.6 Switch Locks

Follow these requirements:

1. Equip with a switch lock (item number 170-6438) all switch stands on main tracks, sidings, and other tracks where trains and engines are not required to move at restricted speed.
2. When spiking switches or taking them out of service, properly tag them with a label attached to the shackle of the padlock according to Standard Drawing No. 2225.
3. When using a padlock other than a switch lock ensure shackle is large enough to keep the latch locked during normal train operations.

4. Switch locks come permanently lubricated from the manufacturer and regular maintenance should not be necessary.
5. Take care when trying to thaw frozen switch locks with an open flame. Overheating may cause damage to the internal “O” ring seals, allowing water and dirt to enter the internal mechanism.

5.2.7 Switch Point Locks

In certain areas the Chief Engineer or State/Local laws may require the installation of a secondary switch point lock. If required, install switch point locks on hand throw switches if all of the following conditions are met:

1. Track speed is 30 MPH or greater.
2. The turnout is located within 300 feet of a public road crossing.
3. A facing point move will be made after passing over the crossing.

5.2.8 Switch Point Clamps

Switch Point Clamp – Item number 410-1321
R&B Pad Lock – Item number 170-6103

Switch point clamp to be used only when:

- No switch stand/machine has been installed (i.e. new construction)

  NOTE: In any class of track switch point clamp(s) can be utilized to secure switch point when no switch stand/machine has been installed. Signal rules 3.7 and 3.8 dictate that a train can only move at 25 MPH if a switch circuit controller is installed. If no switch circuit controller then trains must move at restricted speed with a qualified signalman inspecting the switch after every move.

- Maintenance personnel desire to restrict access to a track(s) by making the switch inoperable.

Installation of switch point clamp:

1. Inspect jaws and locking ring of switch point clamp for cracks. If any cracks are found scrap switch point clamp.
2. Line switch for the intended direction.
3. Remove dirt or debris from single crib between the point of switch and #2 throw rod that is to have switch point clamp installed.
4. Turn lock ring counter clockwise until sufficient distance between jaws is achieved to secure switch point to stock rail.
5. Position switch point clamp in crib and attach one jaw to the base of the switch point and the other jaw to the base of the stock rail on the field side.
6. Turn locking ring clockwise with wrench until tight.
7. Inspect point of switch to ensure no gap exists between switch point and stock rail.
8. Install pad lock to secure lock ring to jaw (only one jaw has hole for pad lock).
9. Place out of service tag on switch stand/machine.

Refer to Standard Drawing Nos. 2250 and 2252 for more information.

5.2.9 Switch Point Rollers

Install switch point rollers on all switch points over 16 feet 6 inches long. Install rollers on other points as necessary. Refer to Standard Drawing No. 2223.

Eko-Slide roller designs that reduce turnout throw force are available. In situations where hard to throw switches are an issue, Eko-Slide rollers can be utilized. Alternative roller designs are not a replacement for good switch maintenance practices.

When utilizing alternative roller designs such as Eko-Slide, care should be taken to limit the amount of lubrication applied to the plates. These rollers are designed to reduce lubrication requirements and excess lubrication can cause them to gum and bind.

5.2.10 Switch Point Guards

Follow these requirements for switch point guards:

1. Do not use switch point guards on turnouts in main tracks or sidings where track speed is greater than 20 MPH
2. Use a switch point guard of the correct rail size and brace plate design. Refer to Standard Drawings Nos. 1200 to 1215. Follow the manufacturer’s installation instructions.
3. When the distance between the gage line of the running rail and the guarding face of the point guard reaches 4-3/16 inches, adjust or replace the wear bar. See Figure 5-I.

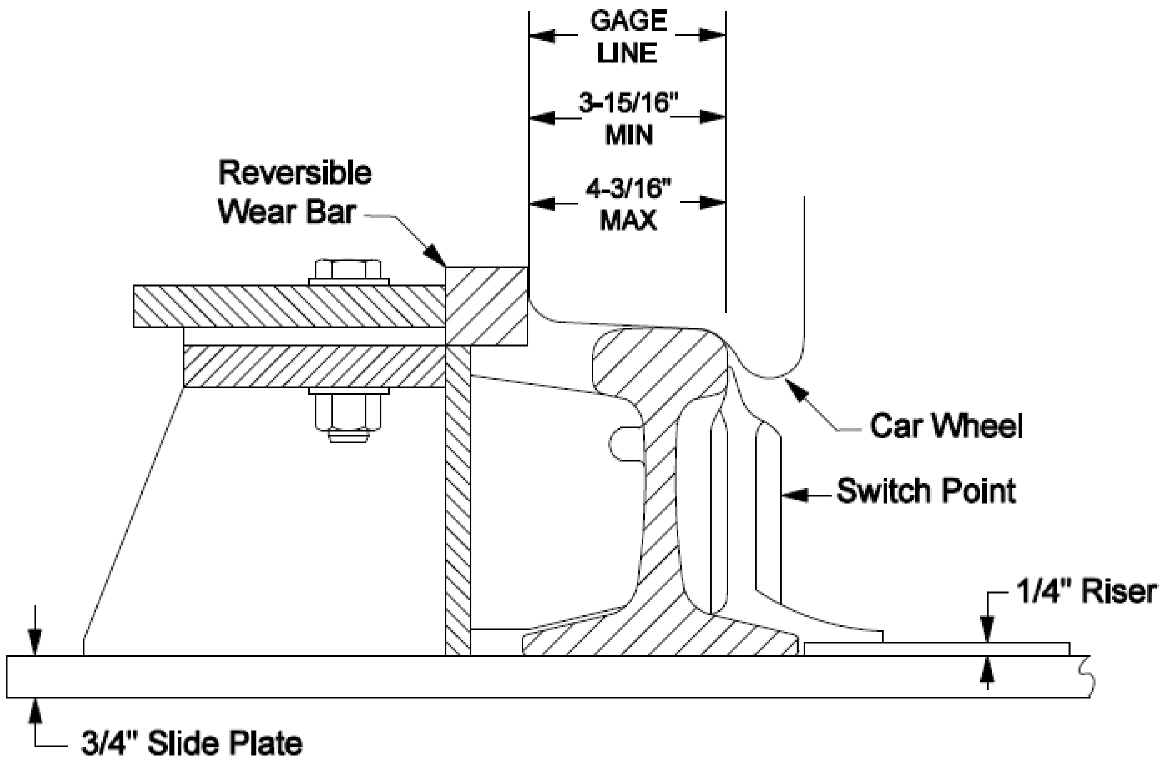


Figure 5-I

4. Do not build up switch point guards by welding in track.

5.3 Switch Rods

Switch rods space switch points the proper distance apart to ensure that the switch points fit tightly against the stock rails.

- Switch rods are identified by rail weight, switch point length, and rod number.
- Adjust vertical type switch rods to the correct overtee dimensions (Figure 5-J) to ensure proper switch point spacing. Refer to Standard Drawing No. 2235 or Common Drawing 241600 for the correct overtee dimensions.
- Semi-Tangential and Clothoid geometry switches have additional rods and may have different Overtee dimensions. Contact Methods and Research for clarification.

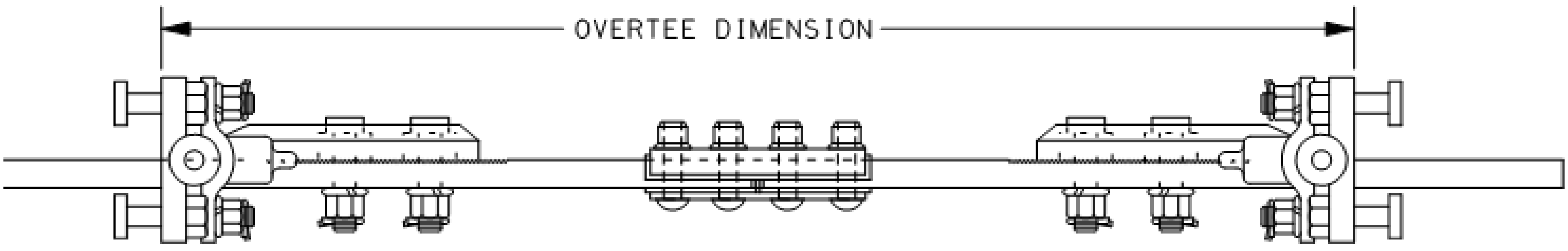


Figure 5-J

5.3.1 Connecting Rods

The connecting rod connects the switch stand to the head rod or No. 1 rod of the switch.

Do not allow the connecting rod to rub against the head block ties. See Standard Drawing No. 2175 for more information on connecting rod specifications.

A. Connecting Rod Length

Determine the length of the connecting rod used by considering clearance restrictions or operating conditions. In general, use the following connecting rod lengths for the specified applications listed in Table 5-D.

Connecting Rod Length	Application
3 feet 4 inches	Between tracks with track centers less than 20 feet.
5 feet	Yard and ladder tracks
6 feet 3/4 inch	Main tracks
13 feet 9 inches	Inside switches on ladder tracks

Table 5-D

Do not use connecting rods shorter than 6 feet with high mast switch stands.

NOTE: Spring switches use a special "spring buffer" assembly instead of a standard connecting rod. See Standard Drawing No. 2200.

B. Connecting Rod Repairs

Do not repair connecting rods by welding.

C. Connecting Rod Installation

Attach the adjustable end of the connecting rod to the crank eye on switch stands with adjustable cranks.

D. Spring Switch Buffer Rod

Follow these guidelines for spring switch buffer rods.

- Keep buffered connecting rods used on spring switches full to the oil level at all times.
- Fill buffered cylinders only with an approved fluid for that unit. When filling and inspecting the unit, do not allow water or foreign matter to get into cylinder.
- When connecting the buffer connect the adjustment end to the switch stand.

5.3.2 Connecting Rod Bolts

Insert connecting rod bolts (of the proper dimension) with the head down and secured with a nut and cotter pin on top. This is done so the bolt can be easily inspected visually.

5.3.3 Switch Rod Use

Follow these requirements for using switch rods:

1. Use the correct number of switch rods for a switch, depending on the length of the switch point.
2. Use only insulated type switch rods where track circuits exist.
3. Allow the switch rod to pivot as the switch is thrown.
   - On vertical type switch rods, periodically lubricate the grease zerk on the MJ clips.
   - On horizontal type switch rods, do not over tighten the bolts that secure the rod to the transit clips. This connection must be allowed to pivot for proper operation of the switch.

5.4 Switch Points

Follow these requirements:

1. Ensure that switch points are the same rail size as the stock rails they are mated to.

EXCEPTION: ZU-160 asymmetrical section switch points are universal. Special switch plating is used to adjust for proper fit with stock rail. These points were used in all #30 turnouts and special application #20/24's on wood ties. They are a "smaller" rail section and use special plates to raise them up and match the stock rail. For assistance with these points contact UPRR Methods and Research.

2. Measure switch point length from the tip of the switch point to the heel block joint assembly of the switch.
3. On extended length type switch points, measure switch point length from the tip of the point to the center of the floating heel block.

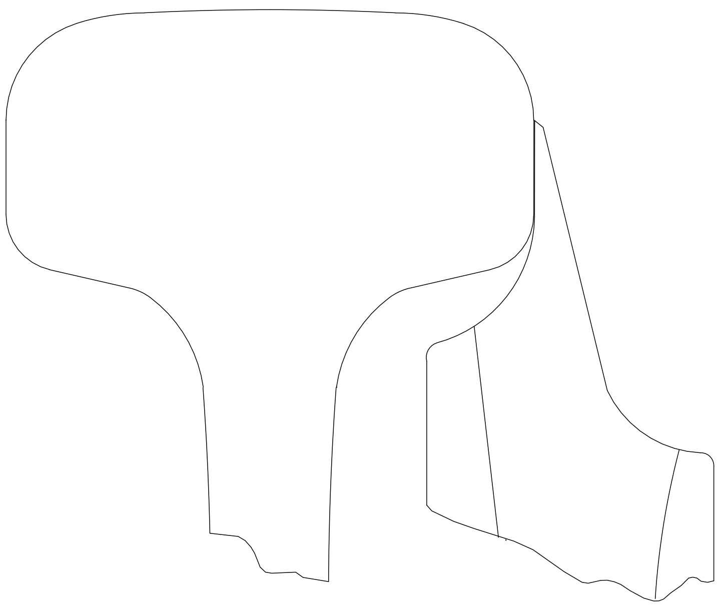
   Extended switch points are often characterized as heel block length and then overall extended length. Example: 16'6" point extended to 39' can be used in 16'6" switch point applications and is able to be welded at its overall length of 39'.

5.4.1 Switch Point Use

Follow these guidelines for using switch points:

Best Practice: Paint switch point tips white to show wheel wear and to aid in switch point inspection.

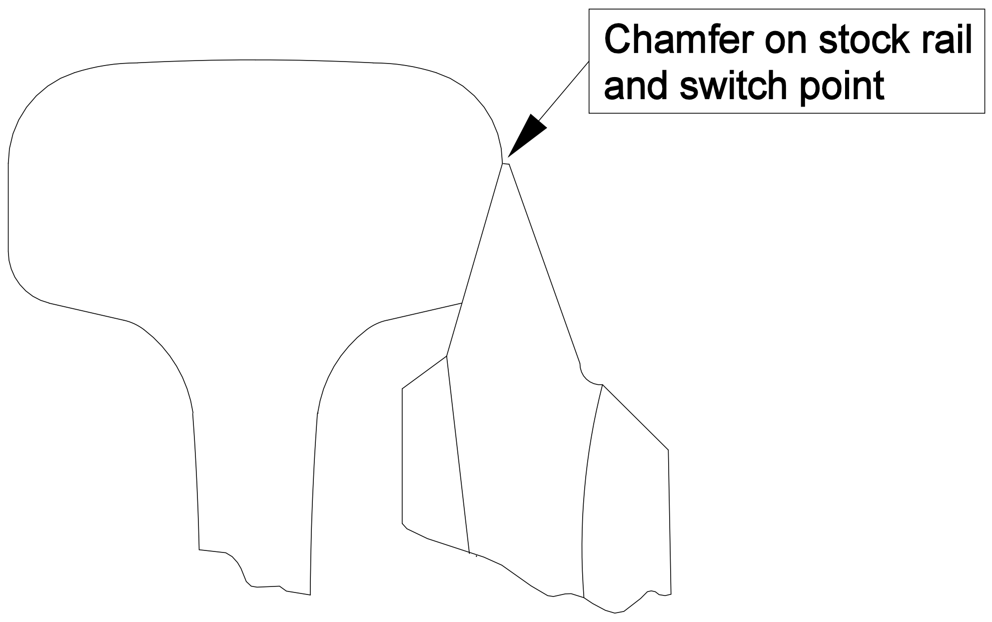
1. Use Standard (knifepoint) design switch points with standard rail section stock rails. See Figure 5-K. Knifepoints should be upgraded to Samson design when replaced and should not be utilized on mainlines.



Standard (Knifepoint) switch point and stock rail

Figure 5-K

Use Samson design switch points only with Samson type stock rails. See Figure 5-L. Conventional bolted heel block Samson points must be upgraded to floating heel block style extended Samson points when replaced in mainline applications Class 3 or greater. Refer to 5.4.2 Heel Blocks



Samson design switch point and stock rail

Figure 5-L

2. Crop extended length switch points and stock rails during replacement operations to facilitate field welding and future replacements. Refer to UPRR Track Standards for turnout cropping locations.
3. Prior to 2012 UPRR utilized manganese tip switch points on the diverging side of all turnouts. Use only thin head bolts to attach manganese tips to the point.
4. Switch Point Tip Inspection Procedure:
   a. Inspect the tip at 2” (inches) back from the front of the tip using the saddle gauge shown in Figure 5-M. The gage will be marked for the particular type of switch point (i.e. 136RE/141AB, 133RE, 39’-0”, etc.). One side of the gauge is for 133RE, and the other is for 136RE/141AB. Item number 410-2003

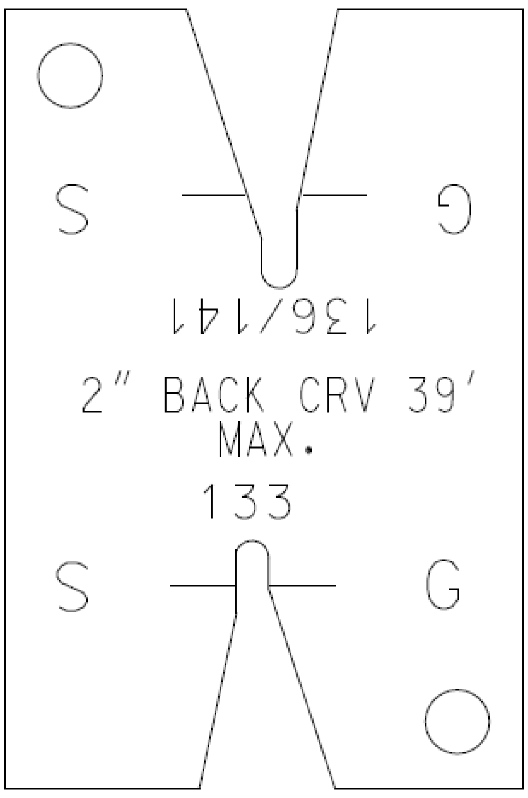


Figure 5-M

   b. Set the gauge over the top of the switch point tip at 2” behind the very front of the tip. Note the gauge is also labeled “G” for gage side and “S” for stock side. With the gauge properly positioned, the top surface of the tip should be in alignment with the scribe-line on the gauge. If the tip is too wide, the top surface of the tip will be below the scribe-line, and the tip must be ground. If the tip fits the gauge, then no rework should be required on that particular switch point tip. If the tip does not pass gauge inspection, then follow the rework procedure described in the following section.

Rework Procedure:

   c. If the switch point tip is too wide, then it must be ground on the gage side face. It is important to maintain the same face angle as well as maintaining a smooth transition. Therefore, equal amounts of material must be removed from the entire gage face, and it must be blended back to the end of the tip. Periodically re-check the gage and the straightness using a 36” straightedge. Try and keep bumps and holes to a minimum. The end result should be a tip that passes the saddle gage test with no bumps or holes along the gage face. Note that the heel of the tip (where the switch point and tip meet up) should not have any material removed and should be the end point of the blend. See Figure 5-N.
   d. If the tip is in track, check the transition to the point tip by setting a 36” straightedge against the stock rail gage line and moving it toward the point of switch. The straightedge should pass beyond the point without contacting the tip of the point.

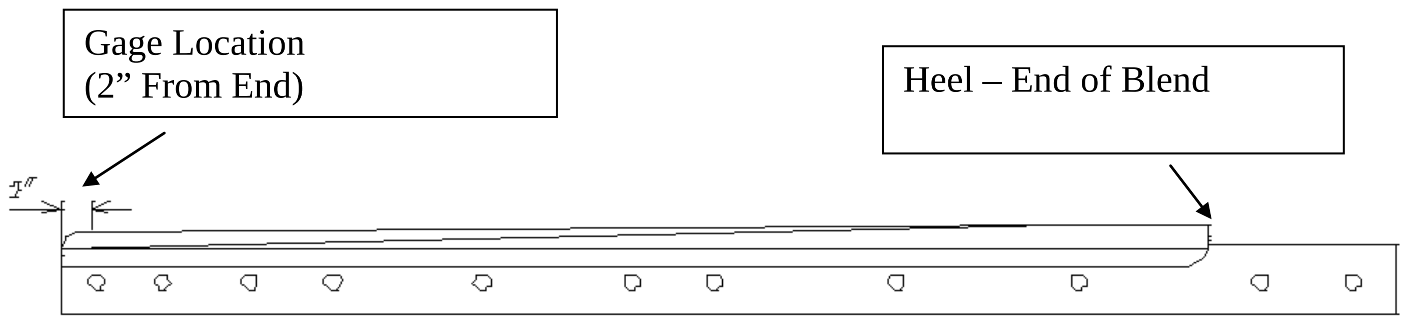


Figure 5-N

5. On turnouts using curved point geometry, place the curved point on the diverging side of the turnout.
6. Use standard 1/2-inch reinforced switch points on hand-throw and power switches. Use heavy-duty 1-1/4-inch reinforced switch points on spring switches. See Figure 5-O.

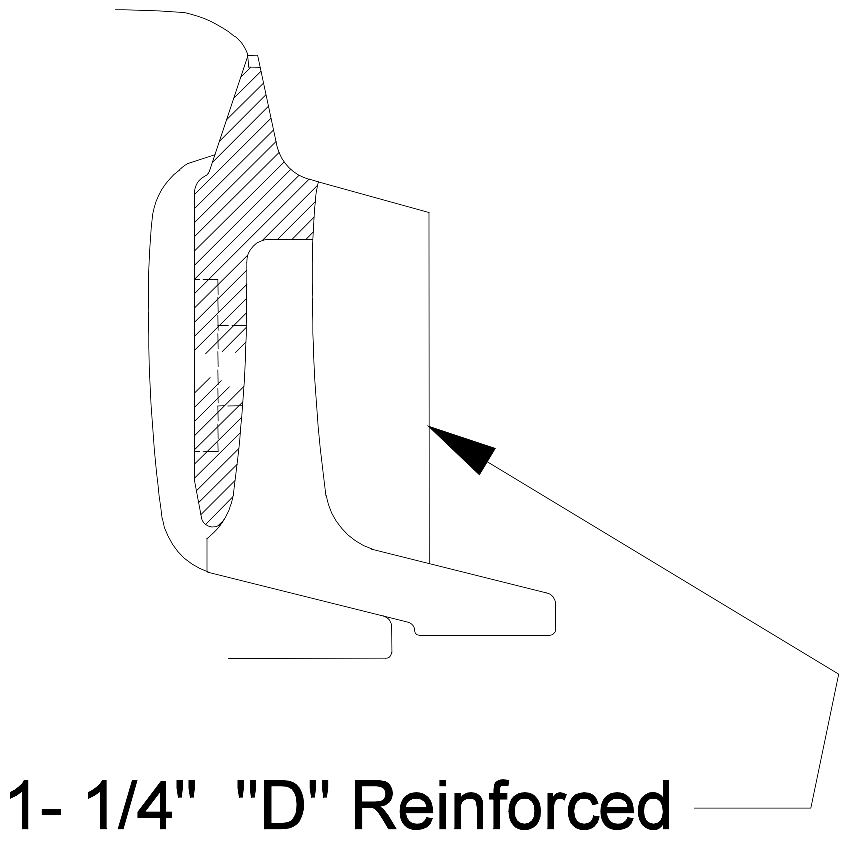


Figure 5-O

7. Change out worn switch points and stock rails together. If changing out a damaged switch point without installing a new stock rail, grind off any overflow on the stock rail and excessive switch point height to prevent tip breakage. See Figure 5-P.

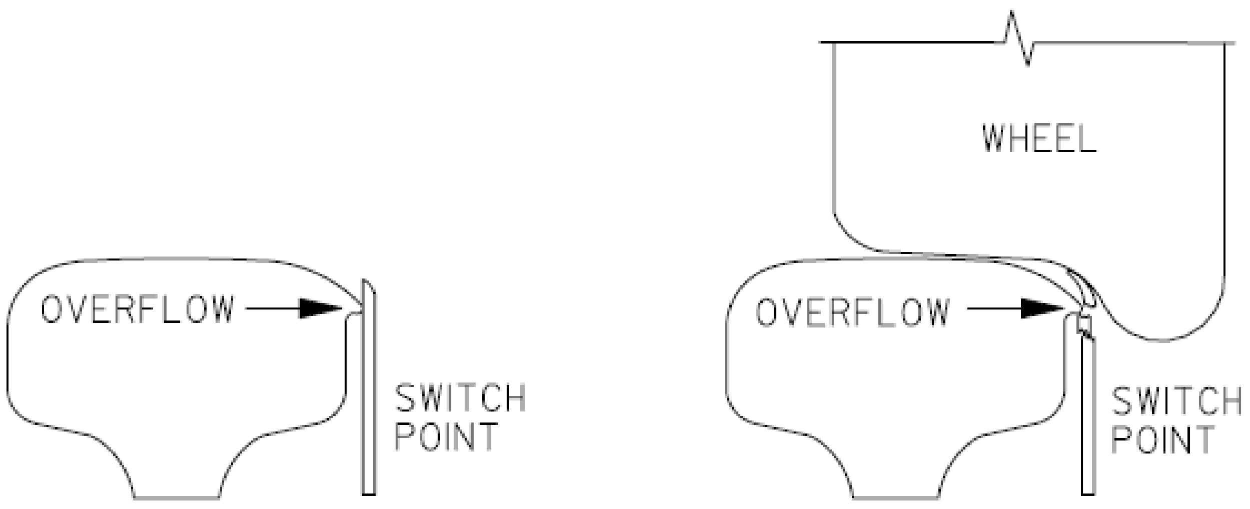


Figure 5-P

5.4.2 Switch Point Maintenance

Repair switch points as follows:

1. Grind off rail flow from the switch point that prevents it from bearing fully against the head of the stock rail. See Figure 5-Q.

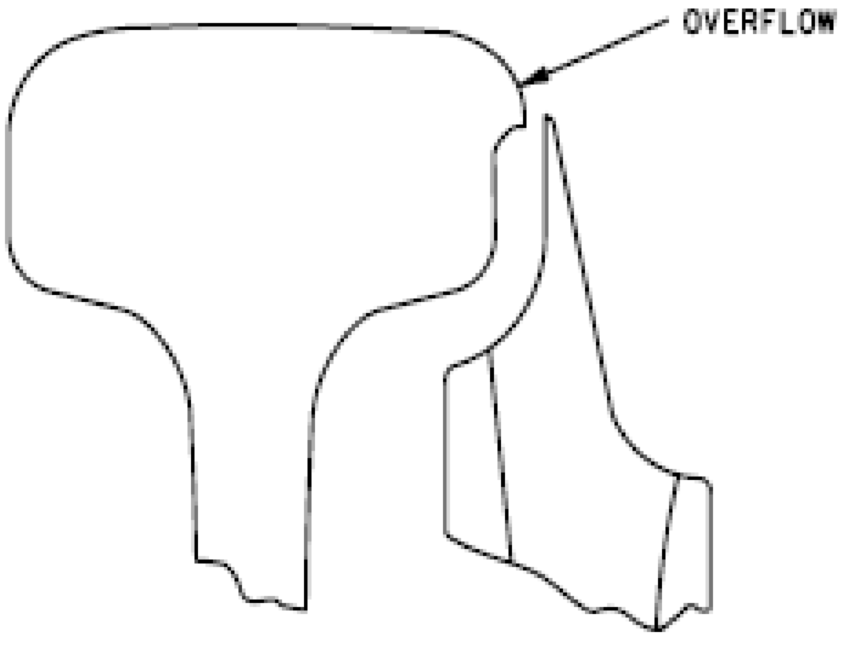


Figure 5-Q

2. Grind the flowed metal from the stock rail from 4 inches ahead of the switch point toward the heel to a point where the switch point no longer contacts the stock rail. Grind the edge of the stock rail to a 5/8-inch radius.

3. Do not replace stock rail only. Stock rail and switch point must be changed as a pair. (See Figure 5-V).
4. Do not use switch points in main tracks that have been repaired or built up by welding.

> **EXCEPTION: Chipped or battered joints at the heel of the switch points may be built up in main track under the same procedure specified for rail end welding.**

5. To repair carbon and manganese tip switch points correctly, refer to Form 7913, "Instructions Governing the Inspection, Welding, Grinding and Heat Treating of Track Components."

5.4.3 Heel Blocks

Heel blocks act as a hinge for the switch point. The following are the different types of heel blocks, See Figure 5-R for examples:

1. **Conventional bolted heel blocks** have a joint held together by a cast block and bolts as shown in Figure 5-S. These conventional bolted heel blocks are associated with short points.
2. **Floating heel blocks** do not have this joint and use a small block and two bolts. These floating heel blocks are associated with extended switch points.

Maintain heel blocks properly to ensure that the switch can be operated without using excessive force.

> **NOTE: When conventional bolted heel blocks require replacement they must be replaced with floating heel block style extended switch points in mainline and siding applications Class 3 or greater when one or more of the following criteria are met:**
>
> - **Switch points displaying signs of running rail for mainline or siding track**
> - **Switch points are part of a mainline crossover**
> - **Switch points are in control points with diverging mainlines**
> - **Switch points are on mainline turnouts to a siding regularly used to meet and pass trains**

Follow these requirements:

1. Keep spikes or welded stops from preventing the hinging movement of the switch point in the heel area.
2. Lubricate heel joint assemblies with switch plate oil and do not over tighten them so as to bind the switch point.
3. Use good ties to support the heel and solidly tamp the heel joints.
4. Use the appropriate joint bars as follows:
   - For floating heel joint assemblies for 16-foot 6-inch and 24-foot switch points, use 5-hole angle bars.
   - For 39-foot switch points, use 6-hole angle bars.
   - For extended switch points, no joint bar is required at the heel location.
   - For continuous filler block assemblies, use the bent 5-hole bar designed for that purpose. See Figure 5-S.

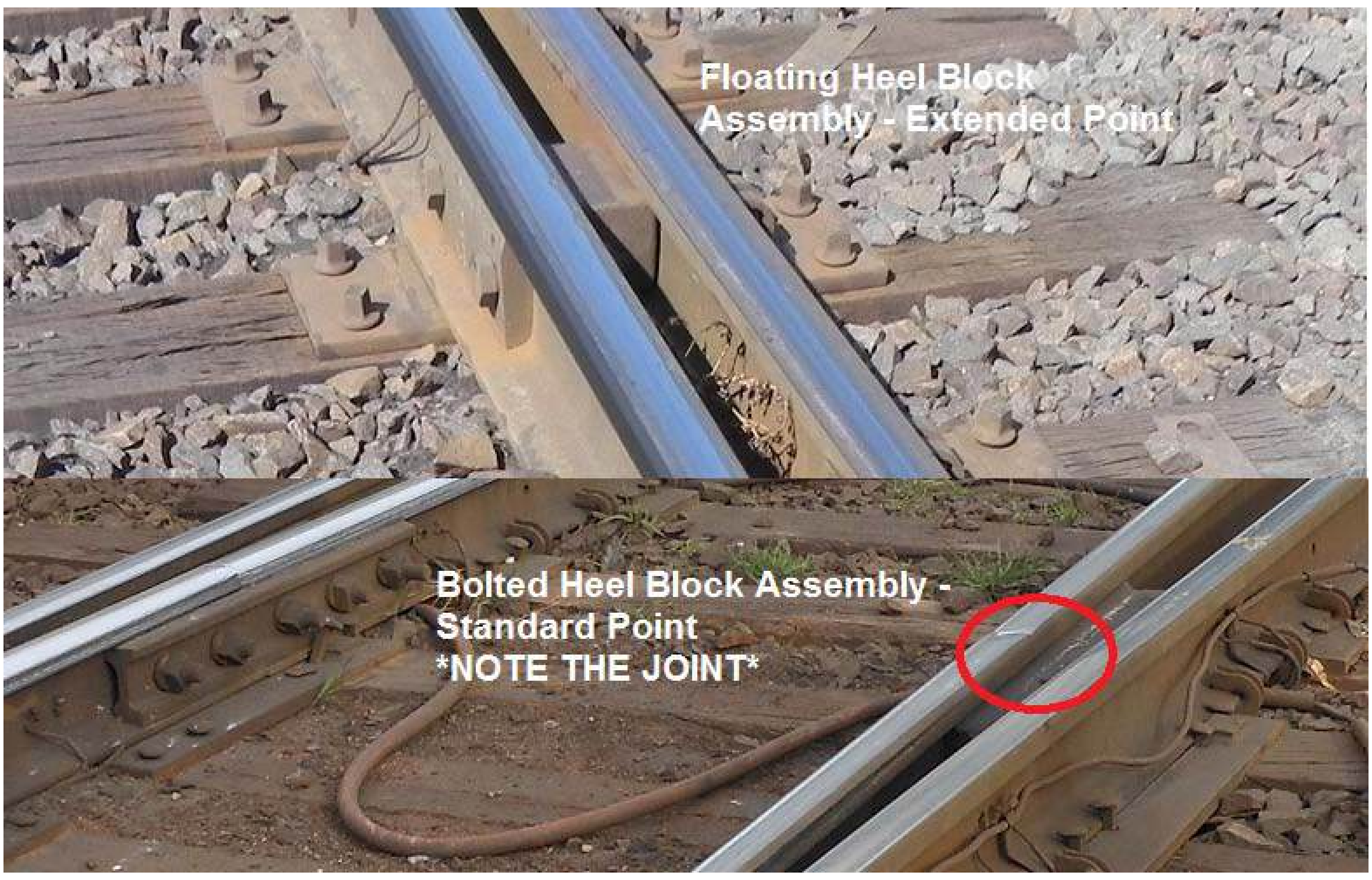


Figure 5-R

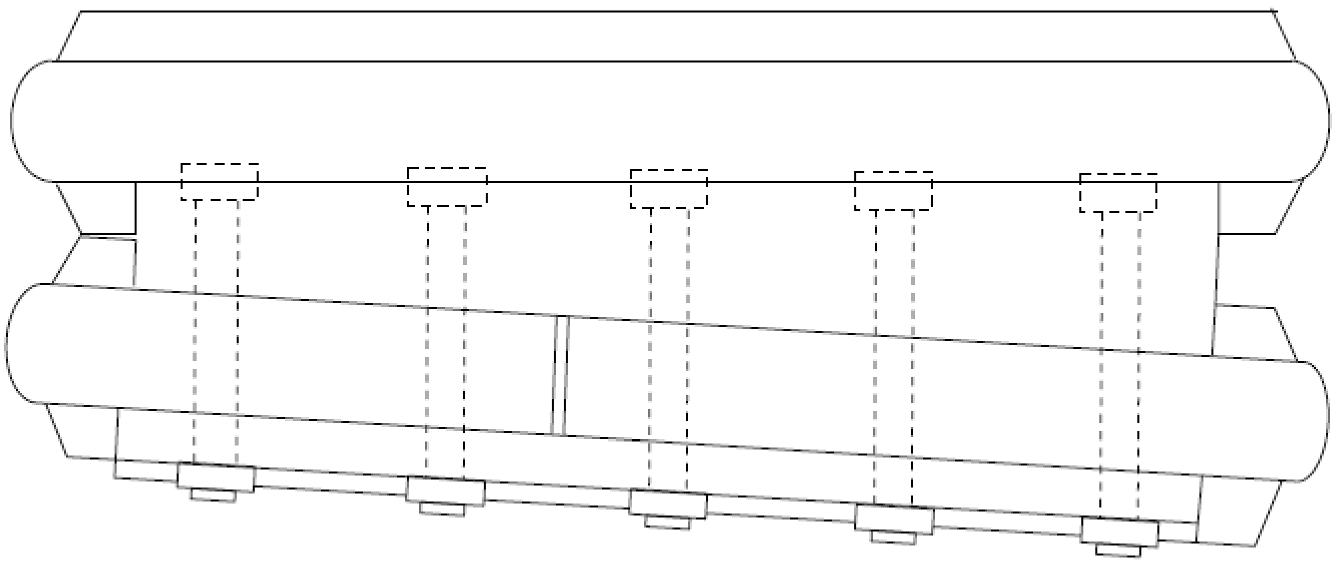


Figure 5-S

5.4.4 Stock Rails

Stock rails must be the same rail size as the switch points they are mated to.

EXCEPTION: ZU-160 asymmetrical section switch points are universal. Special switch plating is used to adjust for proper fit with stock rail on #30 turnouts only.

5.4.5 Stock Rail Replacement

Follow these requirements to replace stock rails:

1. To prevent wheels from striking the tip of the point, replace stock rails that are curve worn more than 3/16 inch ahead of the switch point.
2. Do not place a new stock rail against a worn switch point.
   - The switch point should rise a minimum of 3/16 inch above the stock rail where the wheel transfers from the switch point to the stock rail. See Figure 5-T.

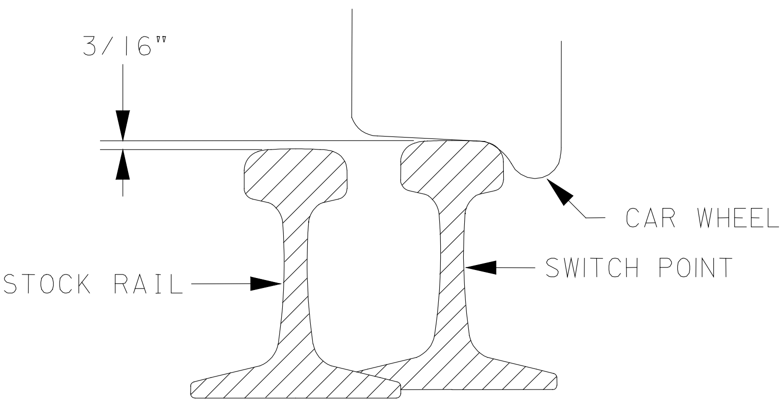


Figure 5-T

   - The outer edge of the wheel tread must not contact the gauge side of the stock rail. See Figure 5-U. When correcting this defect ensure that the switch plates are not worn. Replace if necessary.

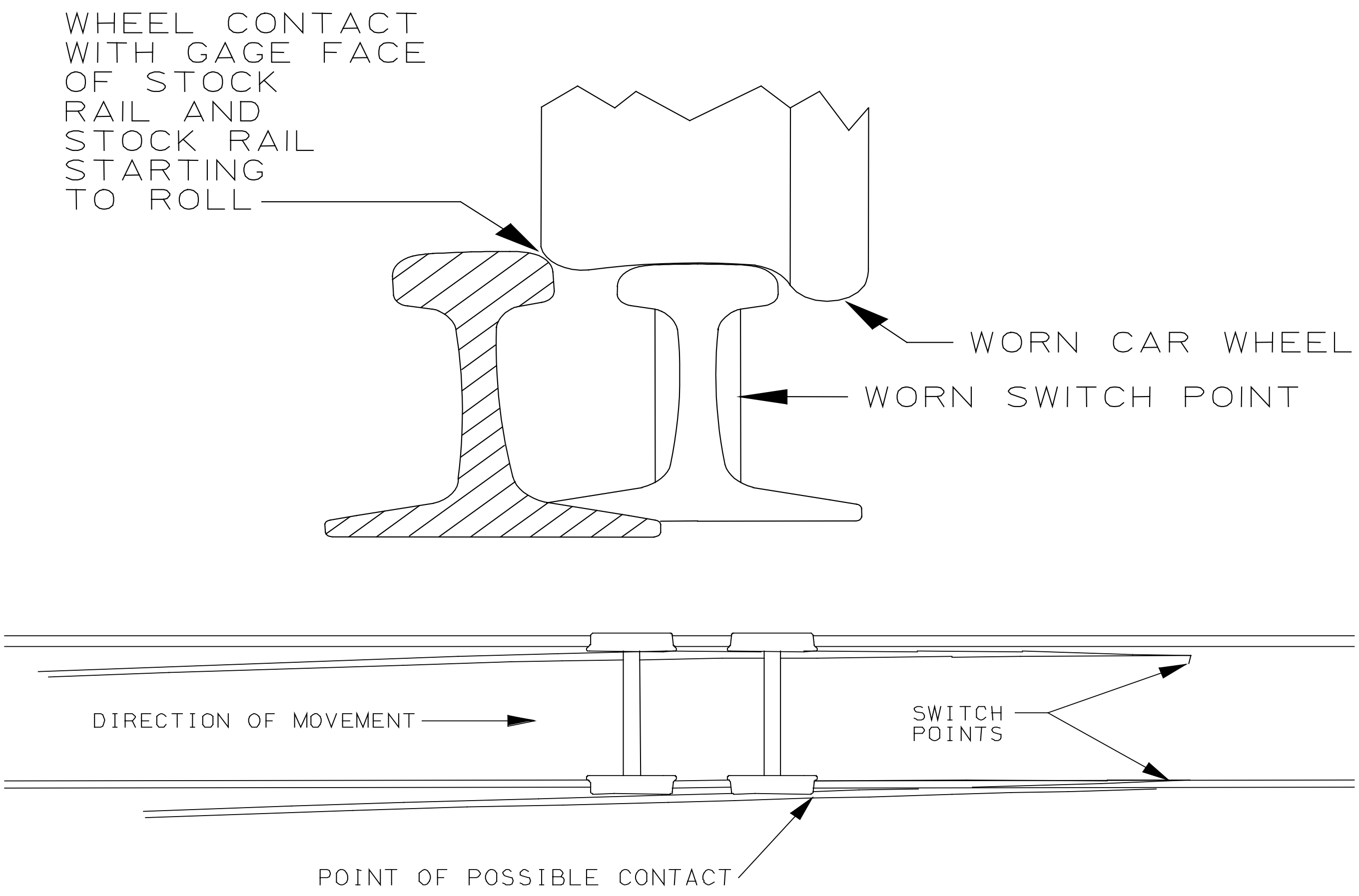


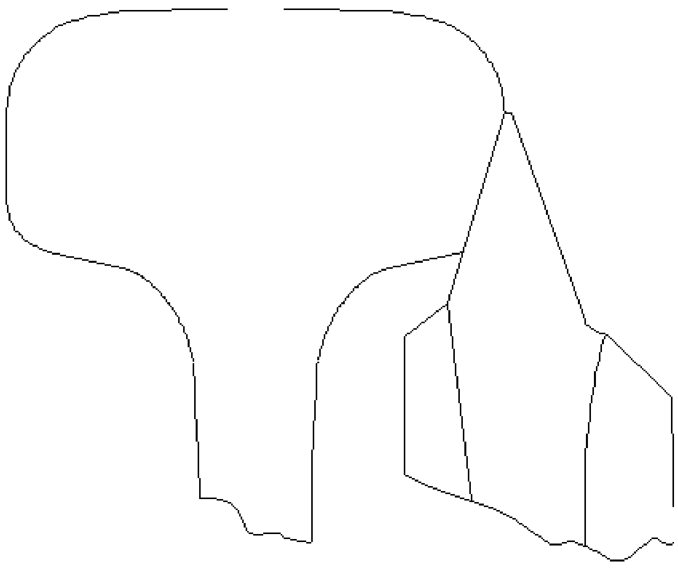
Figure 5-U

3. Keep adjustable brace plates tight to keep the stock rail securely fastened in the riser plates, but do not over tighten them to the point that the stock rail is canted. The stock rail should not move when the switch point is brought up tight against it.

5.4.6 Stock Rail Use

Follow these requirements for using stock rails:

1. Stock rails will be made using head-hardened rail.
2. Use Samson (undercut) stock rails only with Samson design switch points. See Figure 5-V.
3. For 115-pound and heavier rail, use bent stock rails that were pre-bent at the manufacturer.
4. Depending on switch design universal stock rails may be utilized. Universal stock rails can be utilized for many different straight stock applications and can cut down on inventory requirements and cost.



Samson design switch point and stock rail

Figure 5-V

5.4.7 Plating in Turnouts

The different plating types are as follows:

- Switch plates refer to plating from the point of the switch through the heel of the switch.
- Turnout plating refers to the special plating behind the heel of the switch to the toe of the frog.
- Frog plating refers to the special plates used under the frog.
- Guard rail plating refers to the special plates used under the guard rail.
- Special trackwork plates are stamped with the plate number and rail size.

Follow these plating requirements:

1. Fasten plating with round holes to ties with screw spikes. Use the square cut spike holes in these plates for gauging purposes only. You may use cut spikes at the base of the rail when no elastic fastener is present.
   - Fasten plates to ties using two screw spikes per plate end.
   - Use the outer two holes unless one of the holes is within 1 inch of the end of the tie. In this case, you may use the middle hole. See Figure 5-W.

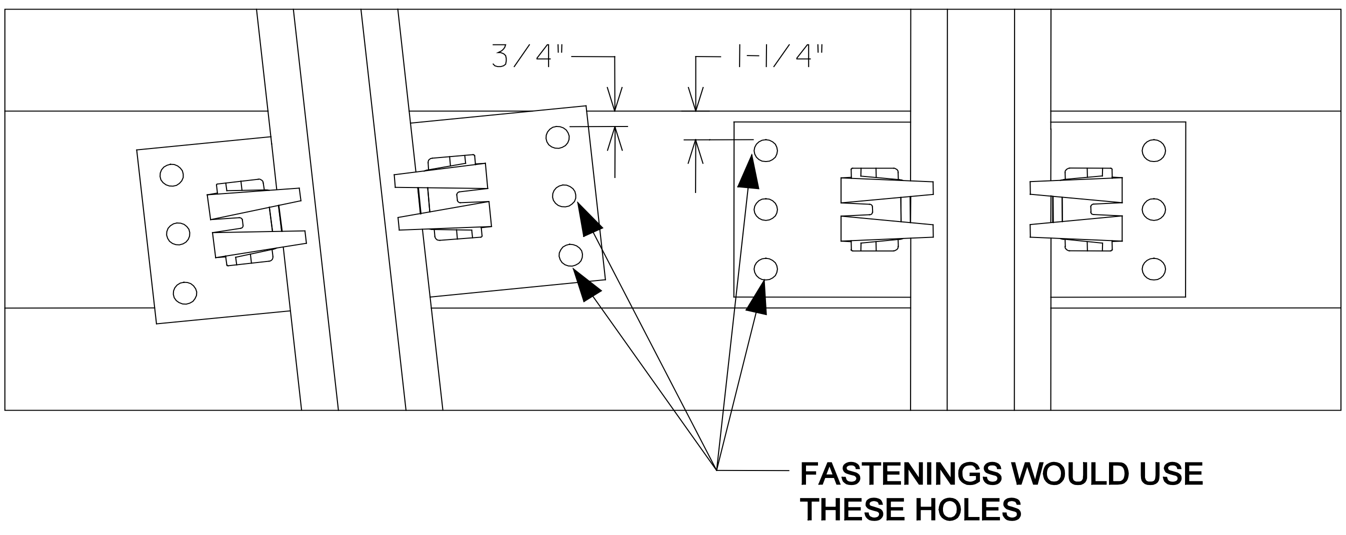


Figure 5-W

2. Securely seat rail in switch plates and keep rail braces tight. Do not over tighten.

5.5 Frogs

Frogs allow wheels to pass over one rail and onto another.

1. Frogs are designated by frog number according to their angle. Use frogs with turnouts of the same number. Refer to Standard Drawing No. 0080 for frog applications.
2. Frogs are furnished in extended lengths to provide clearance for field welding in track and replacement in the field without having to add additional rail. This type of frog may need to be cropped before installation in the field to take advantage of its versatility. Refer to the appropriate turnout Standard Drawing for cropping locations.
3. Tighten per 5.5.6.

5.5.1 Identification of Frogs by Number

The rail weight and frog size are stamped on a tag attached to the heel of the frog or cast into the top of the filler block. If these markings are not clearly visible, determine the frog number as follows:

1. With a tape measure, mark a 3-inch width across the top of the frog.
2. Mark a 4-inch width across the top of the frog.
3. Measure between marks. The number of inches measured equals the frog number. See Figure 5-X.

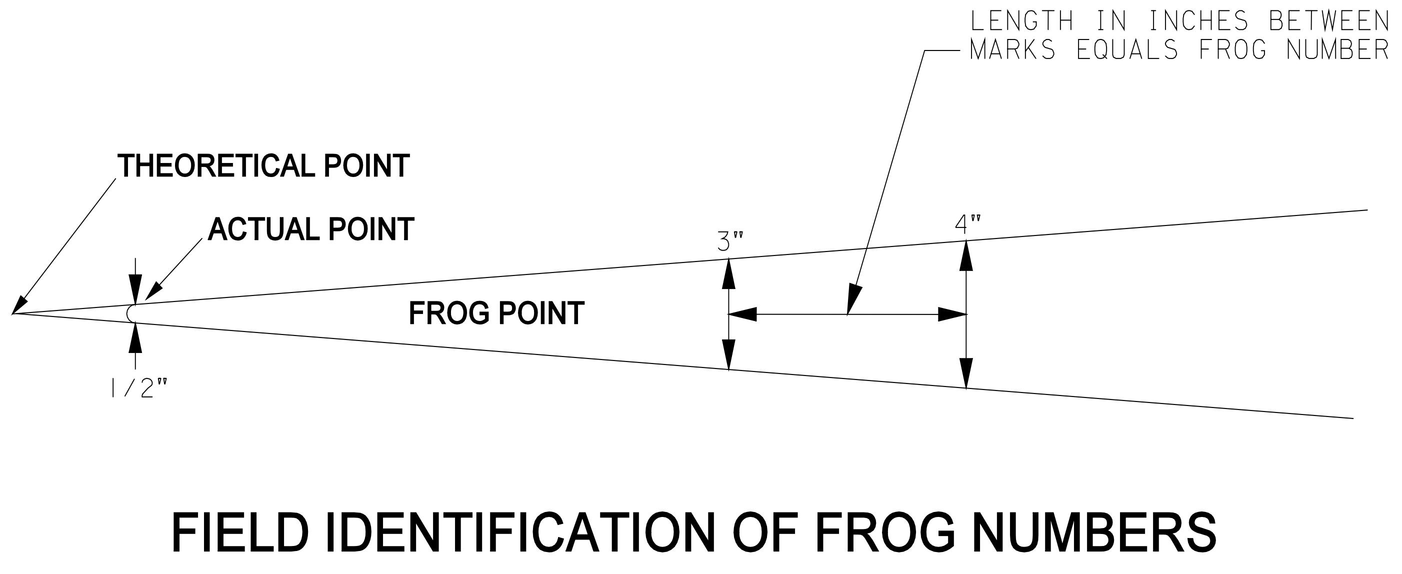


Figure 5-X

5.5.2 Frog Types

Subsections A through F describe typical frog types.

A. Railbound Manganese Frog (RBM)

The RBM frog has a cast manganese body insert for the point section of the frog. See Figure 5-Y. Refer to Standard Drawing No. 3005. RBM frogs can either be Heavy or Standard Point, see section 5.5.7 for additional details.

NOTE: In mid-2000's UPRR and the BNSF converted to conformal top RBM frogs. Conformal top frogs feature a 1:20 slope on the wing portion of the castings where as a standard RBM is flat. For help identifying conformal top frogs see Standard Drawing No. 151900 and Section 5.5.4 Frog Wear Conformal Frogs (Heavy Point RBM's).

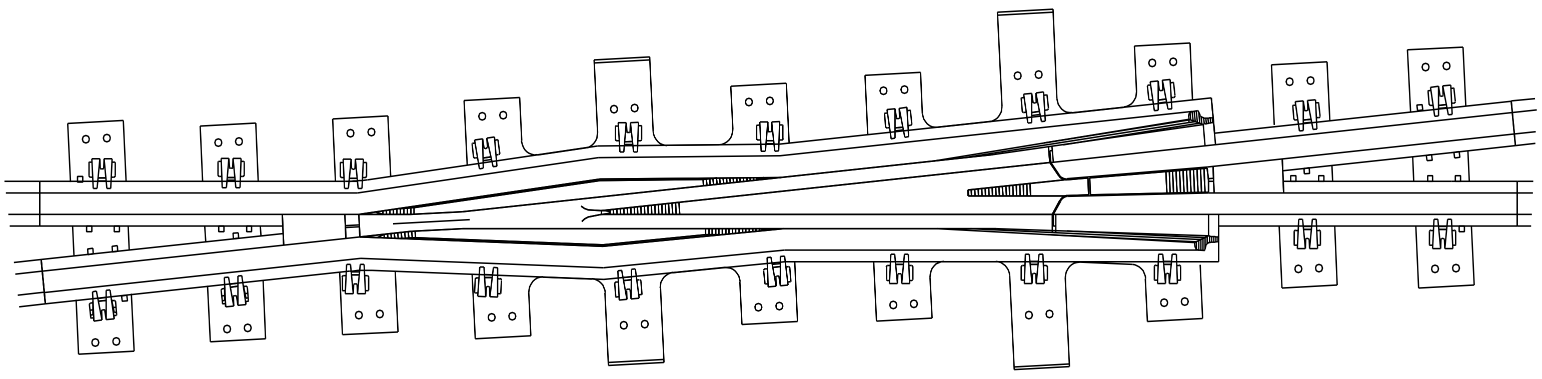


Figure 5-Y

B. Rigid Bolted Frog

The rigid bolted frog is similar in design to the RBM frog, except the point section is constructed from rail instead of manganese. Install a frog with the short point on the turnout side if it is available. See Figure 5-Z.

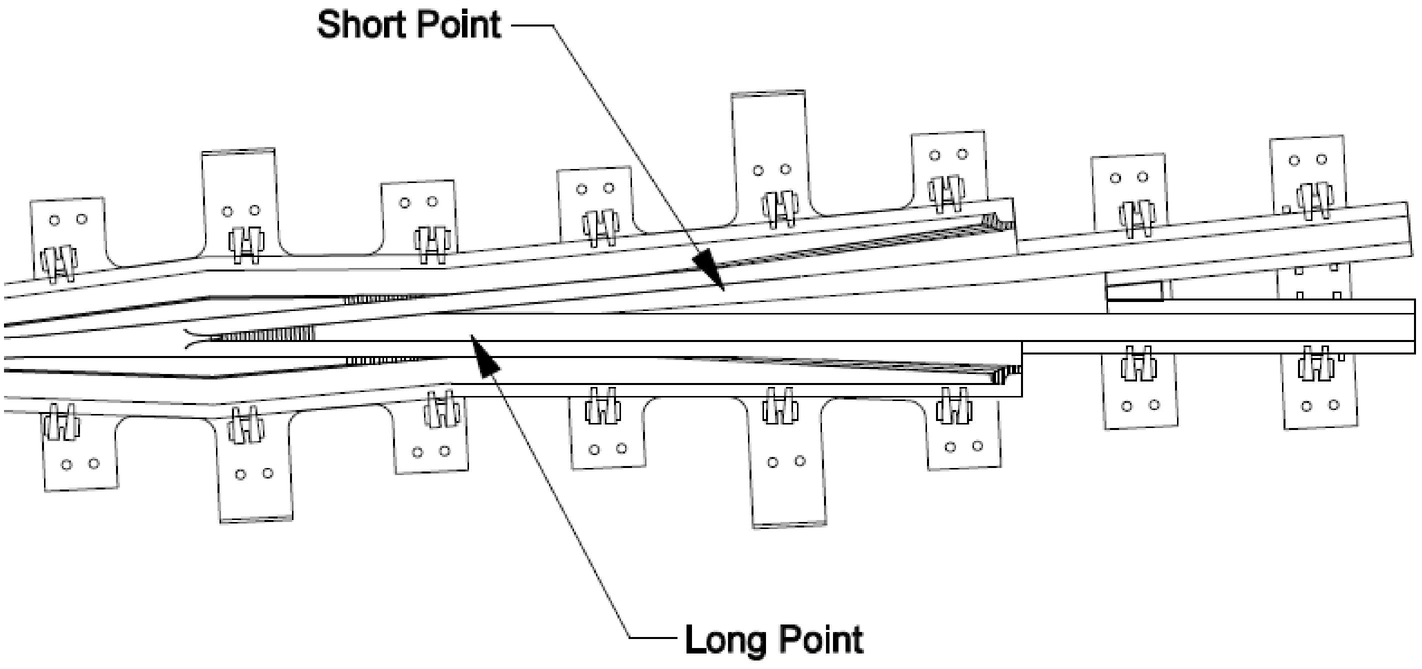


Figure 5-Z

C. Spring Frog

The spring frog has a movable wing rail that is normally held closed against the body of the frog except when pushed open by a diverging movement. See Figure 5-AA. Refer to Standard Drawing No. 3000. Use this frog in main track applications where the diverging traffic is less than 30 percent of the main track traffic.

Follow these requirements for spring frogs:

1. To determine the correct “hand” for spring frogs, stand at the toe of the frog and face the frog point.

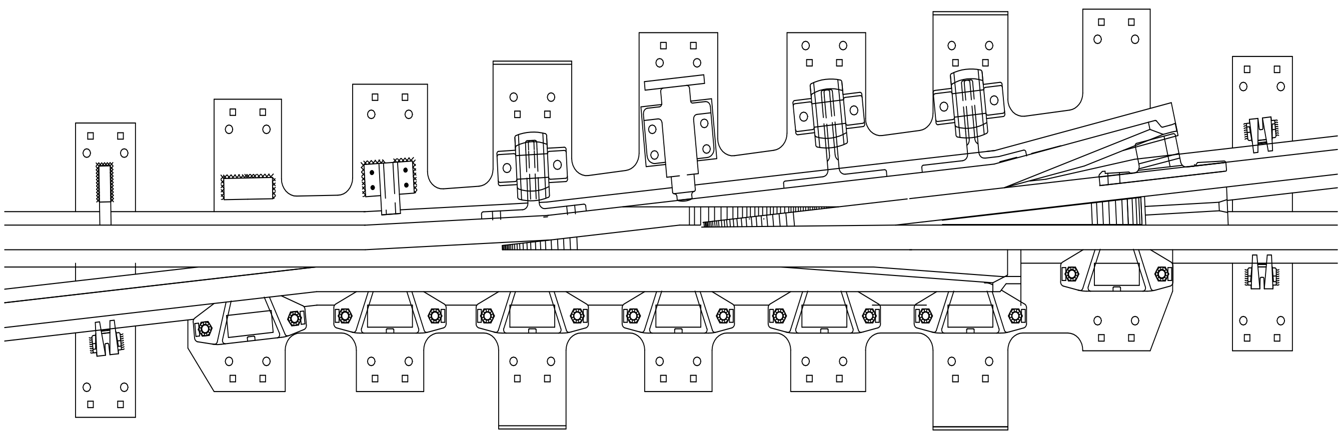


Figure 5-AA

- If the spring wing is on your left, it is a left-hand frog.
- If the spring wing is on your right, it is a right-hand frog.

2. When installing a spring frog without a toe block, align the match marks on the spring wing with those on the frog body. This ensures that the hold downs and horns are centered and the designed 3/8-inch opening is between the frog point and wing rail.
3. Ensure that the ties under the toe of the frog are in good condition and are solidly tamped.
4. Use wing rail retarders with frogs on dual control and spring-operated switches.
5. A WSM – Welded Spring Manganese frog features three welds between the casting and the rail for a “boltless connection”. These frogs are characterized by 2 stainless steel welds at the toe and one at the heel of the casting and no bolted joints.
6. All rail spring frogs do not have a manganese casting and are generally No. 11 and smaller.
7. Spring frogs can be Heavy Point frogs. See section 5.5.7 for further details.

D. Solid Manganese Self-Guarded Frog (SMSG)

The SMSG frog has a body cast in one piece from manganese steel. A raised guard cast into the body protects the frog point from passing wheels, making the installation of a guard rail on the opposite rail unnecessary. See Figure 5-BB. Refer to Standard Drawing No. 3005.

Use this frog in yard and industry applications where the track speed does not exceed 20 mph.

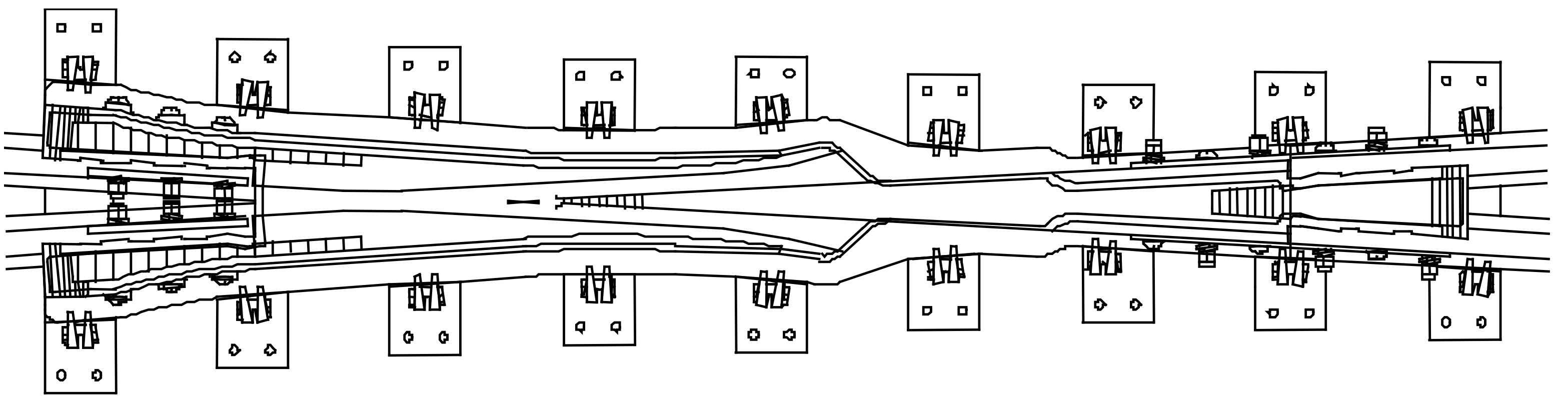


Figure 5-BB

Follow these guidelines:

1. If building the frog point under traffic, build the guarding face before the frog point.
2. Install guard rails as an option in cases where additional guarding may be required, such as curved switches.

E. Movable Point Frog (MPF)

The MPF is equipped with a point that is movable in the same manner as the switch points. See Figure 5-CC. Refer to Standard Drawing No. 3015. This frog is used in heavy tonnage, high-speed main track where the traffic on the straight and diverging side of the turnout is comparable.

Follow these requirements:

Do not build up the frog point by welding.

1. When performing maintenance on the frog, do not jack on asymmetrical wing rails.
2. Ensure good surface for proper frog operation.
3. Lubricate the base plate with a switch plate lubricant over the area where the frog point travels.

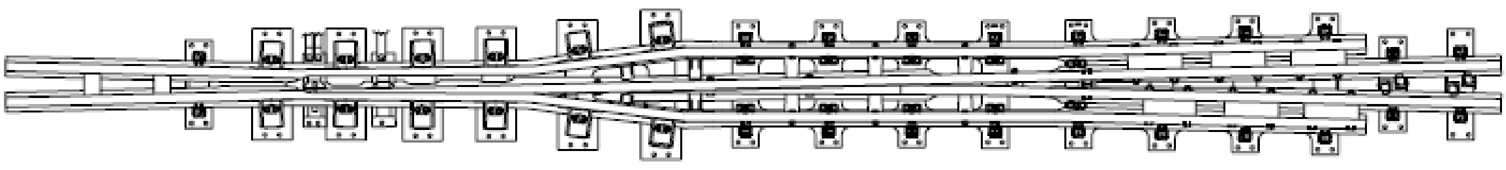


Figure 5-CC

F. Jump Frog

The jump frog features a continuous mainline rail and a flange bearing run on the turnout side. This frog can be utilized in situations where traffic through the diverging route is minimal such as maintenance of way tracks or small industry tracks. Speed is limited on the turnout run to 10 MPH by the FRA.

Follow these requirements:

1. When installing a Jump Frog the mainline guard rail can be removed. Gage plates are required between the frog and the mainline running rail. Do not allow gage through the frog to exceed 57”. For gage plate details see Standard Drawing Nos. 3042 and 3043.
2. The turnout side guard rail must be installed. Guard rail must be upgraded to the latest boltless adjustable style and shimmed upwards at the center per Standard Drawing Nos. 3042 and 3043 to prevent stiff truck derailments.

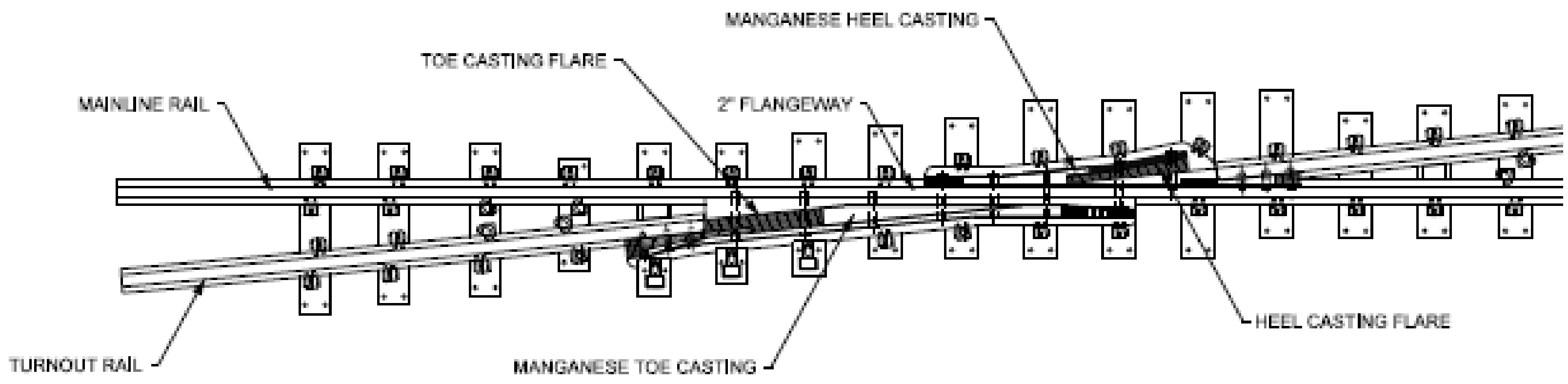


Figure 5-DD

G. Crossing Frog (Diamond)

Crossing diamonds allow two tracks to cross over one another at grade. They may be constructed from all rail or with manganese inserts at the locations where the rails cross over each other.

When replacing crossing diamonds the order of preference is as follows:

1. One Way Low Speed
2. High Angle Reversible
3. Low Angle Reversible

NOTE: When a new crossing frog is installed, the old crossing should be retained near the location of the crossing but a sufficient distance away so that it would not be damaged in a derailment on the railroad crossing. If the crossing in track is damaged in a derailment or otherwise fails, the old crossing can be reinstalled to allow reopening of the line while repairs are being made to the damaged crossing or until a new crossing can be purchased.

NOTE: Lead times on many critical crossing diamond components and replacement crossings can be long. It is recommended that a minimum of ONE SPARE MANGANESE CASTING SET be kept on hand at all times in case of failure. For assistance with ordering spare crossing diamond parts or new crossing diamonds contact the Sr Manager of Engineering Methods and Research. Lead time on new crossings is generally 6 months and will be shipped with a minimum of one full spare set of castings.

NOTE: To access Crossing diamond drawings visit the UPRR Engineering Portal – Procedures and Standards – Track Standard Drawing Index – Crossing Diamonds and pull by location. If drawings are not found contact Engineering Methods and Research for Assistance with locating.

There are three distinctly different designs of rail crossings that include:

- Low Angle Reversible – crossing central angle is 16-40 degrees, refer to Figure 5-EE.

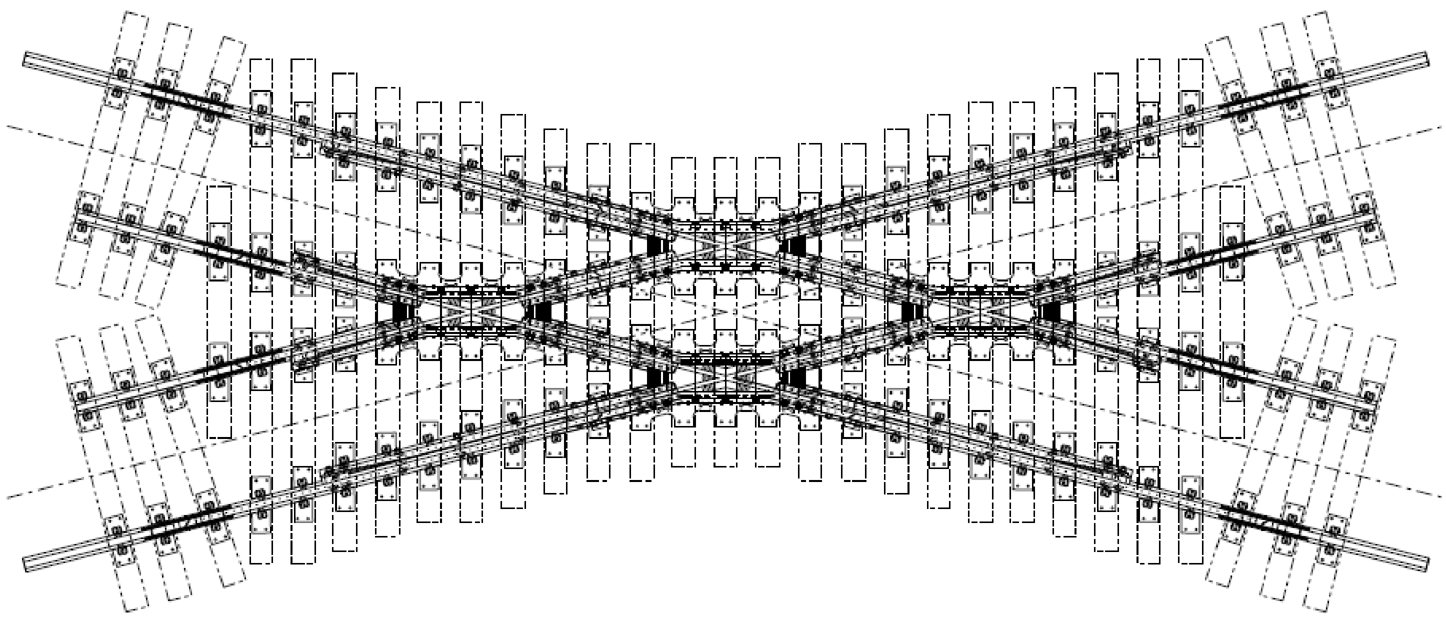


Figure 5-EE

Straight Rail Reversible – crossing central angle is 41-90 degrees, refer to Figure 5-FF.

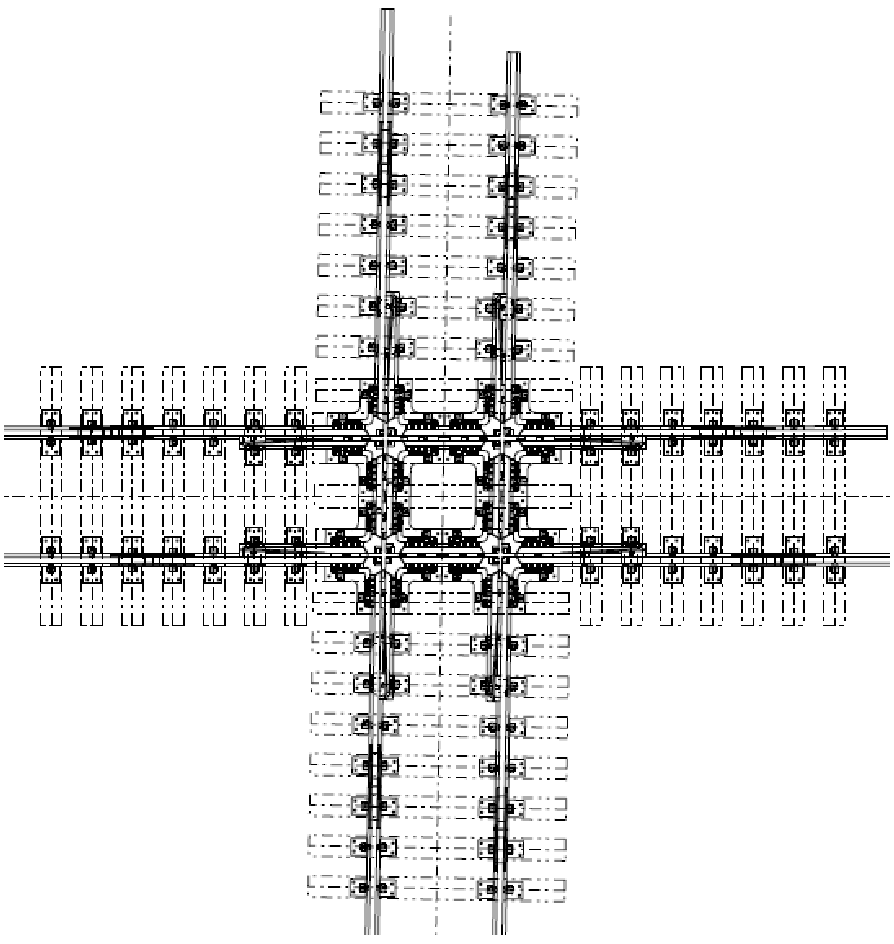


Figure 5-FF

- OWLS (One Way Low Speed) – crossing central angle is 35-90 degrees, refer to Figure 5-GG.
    - OWLS crossings utilize a flange bearing lift on one track that is limited to 10MPH. The mainline run is approved for speeds up to 79MPH.

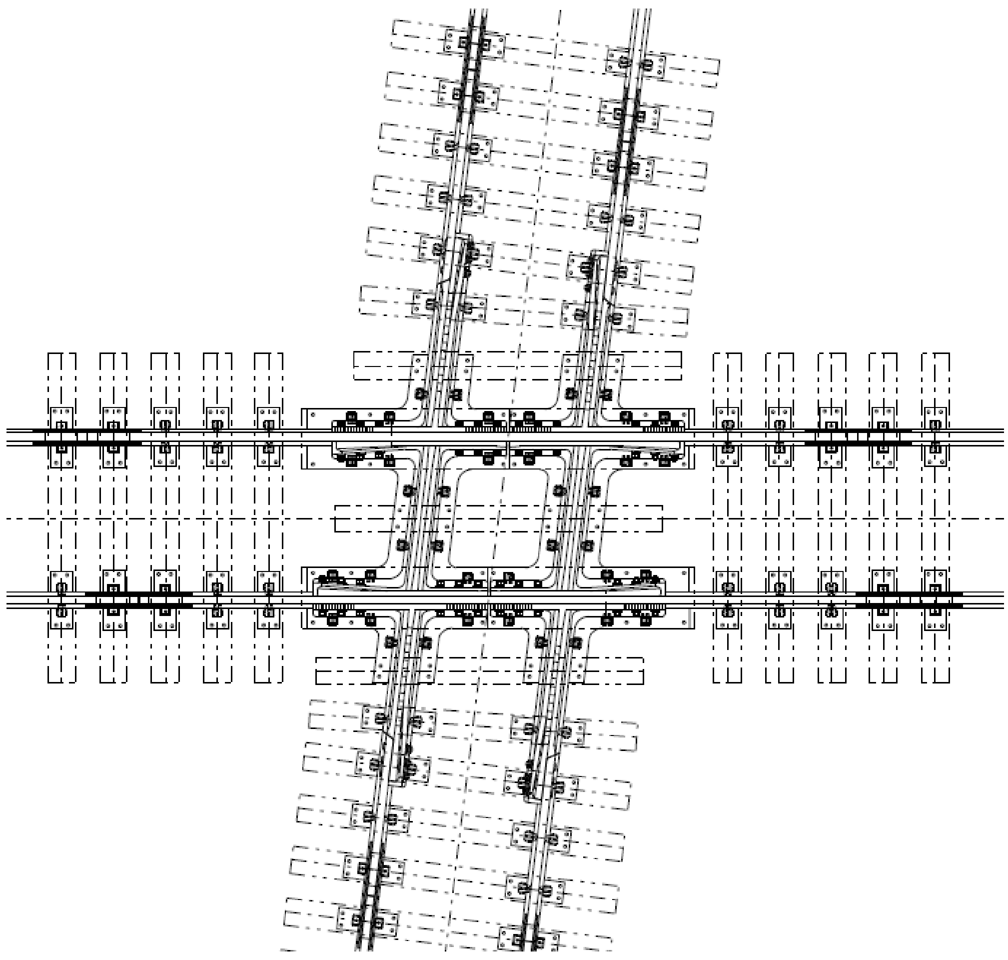


Figure 5-GG

- FBF (Flange Bearing Frog) or Full-Flange Bearing Crossings – crossing central angle is 20-90 degrees, refer to Figure 5-GG-2.
  - FBF crossings utilize a flange bearing lift ramp on both tracks that can be designed for up to 60 MPH.
  - FBF crossings have long signal “deadzones” that require additional signal work to be performed before installation.

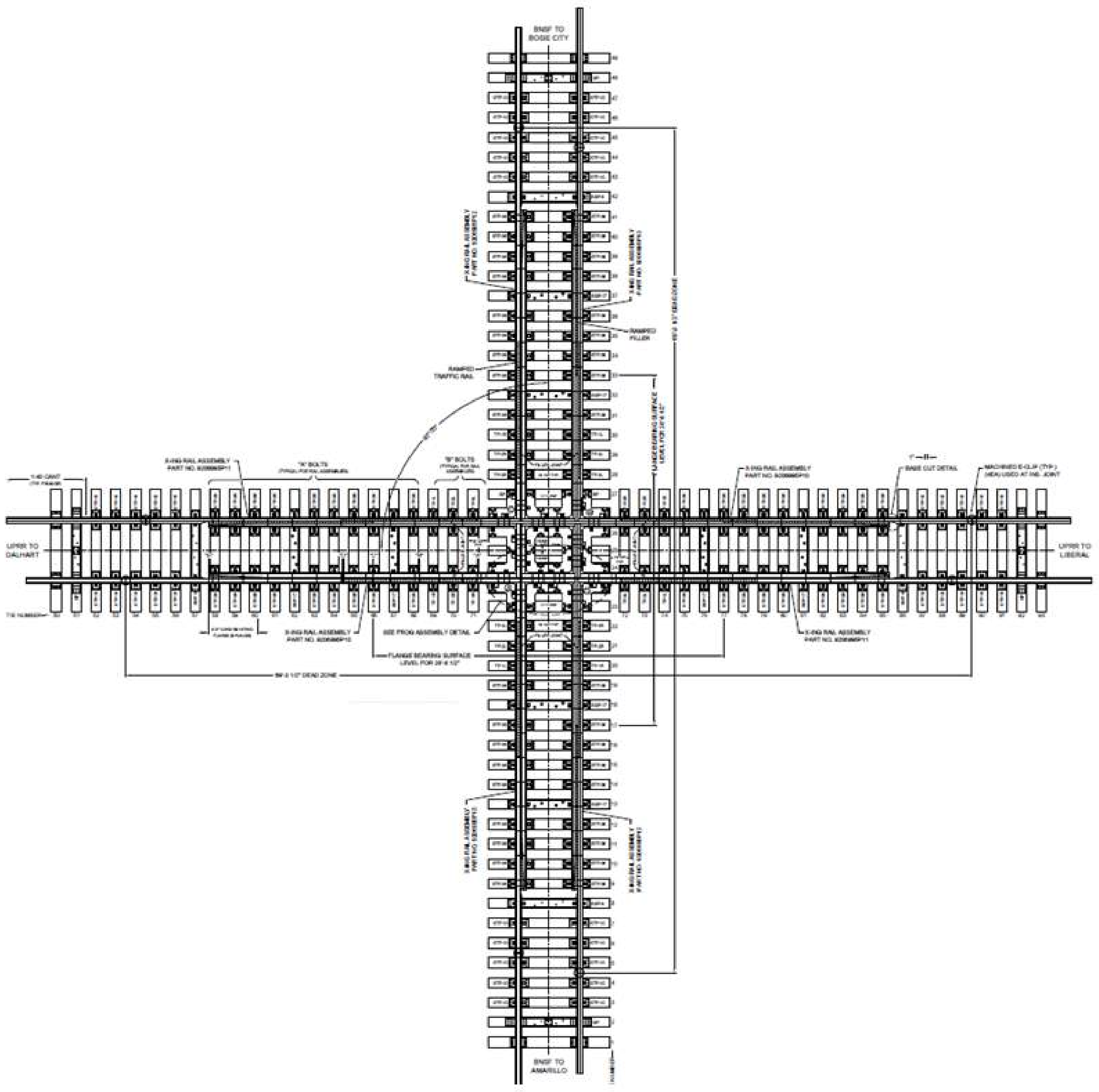


Figure 5-GG-2

Figure 5-HH contains common nomenclature for all three types of rail crossing designs.

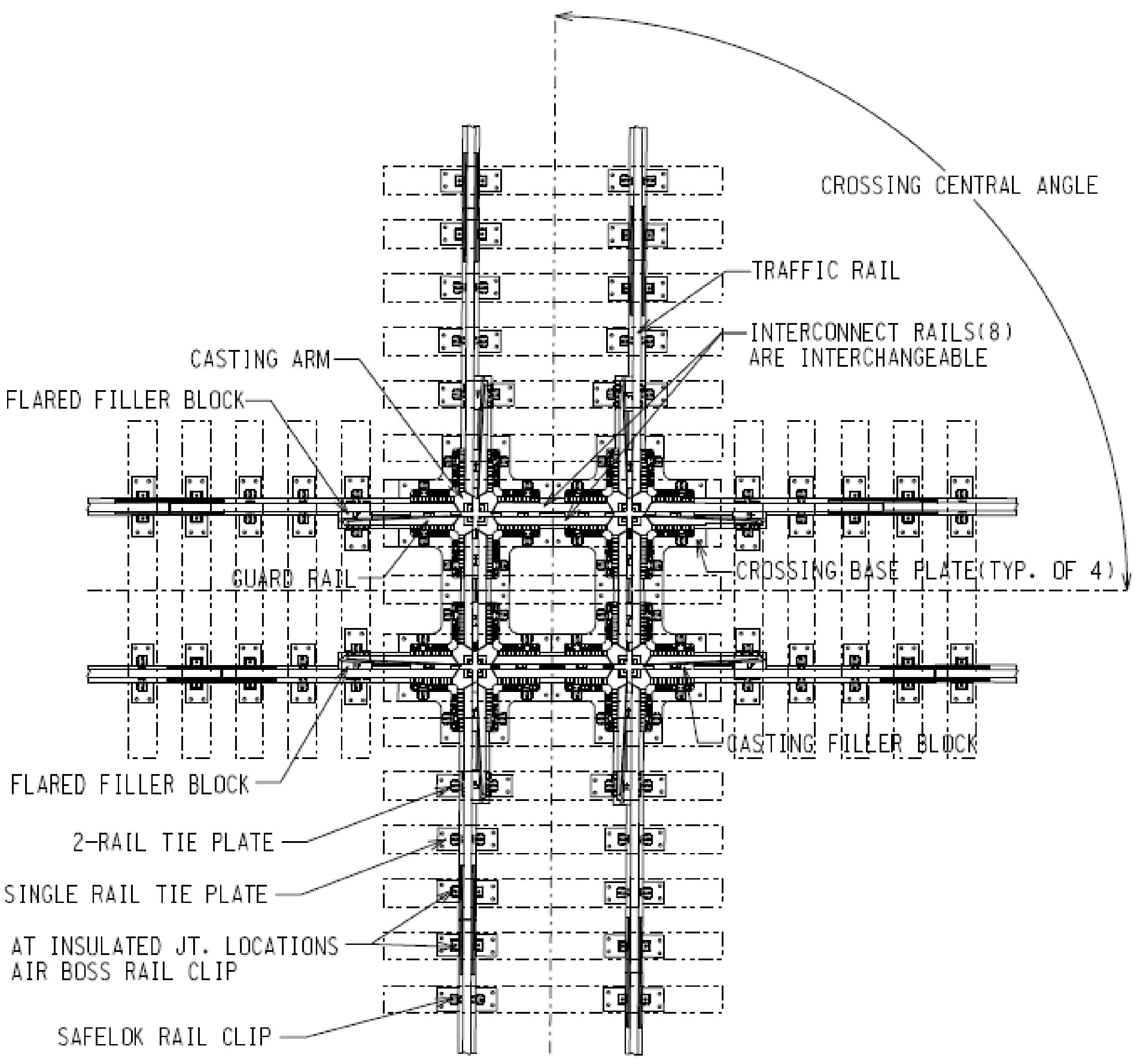


Figure 5-HH

5.5.3 Frog Wear Non-Conformal Frogs (RBM, SMSG, Jump and Diamonds)

Check frog wear on Non-Conformal Frogs as follows:

1. Do not allow the frog to wear such that the flangeway is less than 1-9/16 inch deep or less than 1-1/2 inch wide, as shown and measured in Figure 5-II.

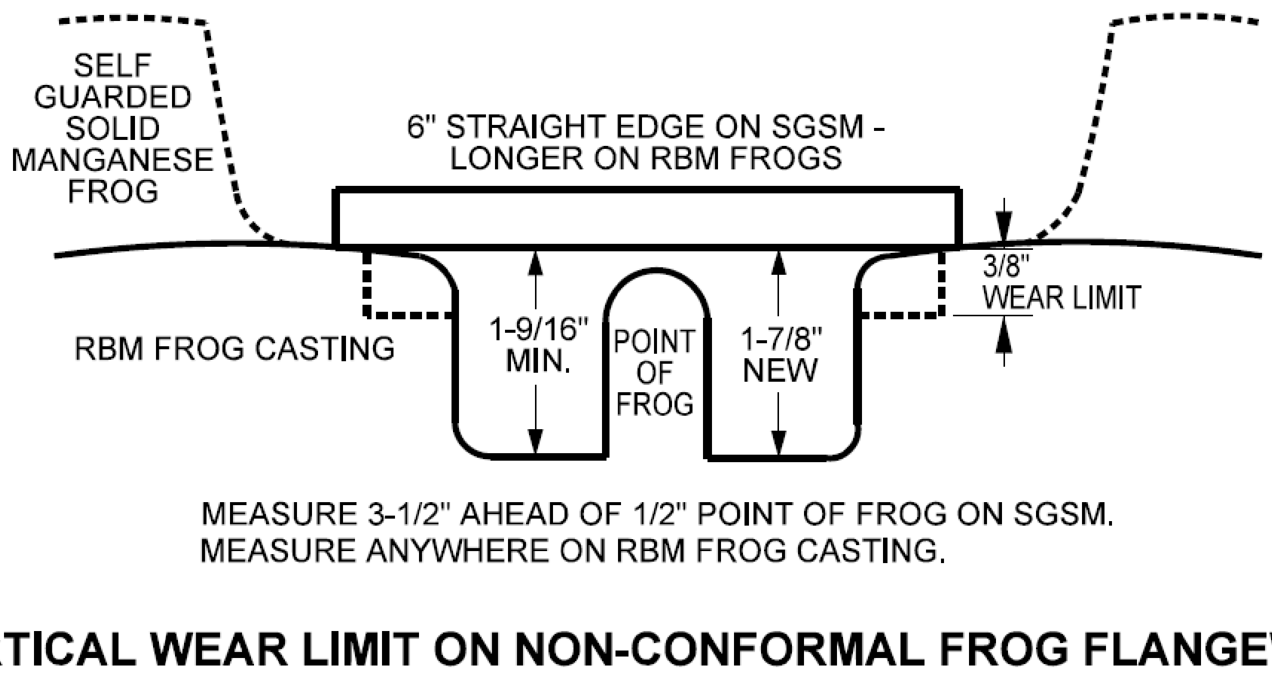
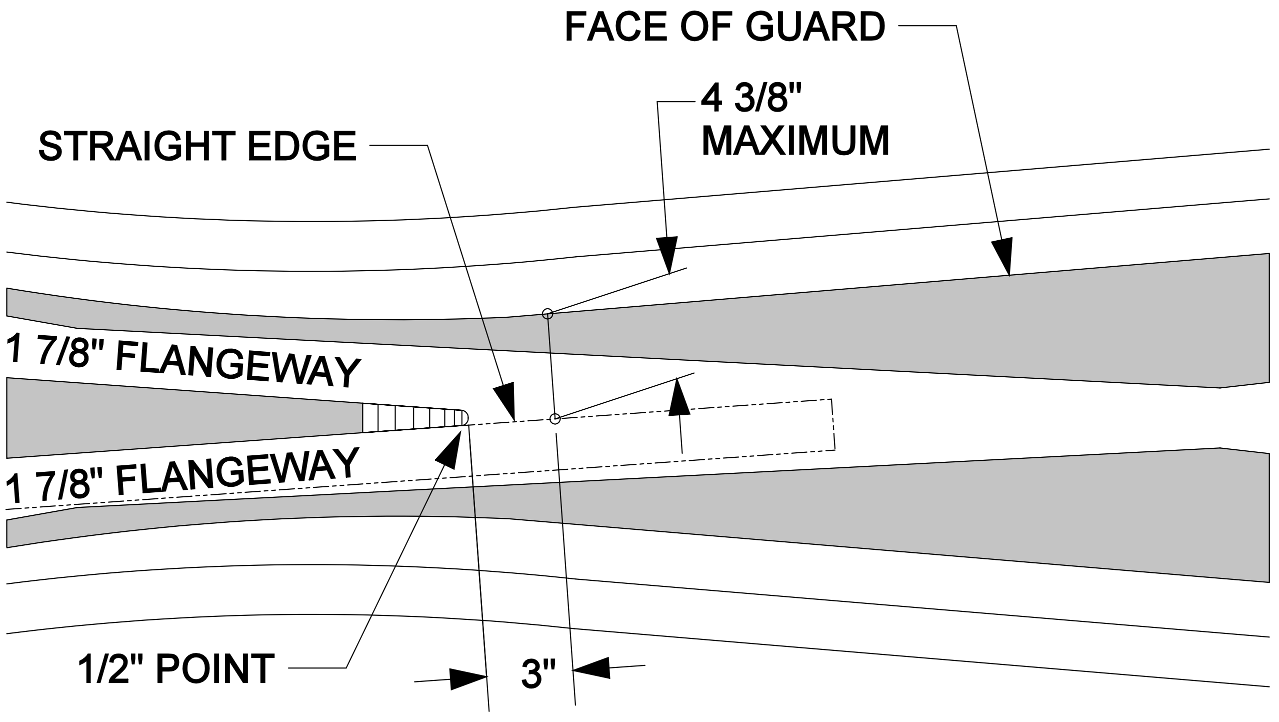


Figure 5-II

2. If the tread portion of a frog casting is worn down more than 3/8 inch below the original contour, restrict the operating speed over that frog to 10 MPH. Wear to be checked using a straight edge.
3. For self-guarded frogs, ensure that the distance from the gage line of the frog point to the guarding face does not exceed 4-3/8 inches as shown in Figure 5-JJ.
4. On OWLS crossing diamonds or Jump Frogs, any gouge made in the mainline running rails by the flange bearing wheels must not exceed ¾" in depth. If any gouges exceed this the mainline rail must be replaced or restricted to 10MPH.



Wear Limit for Self-Guarded Frog

Figure 5-JJ

5.5.4 Frog Wear Conformal Frogs (Heavy Point RBM)

UPRR converted to the conformal top casting on all heavy point RBM frogs in the year 2005. The conformal top frog has a 1:20 slope on the tread or "wing" side of the casting that is designed to better fit the profile of the wheel. To identify a conformal top RBM casting lay a straight edge across the frog at the point, if the castings are sloped as shown in Figure 5-KK the frog is conformal.

Figure 5-LL shows a conformal top heavy point RBM frog. Although it can be difficult to detect visually the slope indicates a conformal top frog. Conformal top frogs will also be stamped Conformal or CF on the castings or will have Conformal indicated on the manufacturers ID tag.

Follow these requirements when measuring conformal frogs for wear:

1. Use the special conformal top gages to measure, flange depth and tread wear limits. Gages can be ordered using item number 555-6750 and 555-6751. Gages are sloped to account for the 1:20 casting slope. Not using these gages can result in inaccurate measurements of wear and depth.
2. When rebuilding conformal castings using a weld repair castings can be repaired back to a flat slope seen in figure 5-II. Weld repairing to the flat slope is simpler than trying to restore the 1:20 slope.
3. Conformal gages must also be utilized to check for point wear. Using a straight edge will provide an inaccurate measurement that does not account for slope.

4. At any point on the frog, flangeways must be a minimum of 1-1/2 inches wide and 1-9/16 inches deep. Tread portion must not have wear in excess of 3/8” below the conformal contour.

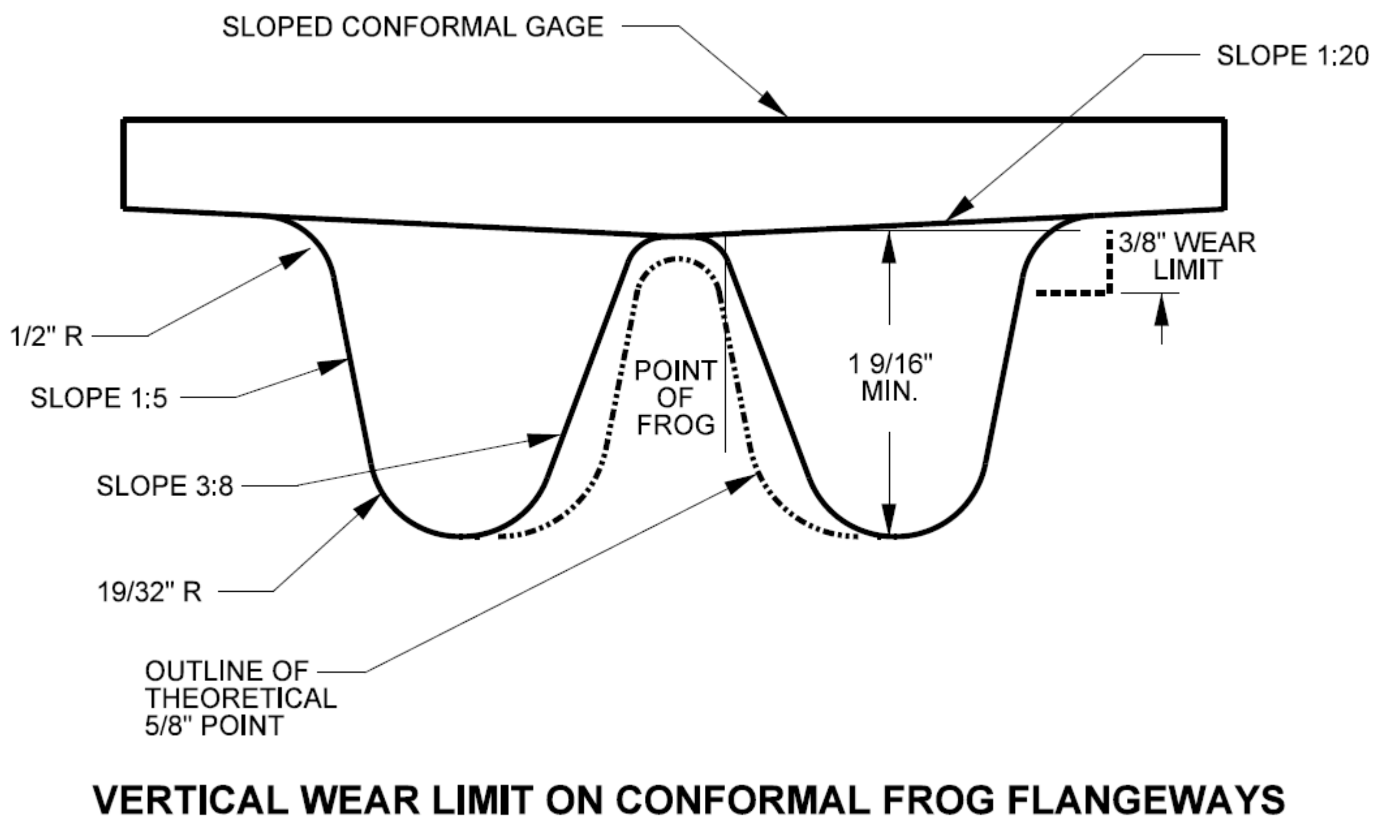


Figure 5-KK

Figure 5-LL

5.5.5 Frog Guard Rail Size and Length

Follow these requirements for guard rail size and length:

1. Use guard rails that are the proper size. Position them correctly in relation to the frog. Refer to the appropriate turnout Standard Drawing for details on guard rail placement. Refer to Standard Drawing Nos. 4019 to 4090 and 160100 for more information on guard rail specifications and settings.
2. Use guard rail lengths for turnouts as shown in Table 5-E.

Frog Size	Main Track Guard Rail Length (Feet)	Turnout Guard Rail Length (Feet)
No. 7 and No. 9	13 feet*	13 feet
No. 10 and No. 14	19’6” feet (min.)	15 feet
No. 11 and No. 15	19’6” feet	19’6” feet
No. 20 and No. 24	26 feet	26 feet

Table 5-E

*** If the track speed is greater than 40 mph, use at minimum a 19’6”-foot guard rail length.**

5.5.6 Frog Bolt Sizes and Torque

Determine the frog bolt and washer diameter and torque from Table 5-F.

Rail Size	Bolt and Washer Diameter	Torque (lb.)
85 lb. or less	1-1/8"	1,500
90 to 100 lb.	1-1/4"	1,750
110 lb. or more	1-3/8"	2,200

Table 5-F

5.5.7 Frog Bolt Installation

Replace frog bolts that are missing, bent, cracked or worn more than 1/8 inch in diameter, or that cannot be tightened to compress the washer.

Follow these requirements:

1. Use only frog bolts made from Grade 8 material. Grade 8 bolts can be identified by 5 tick marks on the bolt head. See Figure 5-NN.

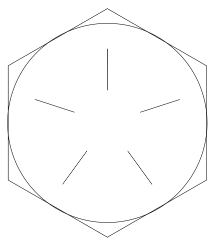


Figure 5-NN

2. Use proper length bolts that do not allow the threaded portion of the bolt to extend more than 1 inch past the nut.
3. Install frog bolts using a torque wrench as follows:
   a. Apply an approved never seize lubricant to the bolt threads and nut threads before tightening.
   b. Use one cam washer with a lock nut (Figure 5-OO):

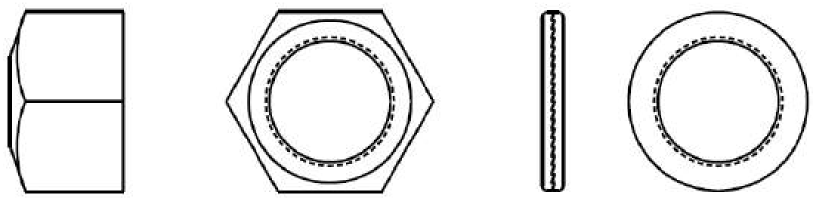


Figure 5-OO

   c. Tighten all bolts to the desired torque.

NOTE: On new rail crossing diamond installs, contact Methods and Research to tighten bolts before installation and once a month after installation.

4. When torque wrench is not available,
   a. Apply an approved never seize lubricant to the bolt threads and nut threads before tightening.
   b. Use one spring washer with a heavy hex nut or one flat washer with a heavy hex lock nut. See Figure 5-PP.

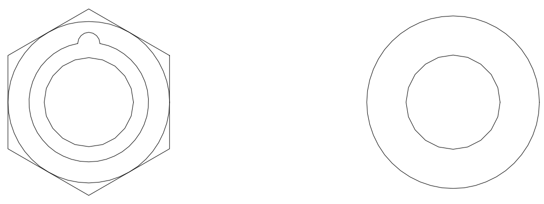


Figure 5-PP

   c. Tighten all bolts to refusal.

5.5.8 Frog Gage Plates

Fit frog gage plates to frog and guard rail plates after you have properly set track gage, guard check gage, and guard face gage. See Standard Drawing Nos. 3031 and 160100.

Frog gage plates must be insulated in signalized territories.

When installing a jump frog, gage plates are required between the mainline and frog to prevent excessive flange contact on the raised portions of the castings. See Standard Drawings 3043 and 3044.

5.5.9 Guard Check Gage

Minimum allowable limits for guard check and guard face gage are shown in Table 5-G. See Standard Drawing No. 4090 for further details.

NOTE: Many Spring and RBM frogs produced size #11 and larger are heavy point frogs. Heavy point frogs have additional material added at the point to increase long term wear resistance. To identify a heavy point frog you can either look at the frog point to determine if it is 31/32” wide at the cut as shown in Figure 5-QQ. These frogs will also be marked with HP on the casting or manufacturer’s tag. Heavy point frogs have extra material that is added to the point that tightens the mainline gage. When installing heavy point frogs the FRA waivers allow for class 4 requirements to be operated at class 5 and higher provided that 3 gage plates are under the frog. Heavy point frogs should be setup at 54 3/8” guard check and 56 5/16” mainline gage.

NOTE: When measuring guard check and mainline gage through the frog area, care should be taken to take the measurement at 5/8” below the top of the frog point. If not you can lose distance on the guard check measurement. Best practice is to utilize a track inspector’s level board to measure for best accuracy, when using a tape it is difficult to get the 5/8” point directly.

NOTE: Guard check and Guard Face gage are key players in keeping wheels from excessively contacting frog points. If frog point wear is excessive make sure to check gage to be sure that wheel flanges are not allowed to strike frog points excessively.

Class of Track	Guard Check Gage may not be less than	Guard Face Gage may not be more than
1	54 1/8"	53 1/4"
2	54 1/4"	53 1/8"
3 and 4	54 3/8"	53 1/8"
5	54 1/2"	53"
HEAVY POINT FROG, CLASS 5 *	54 3/8"	53 1/8"
6 to 9	54 1/2”	53”

Table 5-G

Figure 5-QQ

A. Gage Settings for Standard Point Frogs.

When repairing or installing standard point frogs set Guard Check Gage at 54-5/8 inches and mainline gage at 56 1/2 inches.

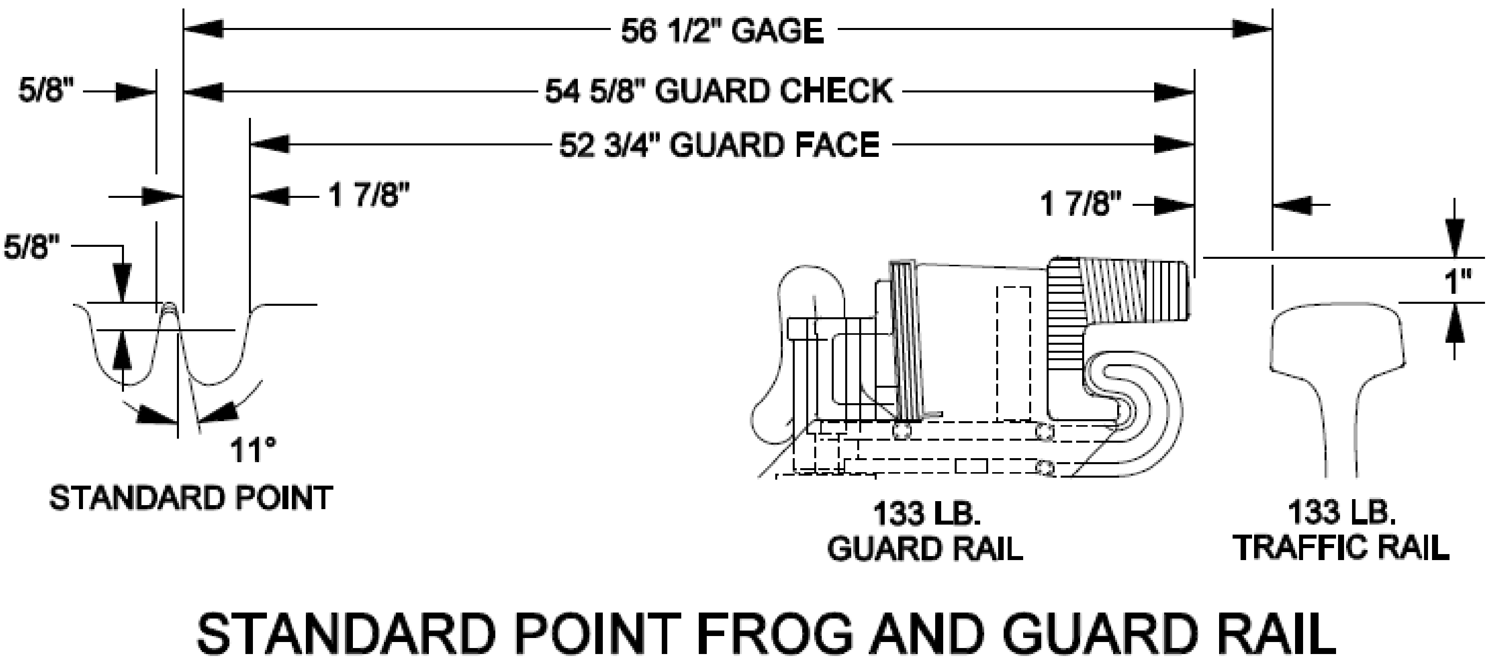


Figure 5-RR

B. Gage Settings for Heavy Point Frogs

When repairing or installing heavy point frogs set Guard Check Gage at 54-7/16 inches and mainline gage at 56 5/16 inches.

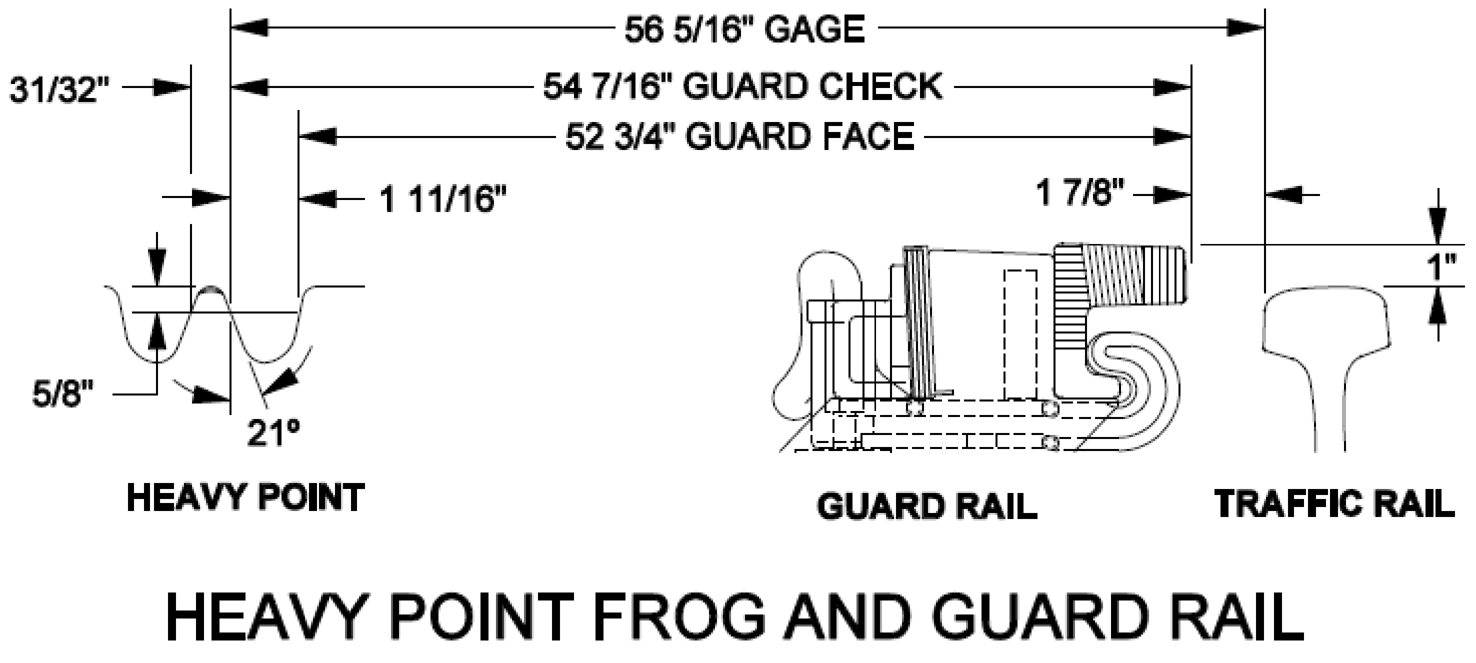


Figure 5-SS

NOTE: Heavy point frogs must have three gage plates (welded) under the frog and guard rails in Class 5 track to allow for Class 4 tolerances. This includes the turnout side. All heavy point frogs are required to be inventoried in the Track Inspection System. SPRING FROGS MAY ALSO BE CLASSIFIED AS HEAVY POINT FROGS, see Figure 5-QQ for identification.

Early wear may be detected on the tip of a heavy point frog, THIS IS NORMAL, this wear is intentional to establish early work hardening. For an example of normal early wear see Figure 5-TT.

Figure 5-TT

5.5.10 Jump Frogs

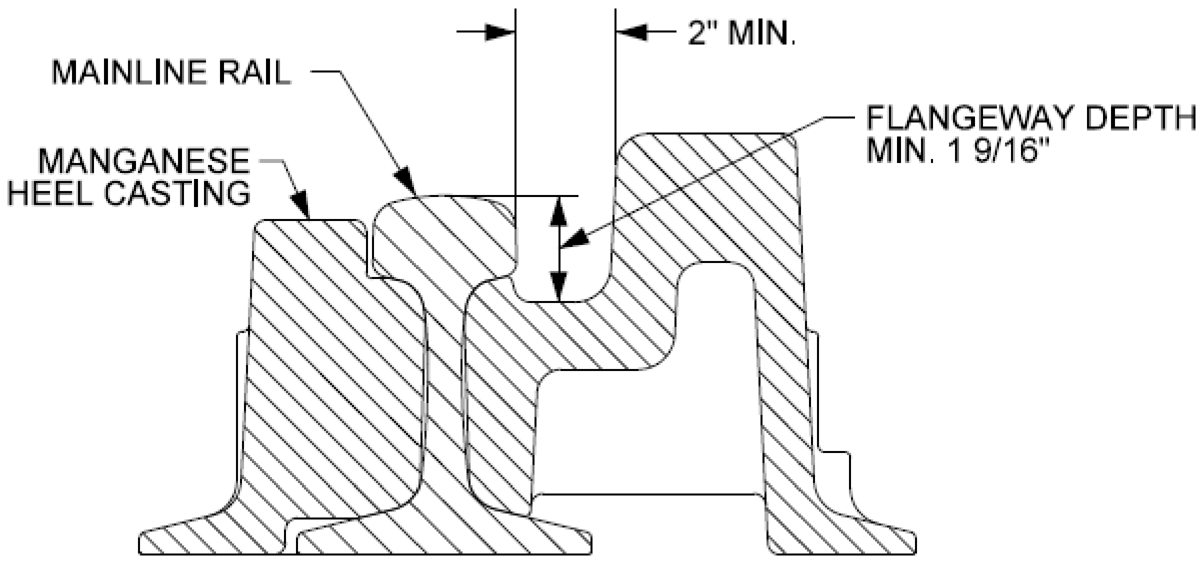
Jump Frogs can be utilized in locations where the turnout route has a maximum of 65 cars at any one time, and the mainline or siding route is heavy traffic. Jump Frogs greatly reduce impact loads and can provide a large maintenance reduction.

Care must be taken to control the mainline and turnout gage to prevent excessive wheel flange contact on raised castings which could lead to a derailment.

1. Mainline gage through the jump frog must not exceed 57”. If 57” is exceeded the frog must be slow ordered to 25MPH until corrected.
2. Jump Frogs are limited to 10MPH turnout side movement.
3. Jump Frog warning sign must be installed per Standard Drawing No. 0562. Care must be taken when hy-railing over jump frogs due to the raised casting potentially contacting the hy-rail wheels.
4. Gage plates must be installed between the mainline rail and the frog itself. Gage plates will help control gage and prevent excessive wheel contact. See Standard Drawing 3043 or 3044 for additional details. See Figure 5-UU. Do not install jump frogs within 200’ of a curve. Lateral force due to curvature can cause issues with jump frogs.
5. All raised portions of the casting above the mainline rail surface shall be inspected for excessive flange contact during ordinary switch inspections. Excessive contact, such as large gouges or extreme amounts of polish, indicate a problem.
6. Shim plates must be installed beneath the turnout side guard rail per instructions on Standard Drawings 3043 or 3044. Shims help prevent stiff truck derailments of on-track equipment when traversing the turnout side.

7. Gouges in the head of the mainline rail caused by turnout movement flange wear should not exceed 1/2" deep. If 1/2" is exceeded slow order to 10 MPH and replace the mainline rail.
8. For Jump Frogs ensure that mainline rail wear does not allow the flangeway depth to be less than 1- 9/16". See Figure 5-VV. Measure by using a straight edge on the mainline rail head to simulate the flat tread surface. Do not allow the flangeway gap between the mainline rail and casting to be less than 2".

Figure 5-UU



MINIMUM ALLOWABLE FLANGEWAY DEPTH ON JUMP FROGS

Figure 5-VV

5.5.11 Welding Repair of Guard Rails, Frogs and Diamonds

1. Do not build up guard rails by welding in the field.
2. Do not repair all-rail spring frogs by welding in track. Frogs with manganese inserts may be welded per current welding instructions for manganese components. See Form 7913, "Instructions for Inspecting, Welding and Grinding of Rail and Track Components".
3. Crossing diamond manganese castings can be weld repaired using the same requirements for turnout Frogs.
4. The Flange Bearing castings on an OWLS crossing diamond frog or jump frog can be weld repaired to rebuild the flange bearing portion if the wear depth does not exceed 1". At no time can the flange bearing area be raised more than its original height.

5.5.12 Spring Frog Inspection and Maintenance Procedures

An inspection and maintenance procedure on frogs is an important part of maintaining good, safe track. Spring Frogs can provide reduced welding maintenance from RBM's if properly maintained. Spring Frogs in Class 2-6 Track are required to have a detailed inspection every 90 days. Due to the moving parts involved with the operation of a spring frog follow these steps to ensure that it is properly maintained.

A. Frog Body

Basic inspection and maintenance items required for all frogs include:

1. Checking for breaks and cracks in the rails and castings.
2. Replacing missing body bolts and keeping bolts torqued to 2000 ft/lbs. A torque wrench can be used, or a standard impact wrench can suffice.
   - Thin head body bolts are used along the spring wing on spring frogs. These bolts are not visible in the normal closed position and should be inspected by opening the spring wing with a hydraulic spreader.
     – Replacement stud bolts, with a thin jam nut, are available for replacement of these bolts.
   - Broken body bolts must be replaced with the thin head variety to ensure that the wing rail will fit properly along the body of the frog.
3. Grinding excess metal flow from the running surfaces to prevent chipping:
   - Slot mating surfaces between adjoining rails and castings to a depth of at least 3/16" and slightly beveled at the top.
   - Grind gage corners of running surface to a 5/8" radius.
4. Flangeway width not less than 1 ½"
5. Flangeway depth not less than 1 9/16"

6. Tread wear on casting not worn more than 3/8” as shown in Figure 5-XX.

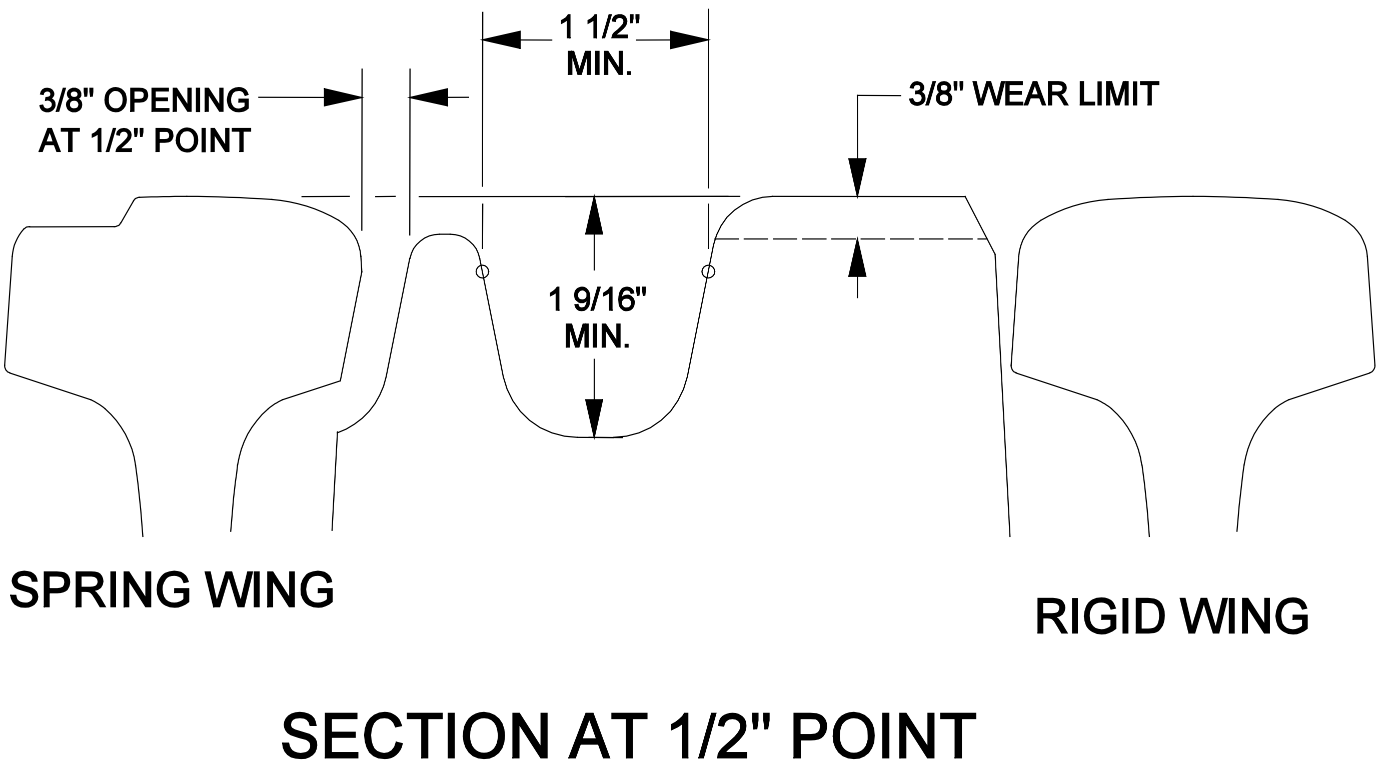


Figure 5-XX

7. Excessive wear and breaks on the point within 16” of the ½” PF should be repaired. This is the critical area where wheel transition between the point and the wing rail occurs.
8. If the running surface of the frog is worn or broken to the point where there are indications that the outer edge of the wheel is contacting the side of the spring wing rail, the frog must be repaired or replaced.
9. Track gage should not be less than 56 ¼” or more than 56 7/8”.
10. Guard check gage should not be less than 54 ½” on frog with a standard point. A heavy point frog guard check gage is 54 7/16”.

B. Handling

1. The spring wing is sensitive to movement. A two or four leg sling should be used during handling to minimize bowing or sagging.
2. If a toe block is not designed into the frog ensure that the match marks on the wing rail and frog body are lined up when installed. This will ensure that the spring wing is set correctly in relation to the frog body and horns centered in the hold-downs.

C. Surface and Line

1. Good tie condition and surface must be maintained throughout the frog area. Surface should not have a depression or crown of more than 1/8” in any 15’ length. Poor surface or cross-level can cause binding of the spring wing and place unnecessary pressure on the spring assembly.
2. Line should be maintained within 1/16” to minimize unequal bearing of the spring wing against the point rail. Unequal bearing and continual slapping of the spring wing can cause point failure and the spring wing to lose its bend set.
3. Tamping with automated equipment can bend the plates and may restrict the opening or closure of the spring wing if precautions are not taken. Auxiliary jacks should be placed under the far rail of the turnout opposite the tamper when surfacing through the frog area to assist in lifting. Surfacing through the diverging side of the turnout before the straight side will greatly reduce the amount of force necessary to lift the frog from the spring wing side. The rail clamps of the tamper should not be used to grab and lift the wing rail or plating anywhere along the base plate supporting the frog on the spring wing side. See Figure 5-YY

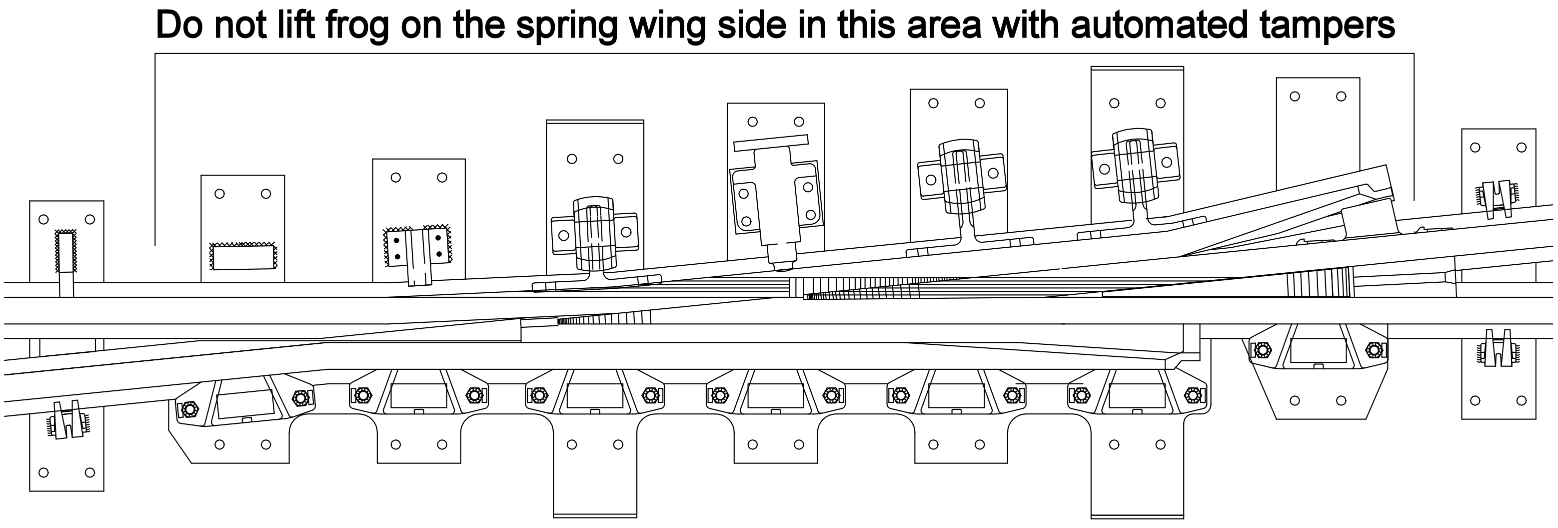


Figure 5-YY

4. Inspect base plates for damage after tamping operation if automated equipment is used.
5. Spring frogs should be hand tamped to avoid damage and ensure proper ballast distribution under frog body.

D. Toe Area of Frog

1. If there is a bolted joint:
   - Make sure all the bolts are in and tight.
   - Check rail ends for chipping or batter. Chips and batter should be repaired promptly and joint slotted with a slotting wheel no thicker than 5/32”.

- Carefully inspect the joint bars for any cracks. A joint bar with any type of crack must be replaced.

2. If there is a toe block, be sure the bolts are the correct size, in place and tight. The toe block provides a hinge point and helps to minimize longitudinal movement of the spring wing.
3. Check the tie condition under the toe to ensure that the ties are in good condition and solidly tamped. This is very important to minimize any vertical movement of the spring wing.

E. Spring Wing

1. Check the gap between the frog point and wing rail in the closed position. The design gap is 3/8 inch. A gap of no more than ¾” should be maintained.
2. Check the alignment of the spring wing along the frog body. The spring wing should fit up against the body of the frog along the entire straight portion of the rail.
3. If the spring wing is not set correctly against the frog body a closer inspection of the situation should be made to determine the cause. Some of the possibilities would include:
   - Inadequate anchoring – Inspect the anchor pattern. All switch ties and track for 120 ties each sides of the turnout should be fully box anchored to the extent possible. Check the anchors to be sure they are the correct size for the rail and they are up against the sides of the ties.
   - Spring box failure – Check that the spring box is in place and springs and spring retaining bolts are in good condition.
   - Retarder failure- If the retarder malfunctions it may not slow the wing rail. If there is no retarder, or the retarder is not functioning properly the constant impact of the wing rail against the frog body may cause point or wing rail failure, or the wing rail to lose some of its bend set.
4. A hydraulic spreader jaw (item number 410-6850) should be used to check the maximum wing rail opening width. Place the hydraulic spreader jaw in the throat of the frog just ahead of the point. On manganese insert frogs, the cylinder end of the jaw should be placed on the moveable wing rail so that the tabs of the spreader bracket fit underneath the rail head. This orientation will help anchor the cylinder to prevent it from dislodging. On all rail frogs the cylinder may be used in either orientation. (Figure 5-ZZ).

Insure that the spreader bracket is securely screwed into the cylinder head. If it is loose there is potential of the bracket head breaking off the cylinder.

Care must be taken when operating the spreader jaw. Do not place yourself in a position directly over the jaw when it is under pressure in the event that it would slip out. Generally a 1,400 to 2,000 psi gauge reading is all that should be required to open up the wing rail to the fully opened position. If the force is approaching the red area on the gage take pressure off the spring to reduce the force required to open the wing.

NOTE: MANY SPRING RAIL TESTING KITS COME WITH A CONVERSION TABLE TO CONVERT LBS. TO PSI. MAKE SURE TO FOLLOW THIS CHART TO AVOID DAMAGING THE TESTING KIT.

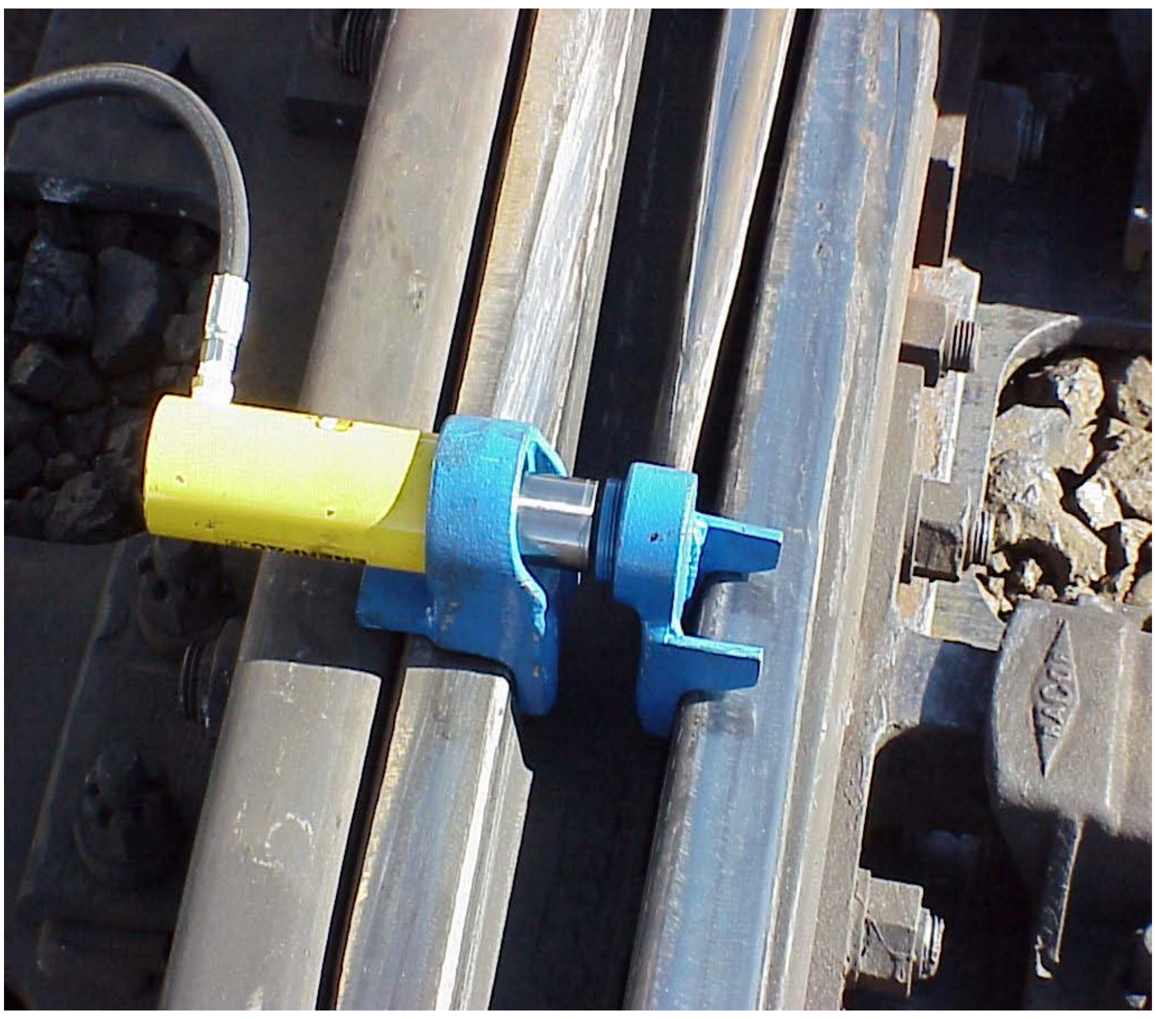


Figure 5-ZZ

5. **Begin by loosening the adjustment bolts to relieve spring tension. Reducing the pressure on the spring will prevent excessive pressure being placed on the spreader head.** Failure to loosen bolts will put excessive pressure on the spreader and may cause it to crack, by loosening spring tension prior to testing the spreader can more easily spread the wing. Use the jaw to open the wing until it is up against

the rail stops. Measure the spring wing flangeway opening at the Frog Point. Adjust wing rail stops if flangeway opening is more than 2”.

6. Inspect the flangeway area and the area over which the spring wing travels. This area should be kept clear of sand, dirt, snow, ice and foreign material. During times when snow and ice can be expected these must be cleaned or a method of heating or de-icing put in place. This must be performed to prevent a build-up of material under the wing rail or in the flangeway that would hold the wing rail open or force the wing to rise up off the base plate. With the wing rail in an open position or raised up, a passing wheel with a false flange could get down below the railhead and roll the wing rail causing a derailment.
7. Inspect the wing rail railhead. Check for any indications where the outer edges of the wheel may be contacting the railhead. This can be caused by:
   - Excessive tread wear on the frog body. In the case of an all rail frog, the frog should be replaced. In the case of a manganese frog the casting may be repaired by welding if the contact area is resulting from a localized defect.
   - Excessive vertical rail movement caused by a build up under the wing rail, in which case the flangeway and base plate area should be cleaned.
   - Excessive movements between hold downs and horns, in which case the clearances between these components should be adjusted.

F. Horns and Hold Downs

1. Each horn and hold down should be inspected for breakage or cracks. Damaged or worn horn and hold down assemblies may permit the wing rail to rise sufficiently to allow the outer edge of a wheel to contact the side of the wing rail and roll it out.
2. Forged components may be repaired by welding in the field. If two or more horns or hold down sets have required welding repair, the frog should be replaced within 30 days.
3. Cast components that break or develop cracks should be replaced. Bolt torque securing the horn and hold down assembly should be maintained at 600 ft/lbs.
4. Inspect each horn and hold down for wear. Excessive wear on the top and bottom of the horns and hold downs can be an indication of vertical rail movement. Excessive vertical rail movement can be caused by:
   - Poor surface
   - Poor ties
5. Excessive wear on the sides of the horn and hold down can indicate misalignment of the wing rail. Misalignment of the wing rail can be caused by:
   - Inadequate anchoring through the turnout (especially on frogs without toe blocks).
   - Insecure base plate
   - Insecure toe (Broken joint bars. Broken, missing or incorrect size toe block or joint bar bolts)
   - Loss of bend set on the wing rail (Missing or inoperative retarder)
6. The horn and hold down area should be lubricated with an approved switch plate lubricant to reduce wear and binding.
7. The clearance between the top of the horn and the hold down should not be more than 3/16”. The clearance between the bottom of the horn and the hold down should not be more than ¼”. The clearance between the side of the horn and hold down should be a minimum of 3/16”. These measurements should be taken at both the front and rear of the hold down assembly. A tape measure or ruler may be used where the horn can be plainly seen. Where the end of the horn is obscured by the hold down, a taper gauge with a range capacity of at least 3/8” should be used. Measurements that do not meet the 3/16” criteria must be corrected:
   - A forged hold down may be heated on top and hammered down until the 3/16" clearance requirement is met.(Figure 5-AAA)

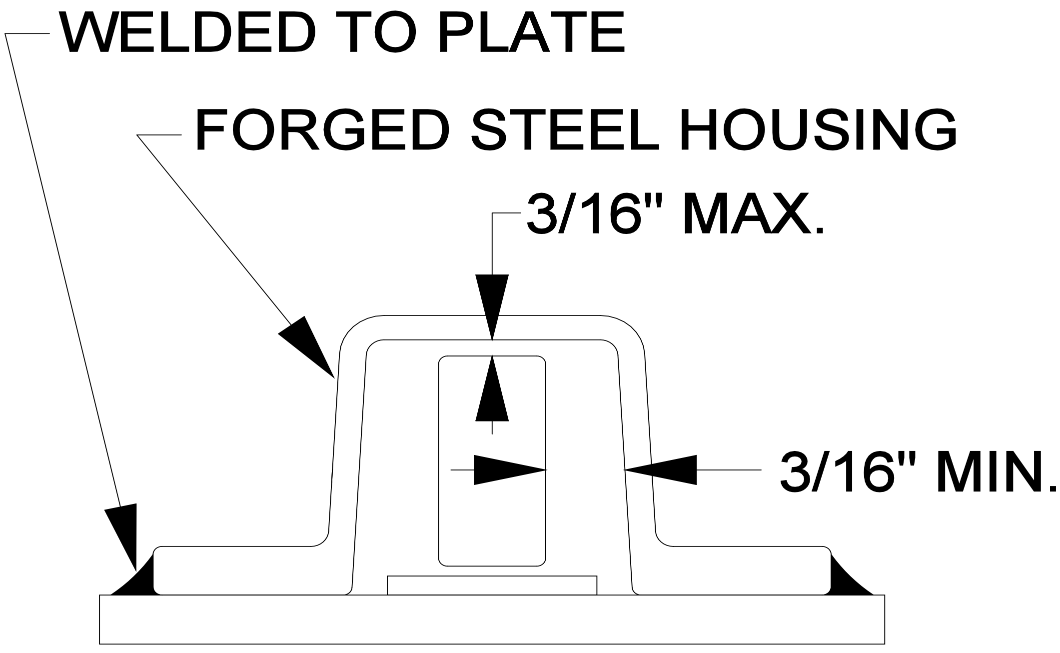


Figure 5-AAA

   - With a cast assembly the horn can be turned over or replaced, the hold down is reversible and replaceable, and the riser pad can be rotated, reversed or replaced. (Figure 5-BBB)

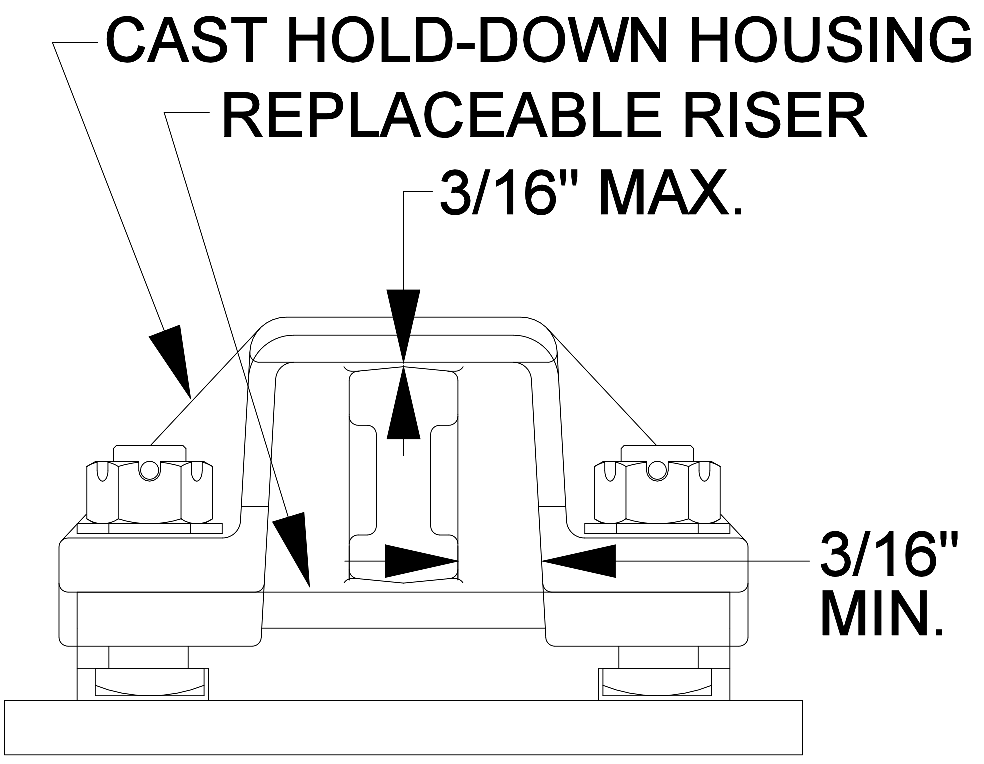


Figure 5-BBB

G. Spring Box Assembly

1. Inspect the spring box assembly to ensure sufficient pressure is being exerted to overcome the force exerted by the frog retarder and hold the spring wing against the frog body in the closed position. The normal force exerted by the spring box plunger against the rail is approximately 600 lbs.
2. Check the retaining nuts on the back of the spring housing to ensure they are in place.
3. The hydraulic spring testing device should be used to check the force exerted by the plunger against the side of the wing rail.
4. The jaw should be placed over the tapered portion of the spring plunger as shown in Figure 5-CCC.
5. The hand pump should be operated slowly until the plunger is first seen to move.
6. The reading on the gauge should then be noted.
7. Release the pressure and repeat steps a second time.
8. The average of the two readings will give an indication of the force.

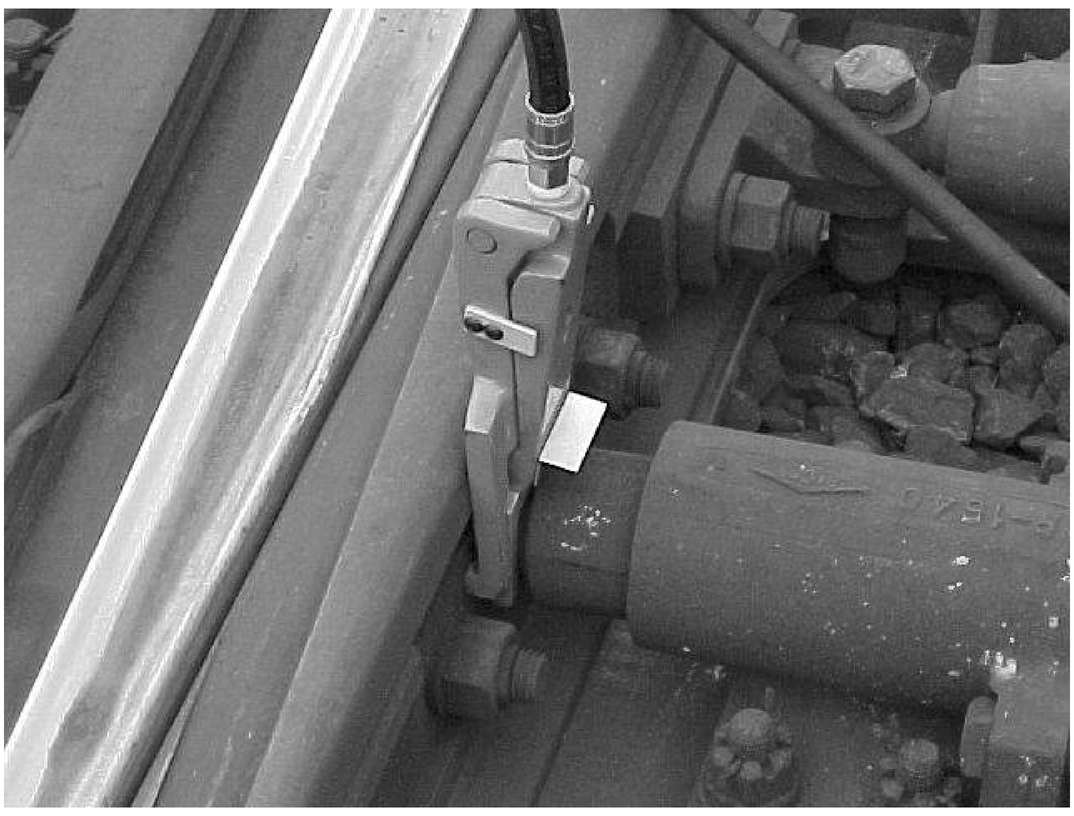


Figure 5-CCC

9. The green area of the gauge (4000 – 5200 psi) shows the acceptable range for the spring force reading. If the spring force gauge reading is below 4000 psi. in the white area of the gauge, the spring pressure should be increased by tightening the nuts on the retaining bolts until the force can be brought to this minimum. If the gauge reading is in the red area, above 5200 psi, and there is no hydraulic retarder attached to the wing rail, loosen the retaining nuts until the force can be brought down into the green area, between 4000 and 5200 psi. Before adjusting the spring force on frogs that have hydraulic retarders attached, check the closing time of the wing rail as described in the section on the hydraulic retarder.

NOTE: SOME DESIGNS OF SPRING FROGS HAVE TWO SPRING BOXES DUE TO THE LENGTH OF THE WING RAIL. WHEN THERE ARE TWO SPRING BOXES ON THE FROG THE SUM OF BOTH MEASUREMENTS SHOULD BE BETWEEN 4000 TO 5200 PSI. FOR EXAMPLE IF ONE READS 2500 PSI AND THE OTHER READS 2700 PSI THE SUM WOULD BE 5200 PSI. WHEN ADJUSTING AN EFFORT SHOULD BE MADE TO BALANCE OUT THE TWO PRESSURES SO THAT ONE DOES NOT HAVE EXCESSIVE PRESSURE AND FATIGUE THE SPRING.

10. A 1/8” of movement of the retainer nuts should equal approximately 500 psi. of force. This may vary, especially if the springs have been in use for a while. If sufficient force cannot be obtained the springs in the plunger must be replaced.

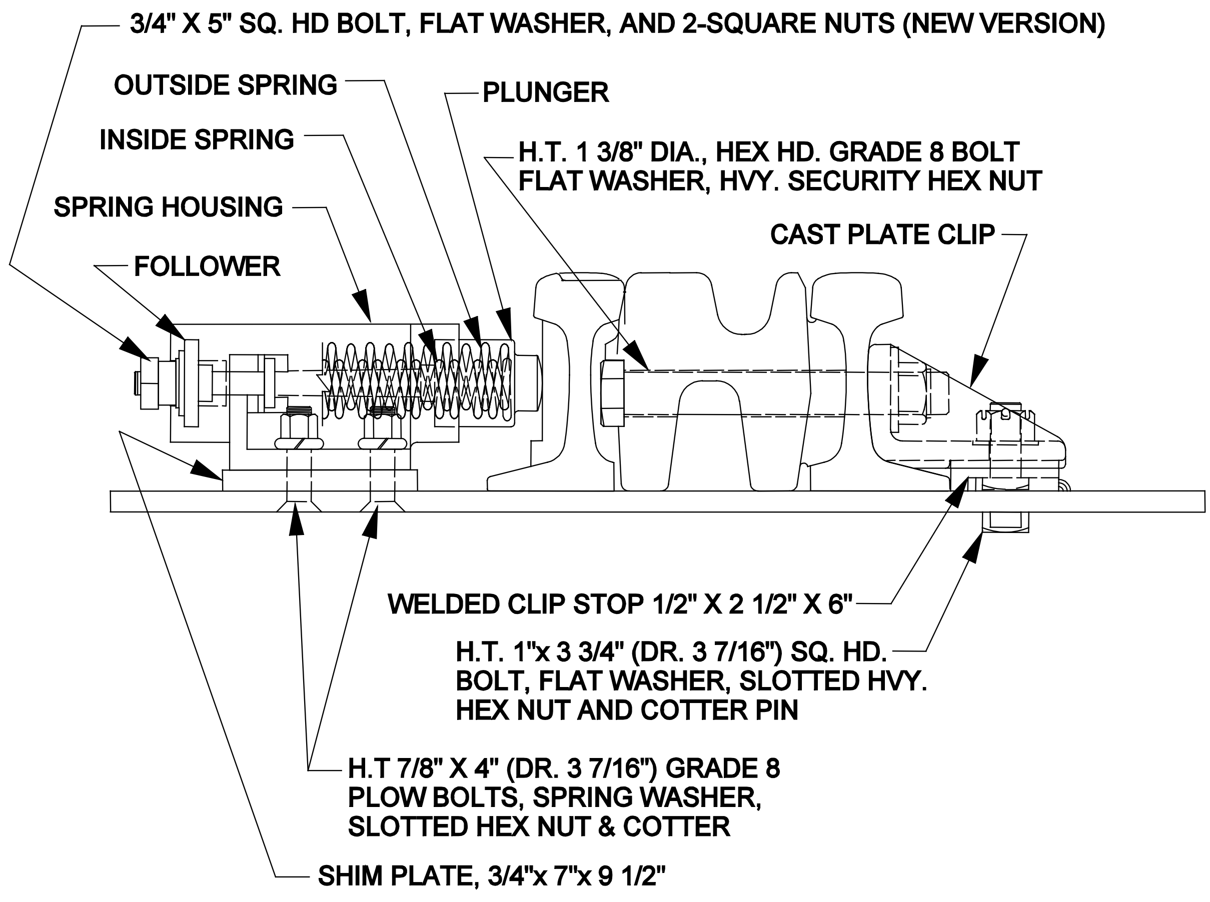
H. Spring Replacement

To replace a broken spring (see Figure 5-DDD) the nuts on the retaining bolts should be loosened alternately ½” at a time until there is no spring pressure felt against the follower backing plate.

1. Remove the retainer bolts and follower plate.
2. Pull out weak or broken springs. Pull plunger out to ensure all the pieces of a broken spring are removed.
3. A coating of lithium or switch plate grease should be applied to the inside of the housing to assure that the plunger will continue to slide smoothly in and out.
4. Where a double spring is used in the spring box. Both springs should be replaced at the same time if available. Item # 555-7775.

To re-assemble the spring assembly follow these steps;

1. Ensure that the wing rail is closed up against the frog body and the spring box plunger is up against the wing rail.
2. Insert the new spring(s) in the spring housing, place the back cover over the retaining bolts and push the springs up against the back of the plunger.
3. Screw the nuts on both retaining bolts up against the backing plate.
4. Mark the bolt with chalk or crayon at the point where the nut is now located.
5. Alternate tightening the nuts on the retaining bolts in ½” increments until 1” of travel has been achieved as verified from the mark on the bolt. This will give the 1” pre-load designed into the spring pack to achieve the force from the plunger into the wing rail.
6. Using the hydraulic force gauge, verify that a minimum of 4000 psi force has been attained.
7. If the required force has not been attained adjust the nuts on the retainer bolts.
8. Repeat last 2 steps until the required force is obtained.



SECTION THRU SPRING HOUSING

Figure 5-DDD

I. Hydraulic Retarder

Where frequent diverging moves are made through spring frogs by trains a hydraulic retarder is generally used to slow the movement of the wing rail return between passing wheel sets. A retarder should be used with spring frogs on dual control and spring operated switches. The amount of time that the retarder allows the wing rail to return to its normal position will vary. A range of between 10 seconds and 3 minutes is acceptable. Retarders should be installed per manufacturer instructions. Ensure that the steel bushing is present in the wing and plate brackets before installing retarder.

1. If the retarder is not operating properly it may fail by:
   - Offering too much resistance against the spring box and holding the wing rail open. This allows foreign matter to fill the spring wing flangeway and also causes point wear and added impact loading due to the wheels now having to jump a flangeway gap.
   - Offering too little resistance against the spring box allowing the wing rail to quickly close between wheel sets. This can cause premature spring failure, plate wear, bolt and point failure, and added impact loading on the spring wing which can cause it to crack or lose its bend set.

2. Visual inspection of the frog retarder:
   a. Observe that the unit is not physically damaged or broken.
   b. Check to make sure the bolts holding the retarder and wing rail bracket are in place and tight.
   c. Look for any signs of oil leaks on the body of the retarder or on the ballast underneath the unit that might indicate it is failing.
3. To check the retarder mechanically:
   a. Check the spring box pressure against the wing rail.
   b. If the spring pressure is within the green area, between 4000 and 5200 psi, on the force gauge proceed to next step. If the spring box pressure is not at an acceptable level see the previous section concerning spring box inspection before proceeding.
   c. Use the hydraulic wing rail spreader jaw to open the wing rail until it hits the stops that are welded on the frog plates.
   d. If any foreign material is observed in the flangeway opening use a stick or broom to remove it.
   e. Release the pressure in the spreader jaw and observe the movement of the wing rail.
   f. If the wing rail does not close within a 10 second to 3 minute range, use a lining bar near the heel of the wing rail trying to force wing rail toward the frog body.
   g. If the wing rail now closes on its own, observe if there are any shiny areas on the plate where the wing rail may have been binding. If the plate is bent it should be heated and straightened. Clean the plate area over which the wing rail travels and apply an approved switch plate lubricant to the base plate area.
   h. Inspect the horn and hold down assemblies to determine if any binding is occurring in this area. Apply an approved switch plate lubricant to the horns and hold downs.
   i. Repeat the process.
   j. If the wing rail still does not close within the specified time observe the lubricated area and check if there is spot where the wing rail is dragging. Check the surface along the frog. If there is any deviation in uniform surface more than 1/8” it should be corrected.
   k. Repeat the process.
   l. If the wing rail still does not close the retarder should be replaced.

J. Retarder Replacement

Note: Retarders are shipped from the manufacturer preset with a 20-5/8” length between the mounting brackets. This is done to ease the installation so a minimum of adjustment is necessary to line up the holes of the frog brackets with those of the retarder brackets. Do not compress the retarder before installing it, as it will be extremely difficult to expand out to reach the frog bracket. If the retarder does become compressed, use the hydraulic wing rail spreader to open the wing rail a sufficient distance to allow the mounting brackets to line up. Be sure to block the wing rail open before attempting to line up the bolt holes.

1. If the retarder has failed holding the wing rail open, place a block in the wing rail flangeway to prevent the wing rail from moving until installation is complete.
2. Remove the old retarder by removing the bolts attaching it to the wing rail and plate brackets.
3. Check the brackets on the wing rail and frog plate to confirm:
   - Wing rail bracket is tight
   - Rear plate bracket is not bent or twisted
   - Hardened steel bushings are in place in bracket bolt holes.
4. If not already performed, check spring pressure against the wing rail in the closed position as described in the Spring Box Assembly section.
5. Attach retarder to brackets according to manufacturer instructions.
6. Apply an approved switch plate lubricant to the base plate over the area where the wing rail will travel and on the horns.
7. Test the retarder operation by opening the wing rail with a hydraulic wing rail spreader tool until a 2” flangeway opening is obtained at the point where the retarder attaches to the wing rail.
8. Release the jack pressure and observe the time it takes for the wing rail to close. A closing time of 10 seconds to 3 minutes is acceptable.
9. If the closing time falls outside the acceptable range Refer to Section I-3 (Hydraulic Retarder) for Procedural Inspection Process.
10. If adjustments fail to bring the retarder within the specified range it should be replaced.

5.5.13 Welded Spring Manganese (WSM) Frogs

Many of the Spring Rail frogs purchased by UPRR since the mid 2000's feature a special stainless steel weld between the manganese casting of the frog and the running rails, see Figure 5-EEE for an example. This weld eliminates a joint in the frog and can provide reduced maintenance. In earlier generations of this frog type there have been issues with the manganese casting quality and quality issues around the welds. Due to these issues it is recommended that these frogs be fully inspected for these issues every month during the switch inspection.

1. Fully inspect the area within 6" of either side of the weld for cracking. If any cracks are present slow order the frog to 10MPH until replaced.
2. Inspect the outside edges of the manganese casting for signs of cracking. If cracking in the casting base is found place a 40MPH slow order on the frog until replaced. If the cracking extends to within 2" of the top running surface of the casting place a 10MPH slow order on the frog until replaced. For a sample crack see Figure 5-FFF.

Figure 5-EEE

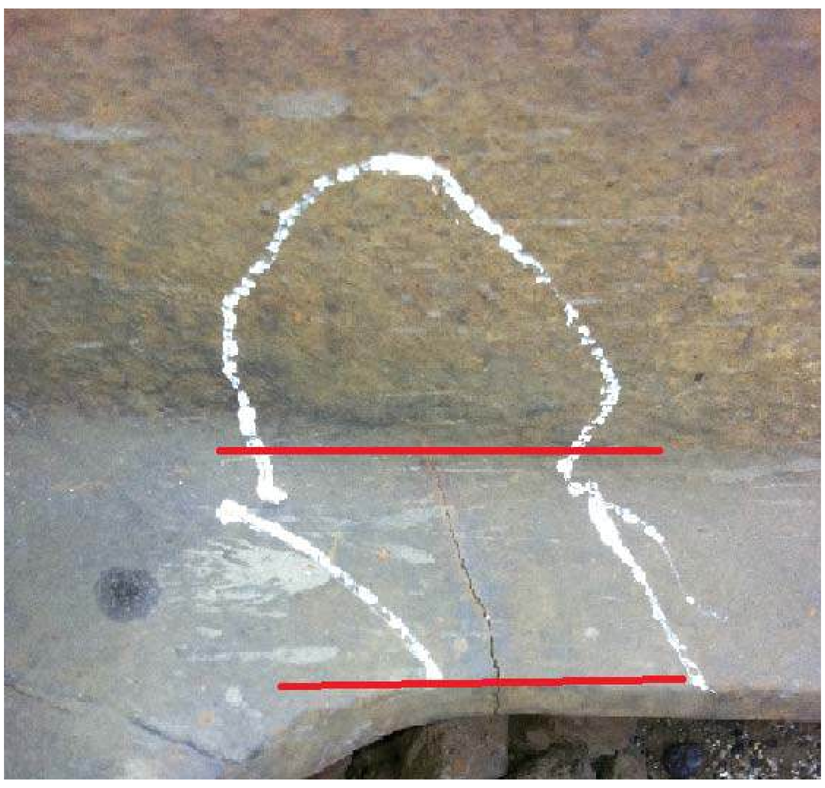


Figure 5-FFF

5.5.14 Movable Point Frog Inspection and Maintenance

It is very important to maintain MPF's to ensure safe operations. All MPF's must have a walking inspection performed every 30 days. The following guidelines should be followed during these inspections.

A. Frog Body

Basic inspection and maintenance items required for all frogs (see Figure 5-GGG) include:

1. Check for breaks and cracks in all rails.
2. Check all plates for breaks and cracks.
3. Replace missing body bolts.
4. The three bolts that hold the short point against the long point are shoulder bolts. With the proper arrangement of washers tighten these bolts to refusal.
5. Grind excess metal flow from the running surface to prevent chipping.
6. Slot mating surfaces between adjoining rails to a depth of at least 3/16" and slightly beveled at the top.
7. Grind gauge corners of all running rails to a 5/8" radius.
8. Flangeway width should not be less than 1 ½".
9. Track gauge should not be less than 56 ¼" or more than 56 7/8".

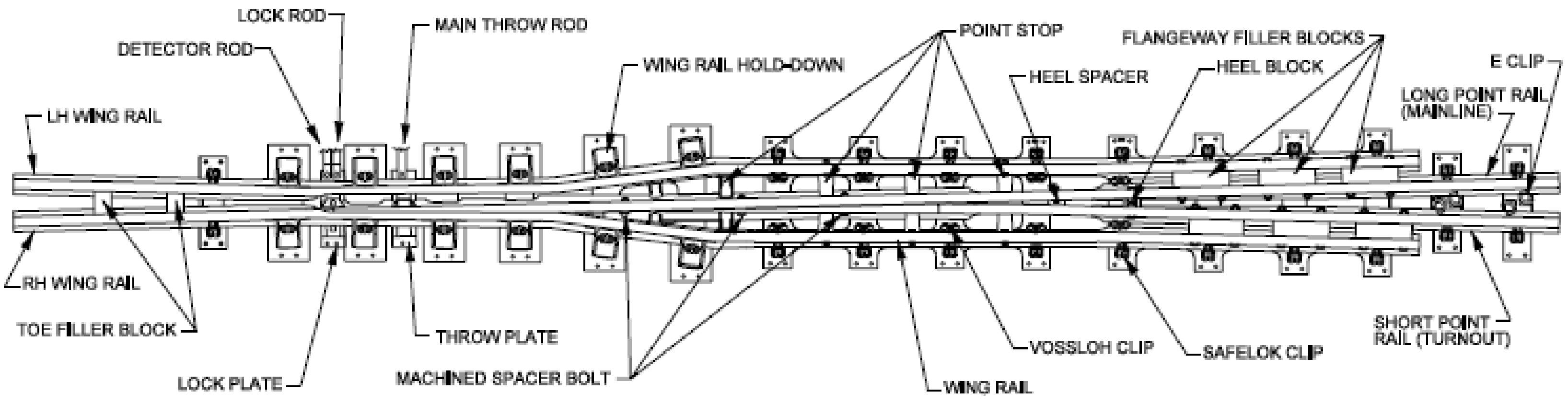


Figure 5-GGG

B. Surface and Line

1. Good tie condition and surface must be maintained throughout the frog area. Surface should not deviate more than 1/8” in any 15’ length. Poor surface in the point area of the frog will result in bending the point causing it to drag either on the plates or on the slide plate.
2. Line through the frog should be within a 3/8” through the entire frog length.
3. When tamping with automatic equipment it is very important to tamp the head block ties to ensure proper surface. If the connecting rods are not disconnected ties must be tamped using hydraulic tamping tools. Failure to do this leads to switch machine failures and has caused several service failures in both the frog point and the wing rails.

C. Frog Point Bolts

There are three (3) machined spacer bolts that hold the long point and short point together. These bolts allow the short point to slide along side the long point when the frog is reversed. These bolts must be perpendicular to the frog. Figure 5-HHH shows these bolts slewed. If not corrected these bolts will shear off allowing the short point to gap thus causing a serious condition.

If one of these bolts are missing the bolt must be replaced immediately or frog point must be clamped for main line use only.

Figure 5-JJJ

1. To correct this defect cut the rail behind the long point and drive the point forward as far as the heel block bolts will allow. Weld the rail, torque the heel bolts to 2000 ft/lbs and replace all three of the machined spacer bolts and washer assemblies and tighten. The front two bolts are the same and may be order through e-procurement using item number 555-6040. The third bolt is slightly longer and may be ordered using item number 555-6042. Bolts come with all washers, nut and cotter pin.
2. After frog point has been adjusted replace all pads, insulators and clips for 120 ties in both directions of the turnout. Adjust rail anchors as necessary.

D. Slide Plate

The slide plate that is mounted to the bottom of the frog point that has the switch machine rods attached to must be maintained much the same way as switch rods.

1. Ensure that bolts holding this plate to frog point are tight at all times.
2. Maintain at least a gap of 1/16” to allow free movement of the point.
3. A gap of more than 3/8” must be repaired.

   (See Figure 5-KKK.)

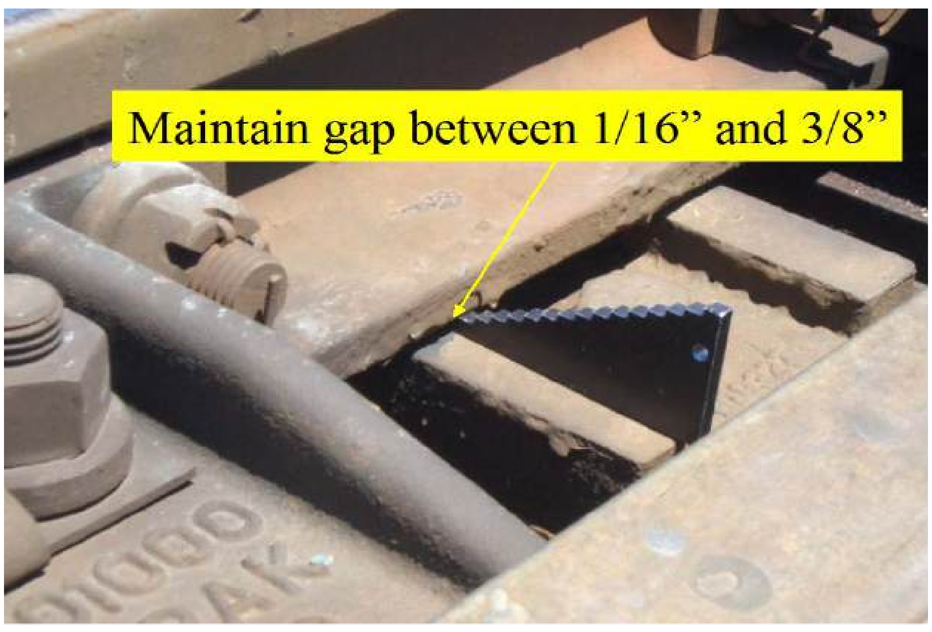


Figure 5-KKK

E. Point Wear

Corrugated rail wear can occur on the point of a MPF between 4’ and 6’ behind the actual point. Point wear of 1/8” should be scheduled for replacement within 30 days. Point wear of 3/16” or more must have operating speeds reduce to 25 mph until frog is replaced.

1. To check this wear use a 36” straightedge.
2. Slide straightedge along the top of the running surface to determine the greatest depth of wear.
3. Measure the wear using a feeler gauge or step gauge. (See illustration in Figure 5-LLL.)

Figure 5-LLL

F. Lubrication

Frog plates must be lubricated periodically to allow free movement of the frog point. When lubricating plates also place a small amount of lubricant between the long and short point where the two points slide against each other.

5.6 Turnout Maintenance

For further details on switch inspection and maintenance, see the UPRR standard work.

NOTE: In track circuit territory, notify the Signal Department in advance when: Changing rails, frogs, switch points, or switch stands. Performing work that may compromise the integrity of the signal system.

5.6.1 Switch Rods

Follow these requirements:

- Repair or replace transit clips, helper rods, connecting rods and switch rods that are bent or broken.
- Ensure that all bolts are in place. Do not over tighten the bolts connecting the switch rods and transit clips. This connection must be allowed to pivot as the switch is thrown for proper operation.
- Clean ballast and foreign material out from the connecting rod and switch rod cribs for a distance of 2 inches below the rod, as shown in Figure 5-MMM.

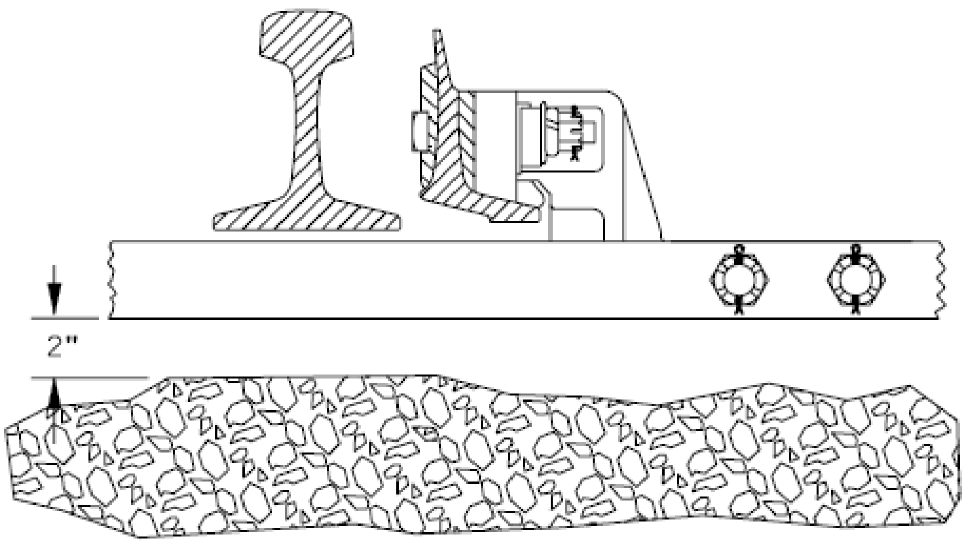


Figure 5-MMM

5.6.2 Switch Points

Follow these guidelines for maintaining switch points properly:

- Check the condition of the switch point stops and make sure they are intact and tight.
- Switch point rollers, if installed, should turn easily. Lubricate or replace rollers as needed.

A. Switch Point Throw

Maintain the dimension between the back of the switch point and the gage side of the stock rail at 4-3/4 inches at the No.1 switch rod location, as shown in Figure 5-NNN.

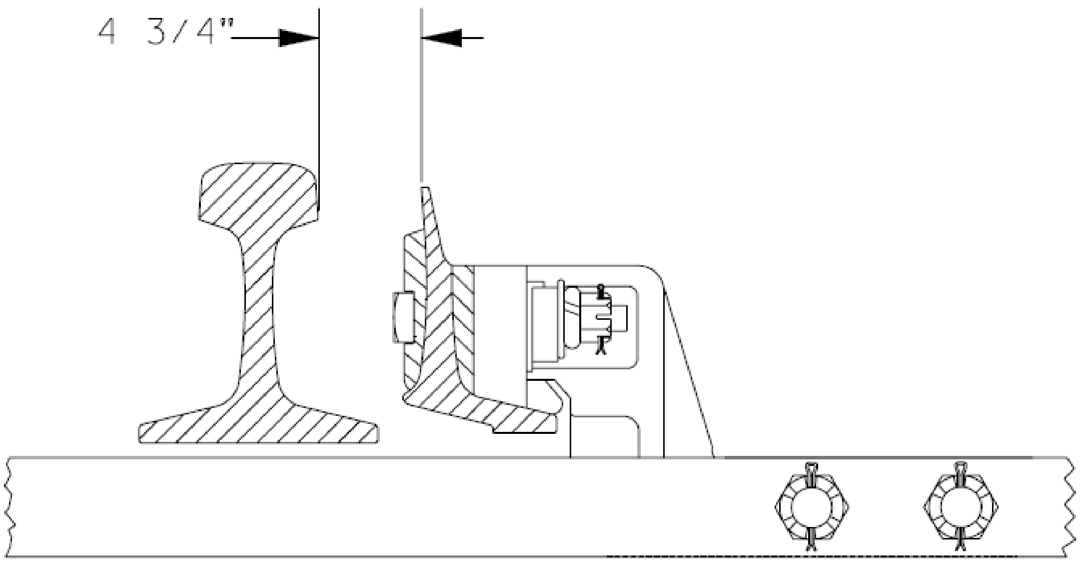


Figure 5-NNN

EXCEPTION: Tangential design turnouts may have throws up to 7 inches.

B. Switch Point Fit

Follow these requirements:

- Grind off metal flow on the stock rail and switch point that prevents the switch point from fitting up flush against the stock rail. Readjust the point for a tight fit. See Figure 5-OOO.

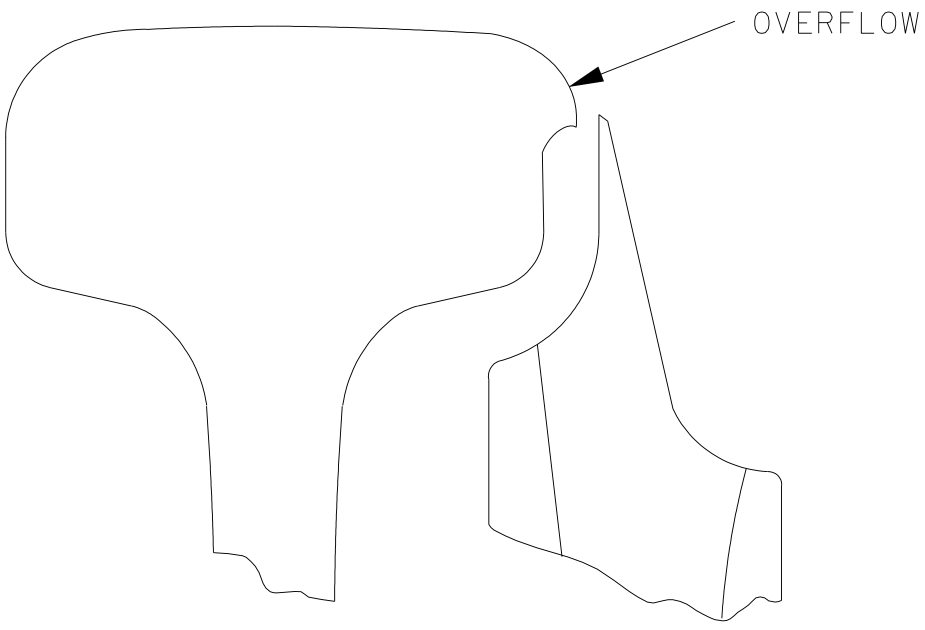
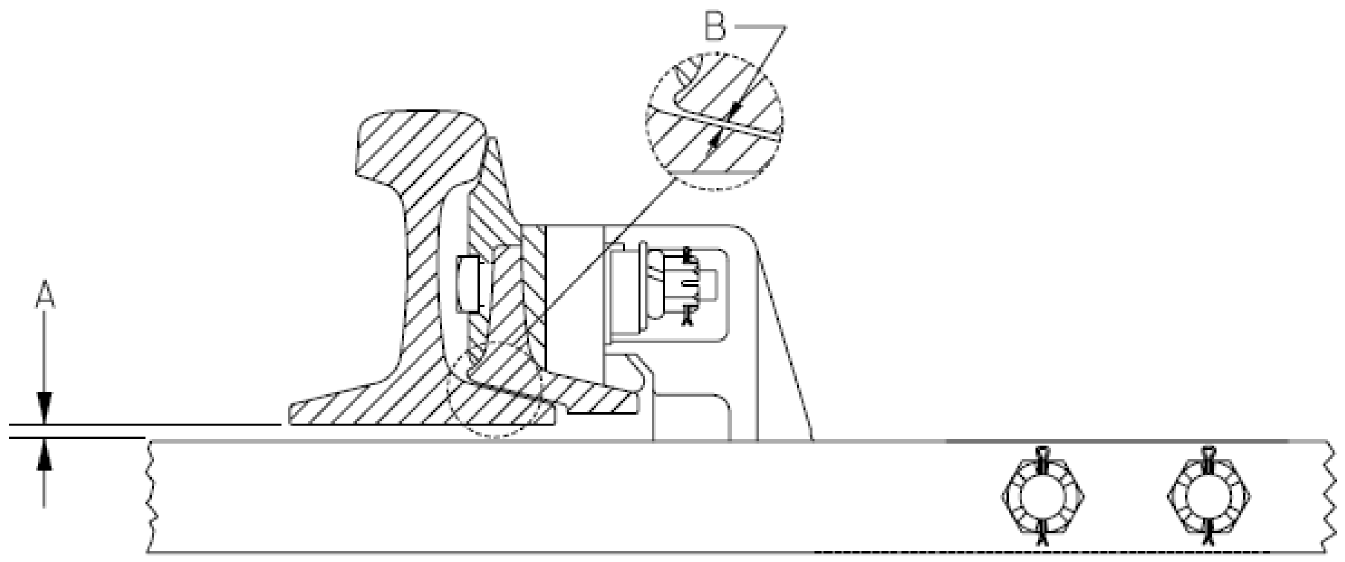


Figure 5-OOO

- Limit switch points to a maximum of 1/2 inch vertical movement at the tip when the switch point is closed against the stock rail. Calculate this measurement by adding the measurement of the clearance between the top of the no. 1 rod and bottom of the stock rail and the measurement between the bottom of the switch point with the top of the base of the stock rail. See Figure 5-PPP.



A + **B** ≤ ½

Figure 5-PPP

C. Switch Point Wear

Follow these requirements:

- Repair or replace a switch point that is worn down or chipped so that the top is more than 7/8 inch below the plane across the top of the stock rail. See 5-QQQ and Table 5-H.

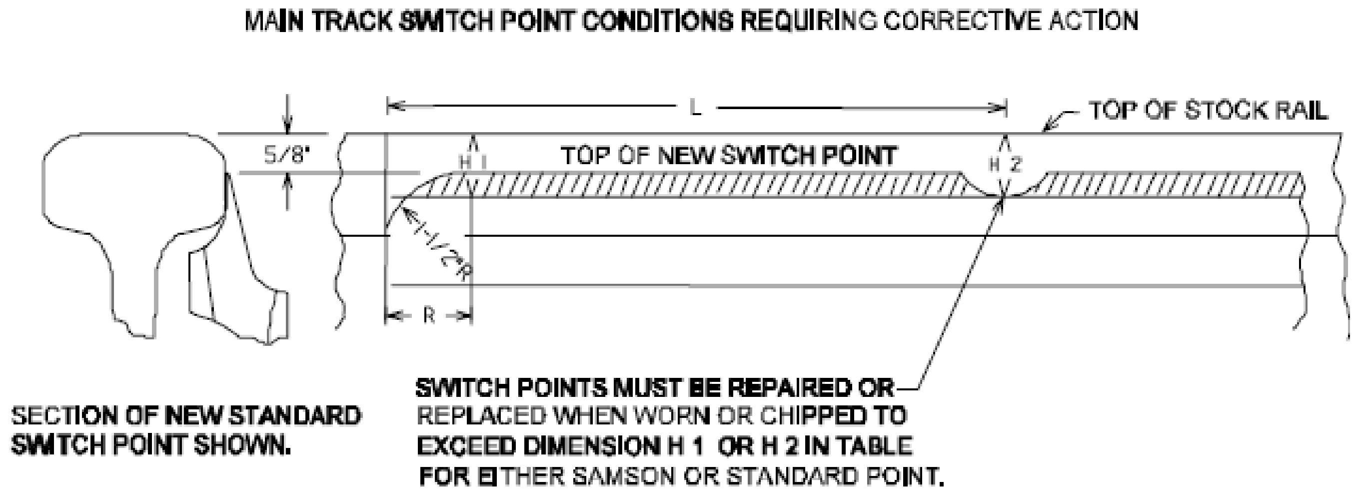


Figure 5-QQQ

Length of Switch Point	Distance			
	R	H 1	L	H 2
Up to 19’ 6’’	1-1/2"	7/8"	Over 10"	3/4"
19’ 6” or over	1-1/2"	7/8"	Over 16"	3/4"

Table 5-H

- Repair or replace a switch point that is chipped and has an unprotected vertical surface that is 5/16 inch or wider 3/4 inch below the top of the stock rail as indicated by Figure 5-RRR.

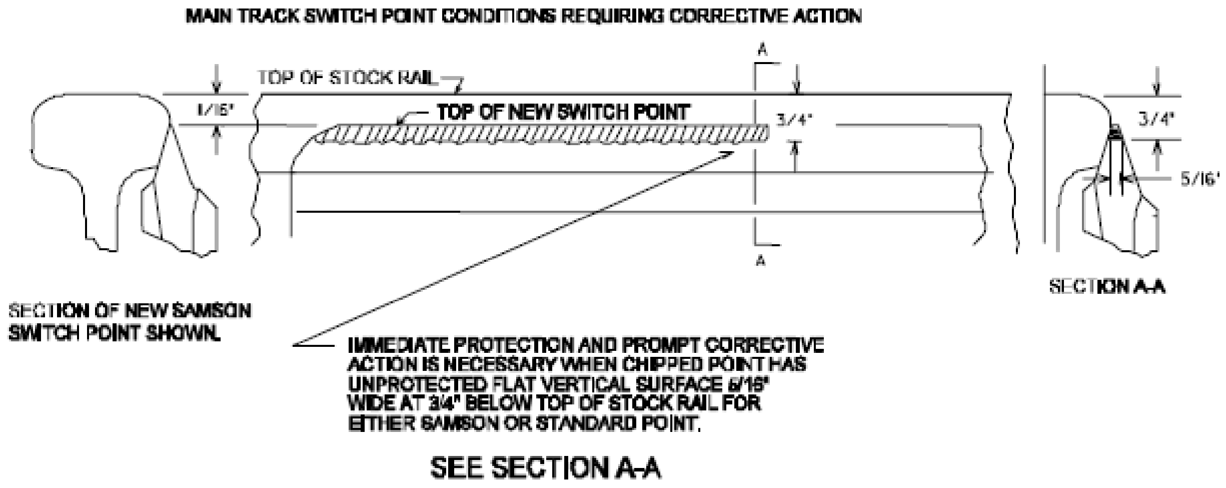


Figure 5-RRR

- Lightly lubricate switch point tips with switch plate oil or grease to prevent excessive wear.
- Switch points should rise a minimum of 3/16 inch above the stock rail where the wheel transfers from the switch point to the stock rail. This prevents the outer edge of the wheel tread from contacting the gage side of the stock rail. If this measurement falls below the 3/16-inch limit, replace the switch point and stock rail. See Figure 5-SSS.

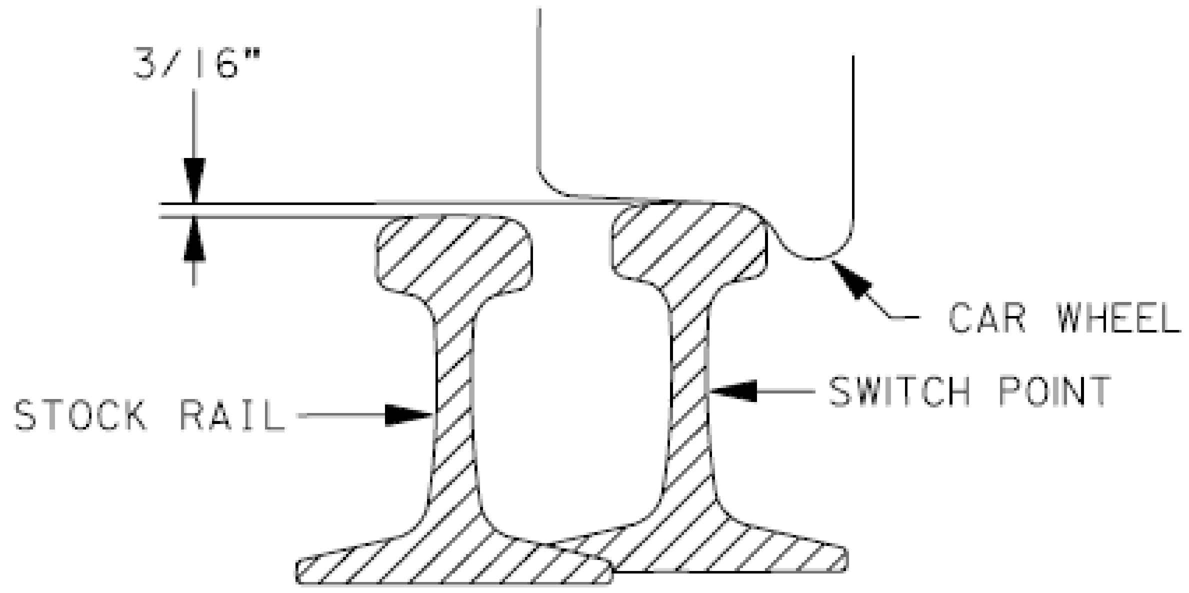


Figure 5-SSS

5.6.3 Frog and Guard Rails

Follow these requirements:

1. Ensure that all bolts and fastenings are of the proper length and diameter and are kept tight.
2. Keep each switch, frog, and guard rail free of snow, ice, and other obstructions that may interfere with wheel passage.
3. Keep frog wear within the limits prescribed in Section 5.5. Wheel marks in the flangeway indicate a worn frog that needs to be repaired or replaced.
4. Set guard check gage and guard rail settings as shown in Section 5.5.9.

Note: On spring frogs the stops must be maintained to not allow the wing rail to open more than 2" at the point.

5.6.4 Lubrication

Follow these requirements:

1. Lubricate switch plates where switch point movement occurs as follows:
   a. An approved switch plate lubricant may be used where switch plates are and will remain clean.
   b. Where switch plate surface contamination is a problem, use only a dry film lubricant such as graphite.
   c. Lubricate frog plates on spring frogs and movable point frogs over the area the rail travels.
2. Lubricate the switch heel joint assembly (if present) with switch plate lubricant.
3. Lubricate the switch stand to ensure proper operation.

5.6.5 Cleaning

Follow these requirements:

1. Clean out ballast and foreign material from the connecting rod crib for a distance of 2 inches below the rod.
2. In the area surrounding the switch stand and turnout where switching operations are performed, clear out obstructions that might hinder walking.
   - When clearing snow from turnout areas, be careful to avoid piling snow where it would blow back into the switch area.
   - Do not use salt mixtures to de-ice switches in track circuit territory.
   - During winter months when snow can be expected, keep switch brooms and shovels at main line turnout locations for use by train and engine crews.
3. Keep flangeways free of snow, ice, and obstructions.

5.6.6 Switch Heaters

1. The Signal Department will install and maintain electric and gas-fired switch heaters.
2. Where oil-fired switch heaters are used, the Track Department will install and maintain them.

Follow these requirements:

- Place oil-fired heaters where they will not interfere with switch rod movement.
- Ensure the oil heater is completely extinguished before refilling it.
- Remove oil heaters from the track after the last snowfall of the season.

5.6.7 Component Warranty

Many of the switch components purchased by UPRR come with a warranty from the manufacturer. The warranties vary greatly by manufacturer and product type. When a component fails prematurely it is critical that the following information be collected and given to Methods and Research:

- Product Serial Number (off the tag on the item, or cast into the item)
- Photos of the item and the defective condition
- Date of the failure and type of failure
- Installation date

The installation date should be inscribed with an indelible marker on the following track components when replaced.

- Frogs
- Guard Rails
- Spring Frog Retarders
- Switch Points
- Stock Rails
- I-Bonds

Common warranties for trackwork items are as follows:

- Frogs: 3 to 5 years from install. 250 to 500 MGT accumulated
- Switch Points and Stocks: 3 years from install. 250 MGT accumulated
- Ties: Varies greatly, contact Methods and Research
- Insulated Joints: Generally 500 MGT accumulated
- Guard Rails: 3 years from install. 250 MGT accumulated

5.7 Derails – Permanent & Portable

5.7.1 Installation of Permanent Derails

1. Inspect and evaluate territory for correct placement of required permanent derails. Refer to Standard Drawing Nos. 2000 through 2010.

   - All mainline routes require the use of derails on all industrial or auxiliary tracks that connect to the main line or sidings.
   - Placement of derail(s) on controlled sidings:
     - Prior to installing derail(s), Manager Signal Maintenance (MSM) will contact the Manager Signal Design to determine proper method of disabling signals governing movement through the siding. Manager Signal Design will then confirm the disabling procedure in a lotus note to both the MSM and the Sr Manager Signal Operations. After the disabling procedures have been confirmed, signal personnel will disable the signals.
     - The MSM will request Signal Operations Control (SOC) to open a ticket that will remain in hold status until the signals are tested and returned to service.
     - SOC will contact the dispatch center to arrange for the issuance of a Form C track bulletin removing the siding from service. The train dispatcher will then place switch blocks on all dual-control siding switches.
     - Engineering personnel will spike or clamp and tag (out-of-service) all switches leading to or on the controlled siding.
     - Engineering personnel will place derail(s) 25 feet from the first and last car in the siding. Derail(s) must be secured and locked with a padlock to prevent removal.
   - To ensure that the correct derail type is used, the grade of the industrial/auxiliary track must be determined.
     1. To determine grade and the likelihood of cars rolling out of a track, all grades must be evaluated for at least ½ mile from the proposed derail location, if track length permits. Note: Level track is defined as plus or minus .25% (3 inches of rise or fall over 100 feet).
     2. Permanent derails must be placed a minimum of 50 feet beyond the 13 foot clearance point.
     3. Installation of the permanent derails should be such that the locomotive or car will derail away from the protected adjacent track or structure.
     4. Unless movement over permanent derails is expected, leave derails lined and locked in the derailing position except where otherwise authorized.
     5. Place permanent derails on solid ties and secure hinge and sliding derails with coach screws.
     6. Locate permanent derails on the outside rail of curves. When necessary to derail rolling stock towards the inside of a curve, install a type two or three derail.
     7. When a hinged or sliding derail is in the derail position, it must lay flat on top of the rail and fully cover the head of the rail.

5.7.2 Hinged or Sliding Derail Installation

When using a hinged or sliding derail it is critical to ensure it is the correct size to match the rail height and that it comes fully locked when closed. See Standard Drawing Nos. 2007, 2008 or 2009 for detailed installation instructions.

To size the derail take the measurement from the top of the ties at the installation location to the top of the rail using a straight edge set across the top of rail. This measurement in inches will indicate the size of the derail. For example 7” will be a size 7 derail. If the measurement is 7.5” then a size 7 derail will be required with a ½” shim to bring the height to 7.5”. Figure 5-TTT shows a correct installation.

DESCRIPTION	ITEM NO.
1/4" PLASTIC SHIM	559-4050
1/2" PLASTIC SHIM	559-4060

If sliding derail does not come down directly on top of the rail (sits above the rail head and will not come down on top) try moving the derail away from the rail slightly. This should allow the derail more room to slide down onto the railhead. If this does not work go to the next size smaller derail. If the sliding derail is hitting the rail head a size bigger derail or additional shimming is needed. Larger or smaller tie plates can also be used to move the head of the rail up/down. Plastic shims can be utilized to ensure the derail is sized correctly, however should be the last option used.

To secure the rail use a cutoff tie plate that does not protrude beyond the base of the rail on the gage side. Plate can be cut on one end by a welding torch.

Correct Installation

- This derail correctly locked into place. The thrust shaft is barely visible and there is no gap between the thrust shaft and the front seat.
- This was a size 7 derail installed at a location with a measurement of 7” from the top of the rail to the top of the tie.
- By visually inspecting the derail looking to make sure this thrust shaft is resting on top of the front seat is a visual indication that the derail is locked into place.

Figure 5-TTT

5.7.3 Use of Portable Derails

Portable derails are to be used only for temporary applications where permanent derails cannot be installed. Portable derails must be applied per the procedure below and UPRR Standard Drawing No. 2003.

Portable derails may not be used to protect tracks with grade greater than 0.25% ascending away (uphill). Calculate grade by using a 32’ stringline and string level. If one end of your level stringline is on the top of the rail and the other end is over one inch (1”) off the rail at 32’, then the track has a grade greater than 0.25%.

Portable derails must be stored inside a locked tool box or storage box on vehicles or inside of a locked storage facility. If no lockable tool box is available on a vehicle for storing portable derails, they must be chained using a grade eight chain and lock or otherwise secured and locked to the vehicle.

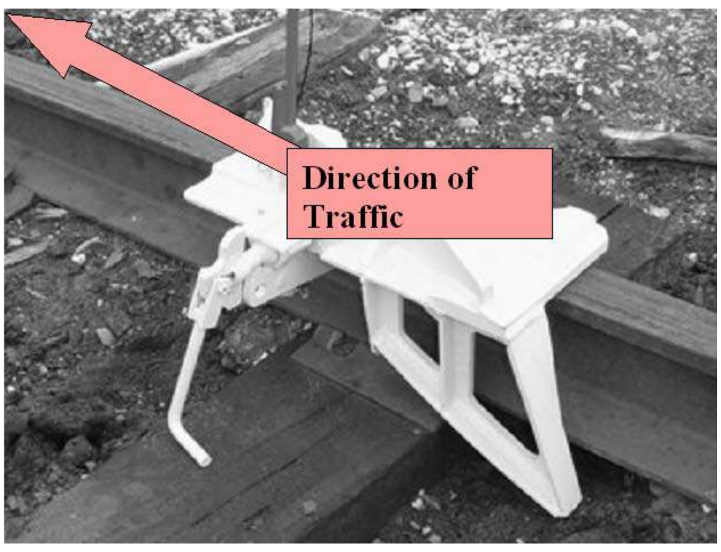
When UPRR Standards require a permanent derail and one does not exist where cars are being stored, a portable derail may be used only if the grade is flat or descending away (downhill) from the protected track. Portable derails may only be installed for a maximum of 30 days. After 30 days, the proper derail must be installed, or the cars must be removed and the track removed from service.

Any portable derails that are struck by equipment must be discarded and replaced.

Portable Derail Installation Procedure

1. Select a location with a solid cross tie to install the derail.
2. Loosen set screw and screw handle of the derail.
3. Determine the direction of traffic to be protected against as it will dictate the required orientation of the derail. Position the derail on the inside of the rail with the graduated teeth section facing away from the direction of traffic. See Figure 5-UUU.
   CAUTION: Ensure the derail is level and parallel to the rail.

4. Position the graduated teeth securely against the corner of a cross tie or tie plate on the inside of the rail.
5. Adjust set screws on the field side of the derail to fit securely under the head of the rail.
6. Hand-tighten the screw handle of the derail to secure derail to rail.
7. Install padlock (Item Number 170-6103).
8. Install warning flag.



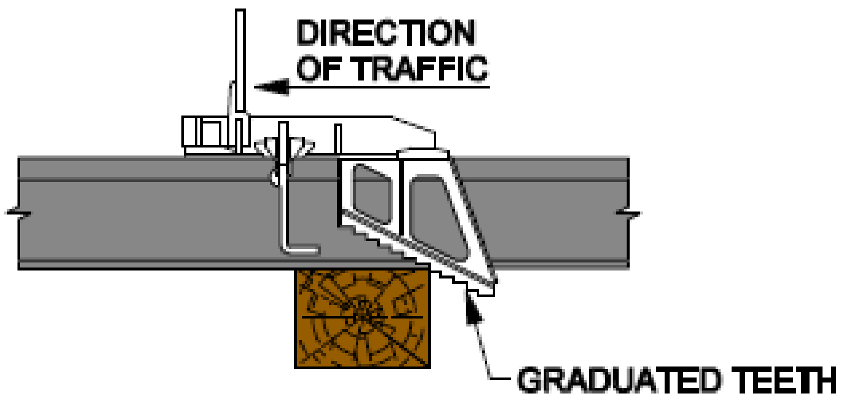


Figure 5-UUU

5.8 Foul Point

1. Ensure the foul point on auxiliary and yard lead tracks are clearly marked with yellow paint and cone. If paint is faded repaint. See Figure 5-VVV. See Standard Drawing No. 0026 for more details.

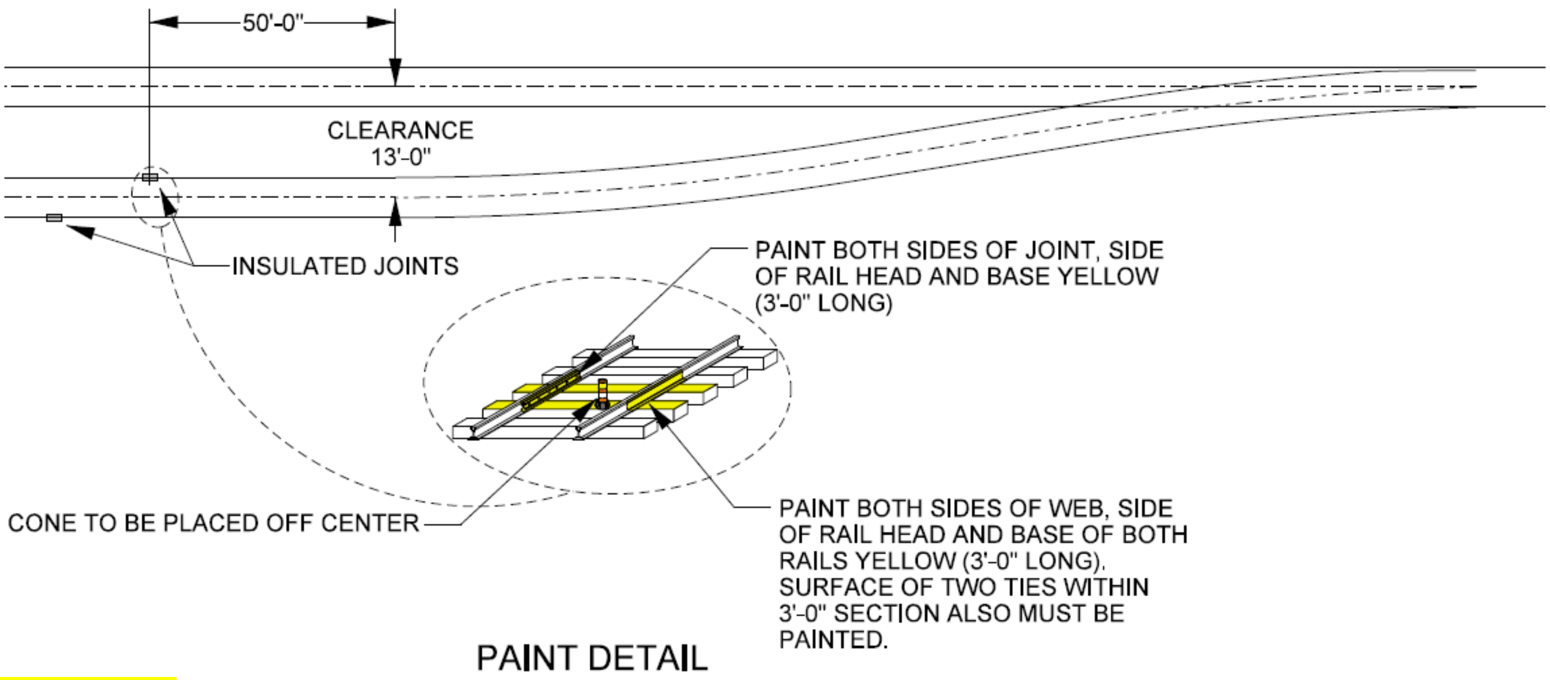


Figure 5-VVV

2. Ensure the effective insulated joint, adjacent rail and top of ties are painted yellow in all fouling sections unless the entrance to the Main Line is controlled by an Absolute Signal.

   The recommended Yellow Paint is Rustoleum Sunburst Yellow #7747.

5.9 Frog Grinding and Slotting

Follow these requirements for grinding and slotting frogs:

1. Grind flowed metal from frogs as needed to maintain a 5/8-inch radius on the gauge corners of all castings and/or rail pieces. Grinding is especially important with new installations while the metal is being work hardened. Item number for the 5/8-inch gauge is 410-1985. See Figure 5-MM.
2. When grinding, do not remove metal below the gauge corner in the flangeways except in conjunction with welding repairs.

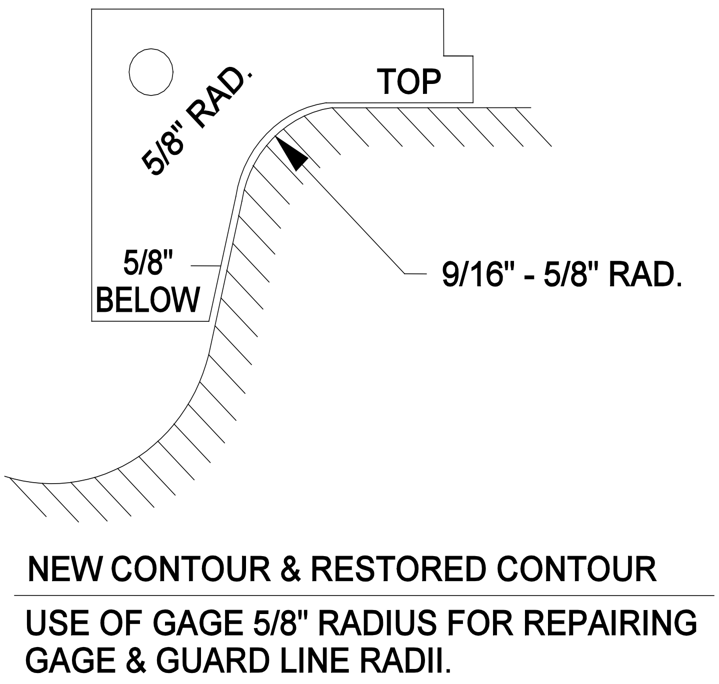


Figure 5-MM

3. Use a slotting type grinding wheel to remove flowed metal from all mating or joining surfaces between the frog casting and/or rail pieces. Components should be slotted to a depth of 3/16 inch and slightly beveled at the top. Refer to Form 7913, “Instructions for Inspecting, Welding, Grinding and Heat Treating of Track Components” for further instructions on frog grinding procedures

6.0 RIGHT OF WAY AND OTHER FACILITIES

6.0 Right of Way and Other Facilities

6.1 General

Employees must maintain the railroad right of way to Union Pacific Engineering Standards. Keep the right of way free of debris, trespassers, and encroachment. Safeguard material and property.

Everyone at Union Pacific plays a vital role in the company's security and in safeguarding information regarding rail shipments.

1. In your daily interaction, be alert for any suspicious or unusual activity:
   - Be aware of people who may ask probing questions about the railroad and its operations, either in person or via telephone, e-mail and other forms.
   - Don't disclose information about UPRR operations unnecessarily - don't disclose train schedules, business lines or any other information to anyone who does not have a "need to know." Be polite but firm in handling inquiries from individuals who do not have a need to know.
   - Report all trespassers or suspicious people on UPRR property, including rail fans.
   - Report any items that are out of place, such as boxes on the right of way, or items attached to a rail car, bridge or tunnel.
   - Report vehicles on the right of way, yards or facilities whether occupied or abandoned.
2. Be proactive:
   - Make sure doors to files, offices and buildings are properly secured or locked when not in use.
   - Remember to log off computer systems or shut off your computer when not in use.
   - Keep passwords and codes secure - never share them.
3. Remember:
   - Anyone may be a potential security threat to fellow employees and railroad infrastructure.
   - Never take any action that will put you in harm's way.
   - Gather as much information as possible and report it to Response Management Communications Center (RMCC) at 1-888-877-7267 (888-UPRR-COP).
   - If you witness or experience any event that you feel is life threatening, call 911 followed by a call to RMCC.

6.1.1 Loading and Unloading Material

Follow these requirements for loading and unloading material:

- Store track material in a secure location. Neatly stack it until you are ready to use it.
- When distributing track material along the right of way, place it in locations that do not create a hazard for employees or the general public.
- When stock piling ballast or other material near road crossings, ensure visibility for vehicular traffic is not impaired.
- Place material a minimum of 7 feet away from the nearest rail.
- Unload ties and poles perpendicular to the rail on fills if there is a chance that they may roll.
- Do not lay material in ditches where it may impede water runoff.
- Do not unload material under power lines.
- When distributing track material ahead of and behind projects may create a stumbling hazard for train and engine employees performing their duties along the track, notify the train dispatcher and issue a Form C track bulletin to warn employees of poor footing.
- Unload company material in a timely manner and promptly release it from loaded status.
- Do not load rail cars without first obtaining a Shipper Car Order from the DHCO Center in Omaha at 402-544-4037. Order cars far enough in advance to allow for delivery time.
- When loading new or relay rail into gondola cars, use wood stickers between the rows to facilitate easy stacking and unloading.
- Evenly distribute loads throughout the length of the car.
- Do not load loose material above the sides of cars if there is a chance it may fall out.
- Bill loaded cars promptly.
- Do not load cars beyond the rated capacity stenciled on the side of the car. If the spring gap between the coils on the outer springs of the car is less than 3/16 inch, the car is overloaded.

6.1.2 Housekeeping

Follow these housekeeping requirements:

1. When work has been completed at a specific location, leave the work site clean and orderly.
2. Pick up OTM released from track and sort it for reuse or scrap.
3. Return scrap to a designated container or area. Return all unused material to the storage site.
4. Collect tools at the end of the workday and secure them where unauthorized persons cannot access them.
5. Lock or secure vehicles and equipment when not in use to prevent theft or unauthorized use.

6.1.3 Property Damage

Follow these requirements:

- Direct public inquiries for damage claims against the railroad to Risk Management at 1-800-638-3891.

6.2 Vegetation Control

Follow these requirements for controlling vegetation.

6.2.1 General

Control vegetation so that it does **not**:

- Obstruct the view at grade crossings, signals, and signs.
- Foul the ballast section and toe path. Generally the toe path is the approximate location where the bottom slope of the ballast section intersects the roadbed. In certain locations the side slope of the ballast section from the clearance point to the roadbed may serve as a toe path.
- Interfere with employees performing normal trackside duties.
- Prevent the proper functioning of signal and communication lines.
- Obstruct drainage in ditches and pipes.

6.2.2 Chemical Herbicides

Employees involved in handling and applying any vegetation control chemical must comply with all applicable safety requirements, regulations, and instructions. Use only chemical herbicides approved by the Chief Engineer.

6.2.3 Clearing for Sight Distances

Vegetation on railroad property that obstructs visibility must be removed for at least:

- 300 feet each way from public crossings {except Illinois (500 ft.), Wisconsin (330 ft.)} and private crossings that have the characteristics of a public crossing, refer to Figure 6-A.
- 50 feet or to property line, whichever is less {except Illinois (100 ft.), Texas (100 ft.)}, refer to Figure 6-A.
- 50 feet around buildings, stations, and platforms.
- 15 feet around all signs and signals when terrain and conditions allow.

NOTE: State or local regulations may require a greater area or distance for vegetation removal or control. See Standard Drawing No. 0025.

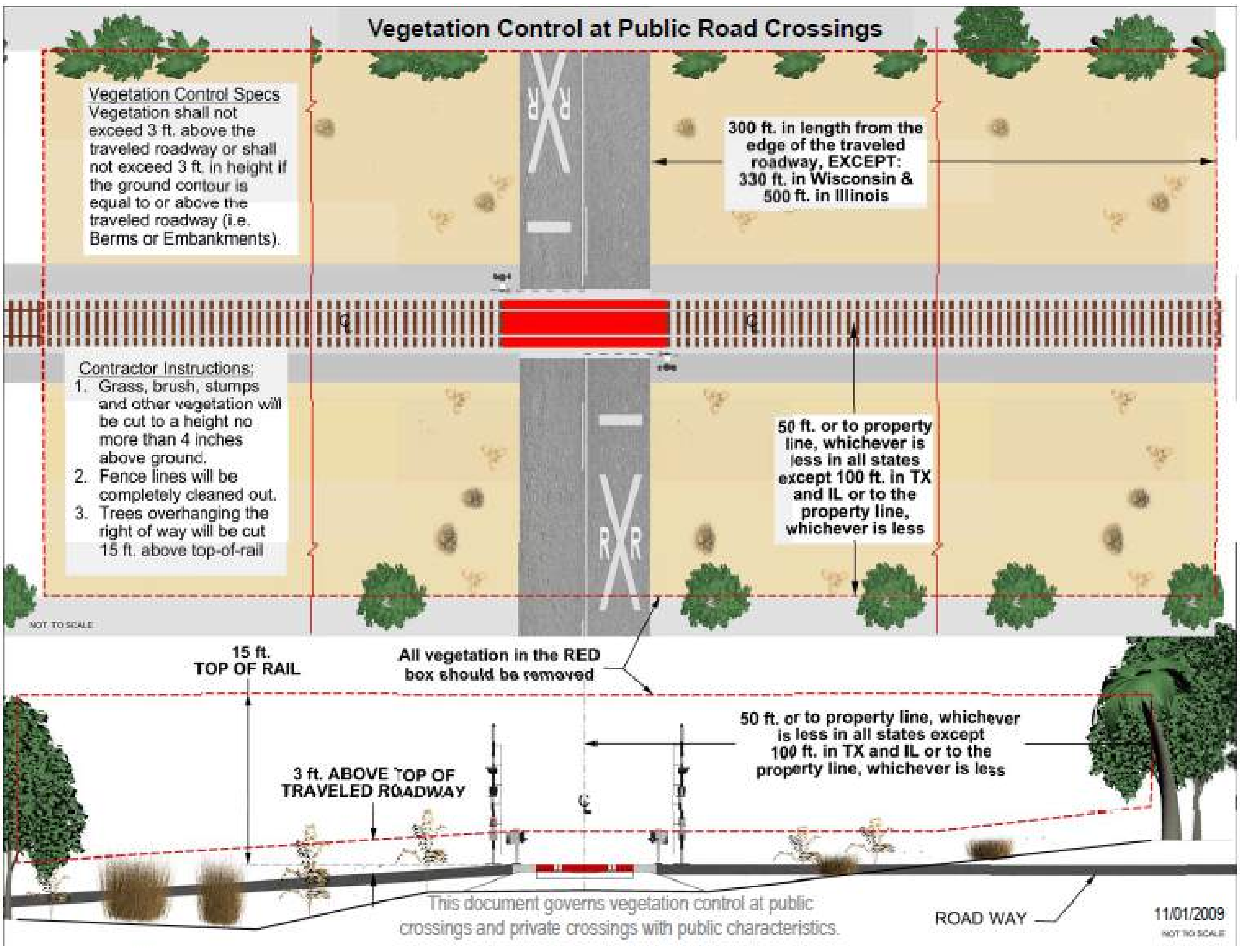


Figure 6-A

6.3 Fire Protection

Employees must make every effort to avoid starting and spreading fire along the right of way. Refer to the Engineering Website at Engineering>Bulletin Board>Fire Prevention Plan for complete copy of plan and associated requirements. The Fire Risk Assessment can be accessed on the UPRR Mobile Web. On a mobile device, enter www.up.com>Employee Mobile>MyUP>log in>Fire Risk.

6.4 Roadway Signs

Roadway signs are an important means to provide information to employees and others. They are a vital part of the safety of the railroad, providing instructions and visual reminders of warnings. They also serve as reference markers for structures and locations. As such, their use and maintenance should not be overlooked.

6.4.1 General

Employees must place and maintain roadway signs where required. Keep roadway signs erect, plumb, and legible. Replace all defaced signs as soon as practicable. Any deviation from the standards must have Vice President Engineering approval.

NOTE: Refer to Engineering Track Standard Drawing Nos. 0501 through 0599 for proper size and placement of all approved railroad signs. When sign is installed, write date on back of sign in MM/YY format. This is for warranty purposes.

6.4.2 Whistle Signs

Whistle signs are used to inform an engineer that that the train is approaching a road crossing. See Figure 6-B. Federal law requires the engineer to sound a whistle. These locations are designated in the time table or can be acquired from the local MIP.

Place whistle signs:

- 1,320 feet (1/4 mile) in both directions from the road crossing. This also applies to territories with directional traffic.
- Outside the track as viewed from an approaching train.
- No closer than 10 feet or farther than 15 feet from the nearest rail.

In multiple track territory where there is insufficient clearance between tracks, you may place whistle signs on the outside of the affected track. Refer to Standard Drawing No. 0555 for additional details.

Quiet Zone signs are used only at locations that have been legislated as a Quiet Zone. Refer to UPRR Standard Drawing No. 0556 for details.

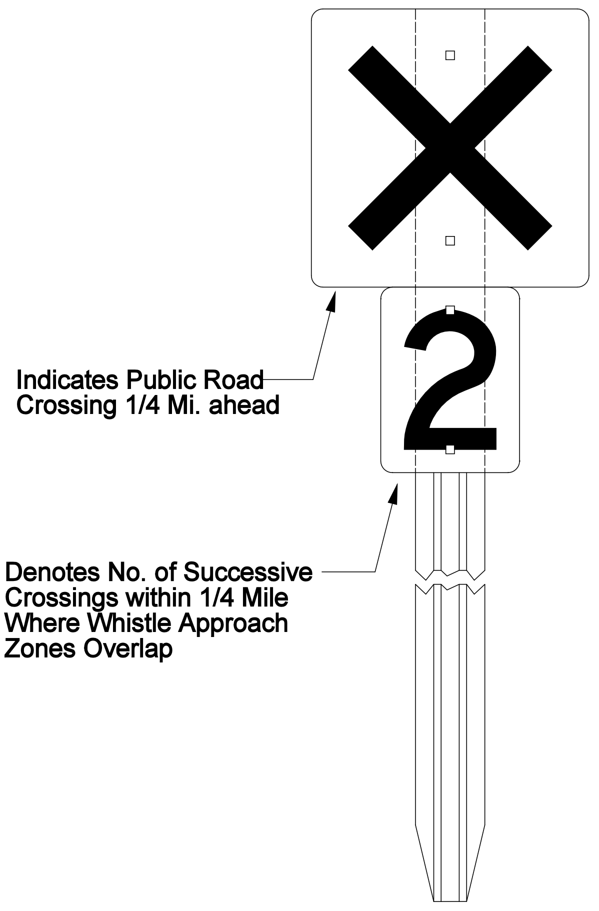


Figure 6-B

6.4.3 Standard Highway Crossing Signs (Crossbucks)

Standard highway crossing signs (crossbucks) must be placed on the right side of each approach of all public road crossings without signalized protection. In 2009 the Federal Highway Administration (FHWA) issued standards mandating the use of crossbucks with yield signs, at a minimum, to be placed at all passive public crossings (those without lights or lights and gates) by January 19, 2019. See Figure 6-C.

The placement of traffic signs other than crossbucks with yield signs (for example, stop signs) is determined by the public authority with responsibility for the roadway, or the state regulatory body, whichever is applicable. The initial installation of yield or stop signs at these crossings is negotiated by the Engineering Department's Industry and Public Projects Group. Union Pacific maintains / replaces these signs after they are installed.

Follow these requirements for installation and inspection:

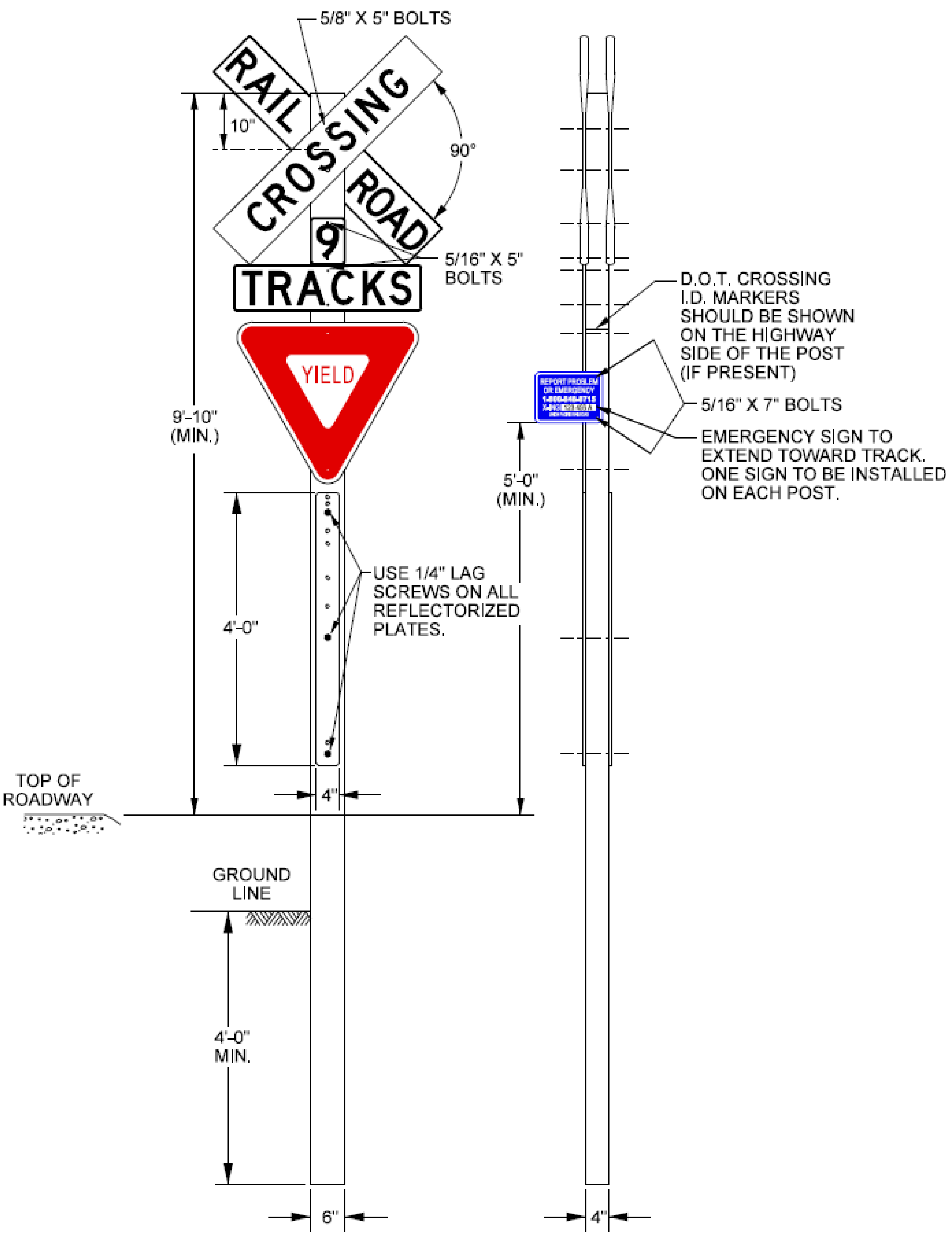
- Refer to UPRR Standard Drawing No. 0529 for design and installation requirements for passive public crossing signage (crossbucks with yield sign, or crossbuck with stop sign).
- Contact your local Industry and Public Projects Manager for information regarding initial stop and yield sign initial installation status, including funding of materials, for your territory.
- Follow inspection requirements for crossing signs as detailed in M/W Rule 53.1.1 Road Crossing Condition.

Follow these requirements for replacement of existing signs:

- For installations where it can be determined that a yield or stop sign was previously installed but is now missing, replace with in-kind size and type of sign. It is imperative to refer to UPRR Standard Drawing No. 0529 prior to replacement of the existing sign.
- To determine the current sign type and standard for existing yield or stop sign installations for any particular at-grade crossing location(s), utilize the UPRR website: MyUP> Public Projects> Facility Reporting> DOT Road Crossing Reports> Summary List of DOT's.
- Contact your local Industry and Public Projects Manager if you have questions regarding installations at crossings that may be exceptions to standards. If local law enforcement or municipalities contact UPRR maintenance forces to request a change to the type of sign installed, contact your local Industry and Public Projects Manager for further handling.

Follow these requirements for placing crossbuck signs:

- Place signs 15 feet from the center line of the nearest track and 8 feet from the edge of the road.
- Maintain a height of 9 feet between the top of the highway surface and the center of the sign.
- Keep the sign face perpendicular to the center line of the highway.
- Refer to UPRR Standard Drawing No. 0529 for additional information.



Typical Crossbuck

Figure 6-C

6.4.4 Clearance Warning Signs

Follow these requirements for mounting clearance warning signs:

- Use close or impaired clearance signs at locations with horizontal or vertical clearances that are less than standard.
- Mount close clearance signs at each end of the restricted track's entrance so they are clearly visible from the direction of approach.
- Mount close clearance signs on posts or structures.

See Standard Drawing No. 0513 for general placement details. Specific requirements for state or local ordinances may also be required on the sign face.

6.4.5 End of Track Sign

The End of Track Sign was developed to eliminate the risk of a red board being placed on a stub track adjacent to the mainline.

- Sign is to be installed on all new end of track applications
- Maintenance or repair of ends of track shall include installation of sign
- For more detail refer to Standard Drawing No. 0522

6.4.6 HTUA Sign (High Threat Urban Area)

The High Threat Urban Area sign was developed to aid train crews in identifying locations where Key Trains and Crude Oil trains are required by the FRA to not exceed 40 MPH.

- For more detail refer to Standard Drawing No. 0506

6.5 Roadways

Follow these requirements for maintaining right of way in these situations:

- Grade crossings.
- Right of way roads.

6.5.1 Grade Crossings

Follow these requirements for maintaining right of way access at road crossings.

A. General

To provide for safe train operation and safe condition of the highway travel crossing, give special attention to road crossing maintenance. Follow these general requirements:

1. Do not construct, install, widen, relocate, or remove any road crossing without the Chief Engineer's approval.
2. Construct all crossings according to UPRR Standard Drawing Nos. 0300-0399 and Standard Drawing Nos. 200100 to 209999.
3. Use concrete crossing panels on crossings constructed on concrete tie track.
4. Use concrete panels for public crossings when available.
5. Use prefabricated timber panels for private crossings outside concrete tie track.
6. Where a road crosses more than one track, keep the top of rail elevation on all tracks as even as practicable.
7. Maintain crossings to a smooth, even grade with no abrupt changes in slope or surface.
8. Before performing any work on a public road crossing that might require a road or lane closure or detour, contact the proper local, county, or state officials to obtain permission and any required permits.
9. When constructing or maintaining road crossings, remove all rail joints within the crossing limits. Keep rail joints at least 15 feet from the edge of the crossing.
10. Follow these requirements for maintaining flangeways:
    - Maintain the flangeway opening along the gage side of the running rail at no less than 3 inches.
    - Keep flangeways free of debris, gravel, ice, or other objects.

B. Crossing Warning Devices (Passive/Active)

Employees must immediately repair or replace all damaged or illegible signs. Report all damaged signalized crossing warning devices to the Signal Department hotline 1-800-848-8715.

Follow these requirements for maintaining crossing warning devices:

- Properly maintain crossbucks and whistle posts at all times.
- Keep the view clear in both directions for vehicles approaching the track. See Section 6.2.
- Work on or about highway crossings with the least possible inconvenience to highway traffic. Take care to protect all employees and the traveling public.
- Refer to M/W Rule 53.0 Road Crossings and Signs for additional requirements.

C. Crossing Drainage

Control the amount of water entering road crossings. Follow these requirements for controlling crossing drainage:

- Make sure the surface of the highway slopes away from the track where possible.
- Maintain approved culverts and ditches to allow water to flow without adversely affecting the track structure or roadway.
- Refer to Section 1.3.3 Grade Crossing Drainage for detailed information.

6.5.2 Right of Way Roads

Follow these requirements for controlling access to right of way roads:

1. Keep the gates controlling entrances to roads closed and locked, when not in use, to prevent unauthorized access.
2. Where access to right of way roads is not controlled, post "No Trespassing" signs according to UPRR Standard Drawing No. 0538.

6.6 Fencing

Follow these requirements for constructing and maintaining fencing:

1. When constructing new fencing be governed by UPRR Standard Drawing No. 0075.
2. When constructing right of way fence, place it on the boundary or property line of the railroad right of way unless otherwise directed.
3. Inspect and repair existing fence as required.
4. If tracks have been removed or train operations have been officially abandoned, you do not need to install or maintain fence along the right of way.

6.6.1 Livestock

Follow these requirements for livestock control:

1. Maintain cattle guards where required.
2. Keep gates closed when not in use.
3. Lead away any livestock found wandering on the right of way. Check the adjacent fence line for open gates or damage.
4. Dispose of livestock that have been killed on the right of way.

5. Call RMCC.

6.6.2 Snow

Follow these requirements for controlling snow:

1. Place snow fences at least 75 feet from the track at right angles to the direction of the prevailing wind. Where storms can be expected from either side of the track, erect fences on both sides. Do not erect snow fences where they will obstruct the view or cause snow to accumulate at road crossings.
2. Keep drainage ditches and culverts clear of snow and ice so they can handle a large volume of water if a sudden thaw should occur.

6.7 Bridges and Culverts

The Track Department inspects and maintains culverts which are less than 48" in diameter. For square or rectangular culverts, the Track Department inspects and maintains culverts with a flow area of 4 sq ft or more and with a flow area less than 16 sq ft.

Follow these requirements for maintaining bridges and culverts:

- When replacing damaged culverts, use a replacement culvert of the same diameter or larger.
- When installing culverts, place the bottom of the culvert at the flow line.
- Ensure the cover thickness over the top of a culvert to the bottom of the tie is at least one-half the culvert diameter.
- Remove weeds, debris, and snow that hinder water flow through culverts.
- Promptly remove drift that accumulates around bridges. During high water, use a crane and clamshell bucket.

Refer to Engineering Standard Drawing Nos. 4000 to 4016 to determine which structures require inside guard rails. These drawings also show construction details.

6.7.1 Bridge Identification

The following illustrations Figure 6-D, Figure 6-E, and Figure 6-F show some basic bridge terminology.

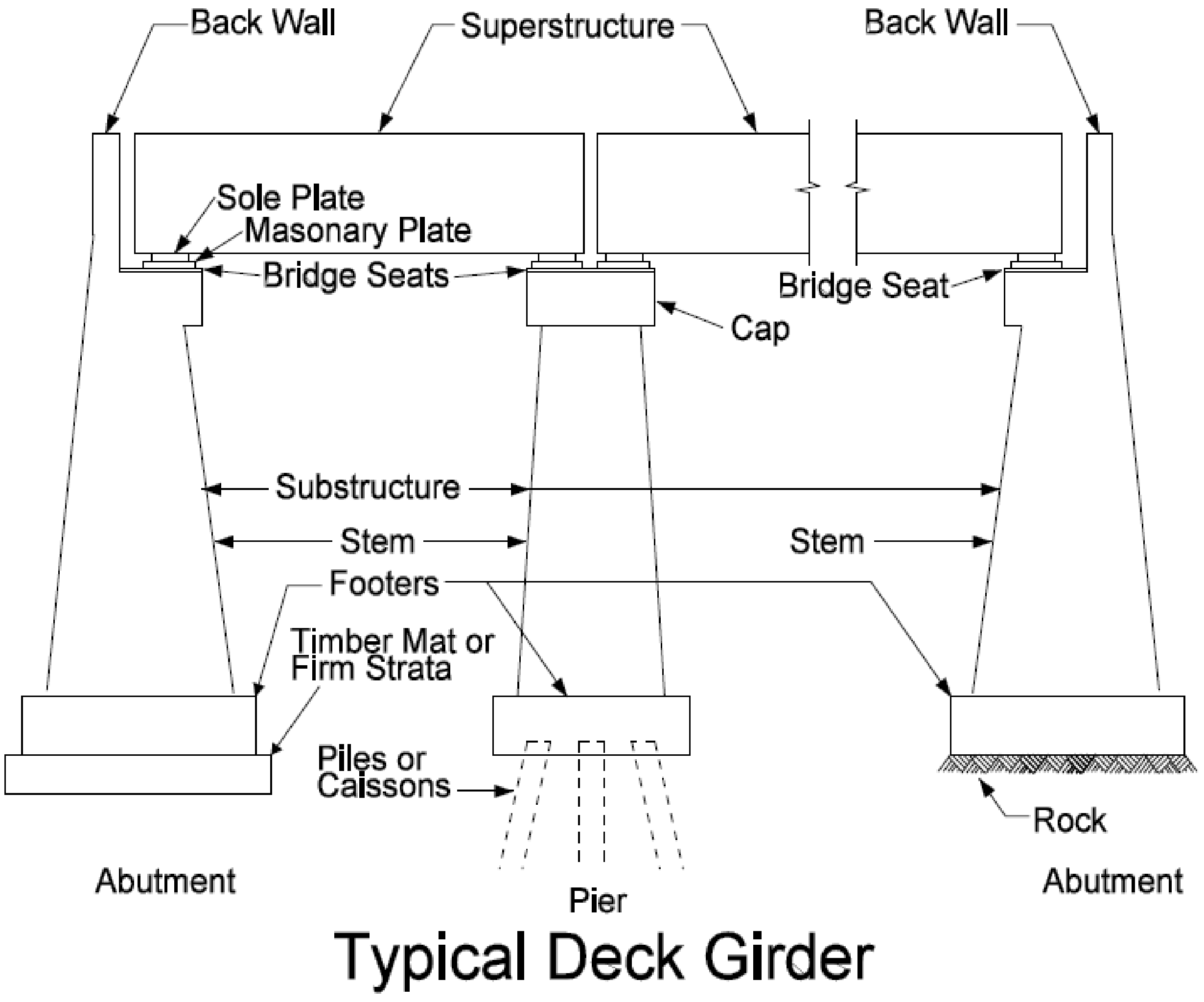


Figure 6-D

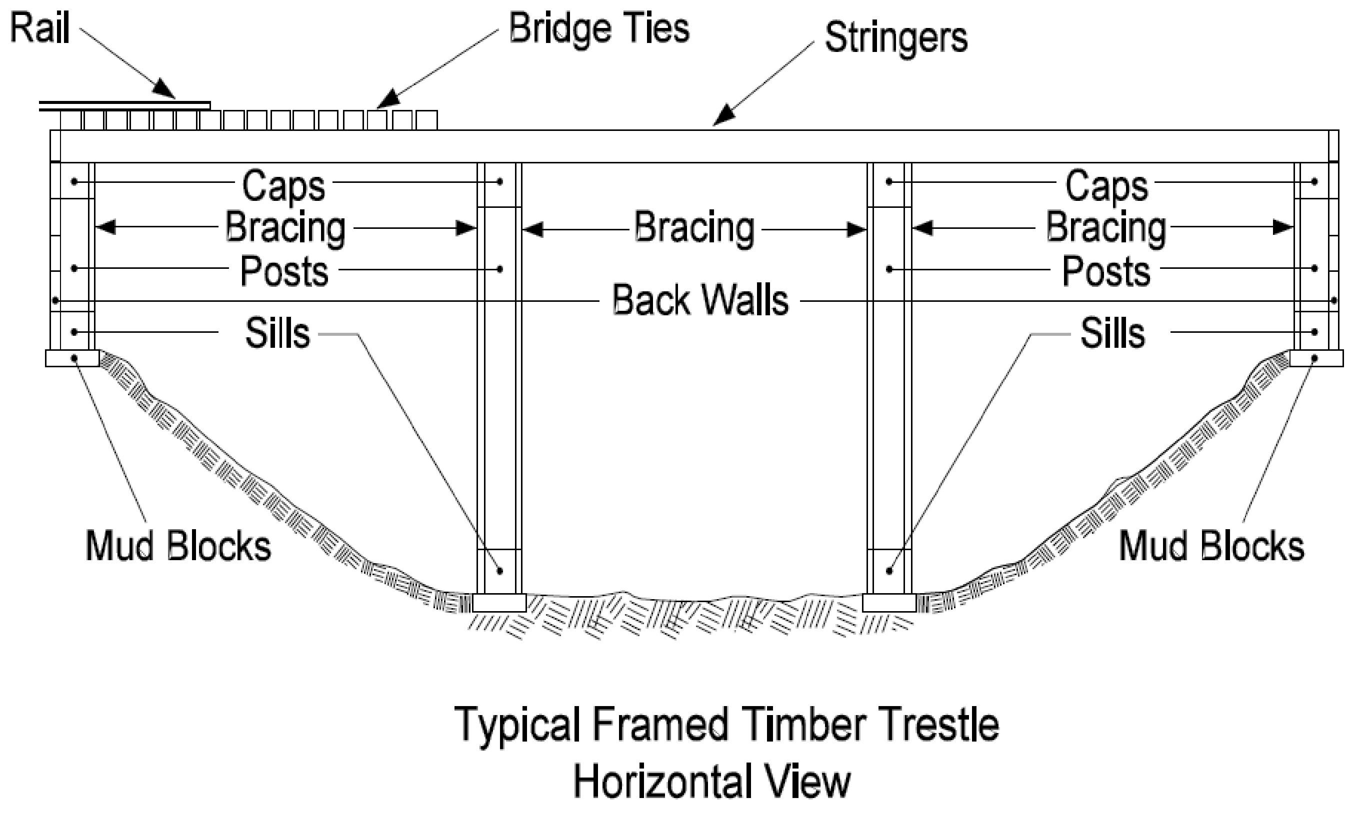
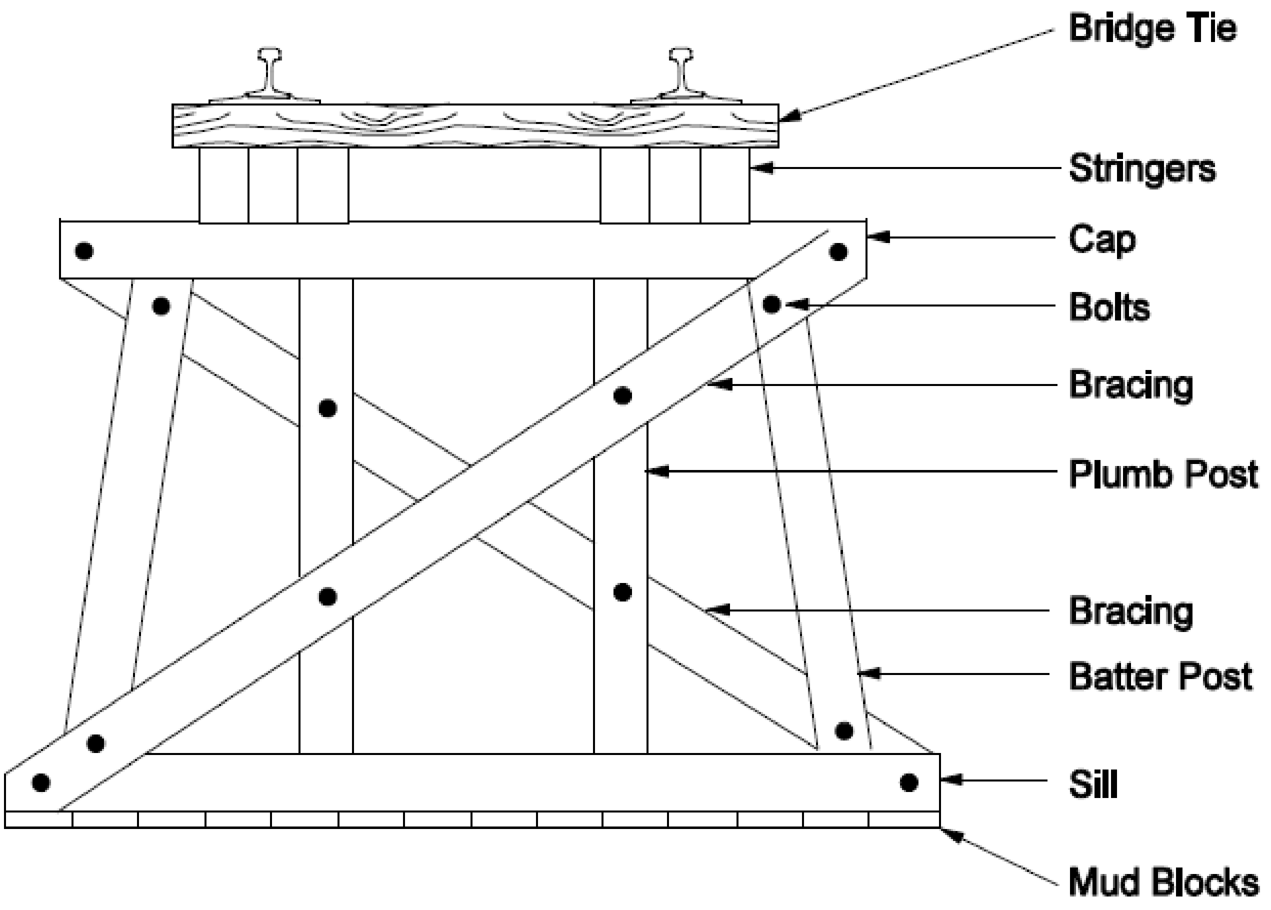


Figure 6-E



Timber Frame Trestle Cross-Section

Figure 6-F

6.8 Environmental

Comply with all environmental laws and regulations:

- Obtain permits when site specific conditions warrant.
- This include storing, applying, and disposing of hazardous materials, fuels, oils, greases, glues, paints, and solvents.
- Handle material released from track in a responsible manner. Do not dispose of material in waterways or store it in an area where rain runoff might carry the material into the waterways.
- Do not bury ties or other hazardous waste material, or burn material of any kind (e.g., ties, trash, for warming, etc.), without written approval from the Superintendent level or above. Approval will not be granted unless you first obtain the necessary environmental and fire permits from state and local authorities.
- Comply with all fire permit provisions. A fire permit alone is not sufficient. Attend a fire until it is completely out.
- Direct questions about hazardous or contaminated material disposal and grading/dirt work affecting storm water run-off to the Environmental Engineering Group.

6.8.1 Hazardous Material and Waste Spills

NOTE: A hazardous material is any substance that can harm people, property, or the environment. This includes fuel oil and many chemicals used in operations. Refer to the Chemical Inventory and Material Safety Data Sheets (MSDS) for types, quantities, and other details.

Follow these requirements for handling hazardous material and waste spills:

1. Evaluate the situation. Determine the type of material spilled and the size of the spill. (Use the size, shape, and location of the container along with the chemical container labels and other placards.)
2. Call for assistance from other employees and your foreman, if necessary, before attempting control or containment.
3. Contact local authorities (fire or police) if their assistance is necessary.
4. Secure the area. Remove or shut in sources of ignition.
5. If you can do it safely, take action to stop or contain the spill. This may include operation shutdown systems and incidental containment activities.

NEVER PLACE YOURSELF AT RISK. ATTEMPT TO CONTAIN OR CONTROL ONLY THOSE MATERIALS FOR WHICH YOU HAVE BEEN TRAINED AND PROPERLY EQUIPPED. CONTAINMENT OR CLEANUP OF ANY SPILL THAT EXPOSES YOU TO A FIRE, EXPLOSION, OR HEALTH HAZARD SHOULD BE HANDLED BY TRAINED SPECIALISTS.

Incidental containment activities may include use of absorption, dilution, dikes, dams, booms, diversions, over-packing, plug and patch, or liquid transfer.

6.8.2 Illegal Dumping

While inspecting and maintaining track and ROW on and about UPRR property, employees need to be aware of activity by company forces or outside third parties that may damage assets. Such activity would include:

- Illegally dumping wastes or discharging wastewater onto UPRR property.
- Undocumented spills or hazardous materials release.
- Loading and unloading hazardous and environmentally sensitive materials on the ROW at facilities that do not have adequate clearances.

IF YOU DISCOVER SUSPICIOUS ITEMS OR OBSERVE SUSPICIOUS ACTIVITY, PLEASE NOTIFY THE UNION PACIFIC RISK MANAGEMENT COMMUNICATION CENTER AT 1-888-UPRR-COP (1-888-877-7267) OR COMPANY LINE 8-216-5641.

6.9 Fiber Optics

Follow these requirements:

- Know if the area you are working in contains fiber optic cable.
- Take necessary measures to avoid damaging cable. Protect it from damage by outside parties.

Signs posted along the right of way indicate the presence of fiber optic cable but not the precise location. The absence of a sign does not necessarily imply that no cable is present, nor does it relieve an employee of the responsibility of checking to see if cable is present.

If you are unsure about the presence of cable, call 1-800-336-9193 before digging. If cable is present, do not dig in the area until the cable location has been marked or it has been determined that the work will not endanger the cable.

Call Union Pacific's *Call Before You Dig* hotline (800-336-9193) to determine if there are any fiber optic cables or other utilities in the work area. Call SOC in a terminal to contact water services and electricians.

Each State has a one-call hotline that must also be contacted at least 48 hours before performing any work. Call the North American One Call Referral System (888-258-0808) to obtain the appropriate state one-call number. Call the state one-call center, who will notify all utility owners within the work area.

***Do not* begin excavation or construction along the railroad's right-of-way until all utilities in the work area have been located and protected by their owners.**

6.10 PTC – Critical Asset Change Management

	9 PTC CRITICAL FEATURES
1	**Track Center Line** Data collected that is the track centerline represented by the Latitude/Longitude/Elevation
2	**Signal** An asset used to display a color aspect for train movement
3	**Switch Point** A location on the track where movement can be made from one track to another track
4	**PTC Clearance Point** A designated location from an asset with a minimum of 13 foot track centers to keep equipment from fouling
5	**Mile Post** Markers used to establish the location using whole mile values
6	**Road Crossing** The Leading and Trailing edges of the crossing that intersects the railroad at grade
7	**Permanent Speed Restriction Sign** Entry and Exit points of the Speed Restriction
8	**Station Signs** Location of station signs in Track Warrant Control (TWC) territory
9	**Method of Operation Signs** Signs designating a change in the operation control of a territory (ie. Begin CTC, Begin ABS, Yard Limits, etc.)

7.0 TRACK BUCKLING PREVENTION GUIDELINES

7.1 Causes of Track Buckling

A track buckle is a lateral misalignment caused by one or more of the following:

- High compressive forces in the rail resulting from thermal and mechanical loads or reduced neutral temperature.
- A weakened track structure due to reduced track resistance and alignment defects.
- Dynamic loading of trains, such as dynamic uplift, high axle loads (lateral/vertical), braking, and traction loads.

A track buckle occurs when the track structure can no longer resist the compressive forces that have built up. The buckle is a relief of the built up forces.

7.1.1 Explanations and Terminology

CWR Joint means any joint directly connected to CWR.

Compressive Forces push toward each other. They tend to squeeze or compress an object.

Tensile Forces pull away from each other. These forces tend to stretch an object.

Thermal Expansion of Rail occurs when a 1,440 foot section of continuous welded rail (CWR) is expanded in length by approximately 9/16 inch for every five-degree (Fahrenheit) increase in temperature. (0.0000067 inch, per inch of rail, for every degree Fahrenheit.)

- Example: A 1,440 foot string of rail was laid at 60 degrees Fahrenheit. The rail was not anchored or restrained at either end. If the rail temperature is increased to 120 degrees Fahrenheit, the rail will expand approximately 6.95 inches in length.

Neutral Temperature is the temperature at which there are no longitudinal forces in the rail. The rail is said to be in a state of equilibrium or balance, which means there are no pushing or pulling (compressive or tensile) forces. The neutral temperature is equal to the installation temperature, at which the CWR is laid and anchored, if no other rail related activities have occurred.

Longitudinal Forces are compressive or tensile forces affecting the length of the rail.

Dynamic Loading of Trains is the force that is applied to the track structure from wheel and axle loads, braking, acceleration, rocking, truck hunting, flat spots on wheels, and slack action.

Critical Buckling Temperature is the point at which the track buckles without any outside forces. When outside forces are applied, the critical buckling temperature is lowered.

Installation Temperature is the temperature at which the CWR was laid and anchored. It is a key component in understanding the dynamics of track buckling. This is the initial neutral temperature.

Note: UPRR installs CWR at fairly high neutral temperatures. In areas where the ambient temperature is in the lower ranges, the installation temperature is controlled to reduce the risk of pull-apart. A rule-of-thumb is that the neutral temperature should be 40-45 degrees Fahrenheit above the annual mean temperature for the area.

Lateral Resistance is the reaction that is presented by the ballast to prevent lateral movement from the rail and ties. As the compressive forces in the rail increase the track structure has a tendency to push outward. The ties and ballast resist this outward movement. This is a key parameter in providing lateral strength and stability for buckling prevention. Figure 7-A shows how the ballast resists lateral movement of the track structure.

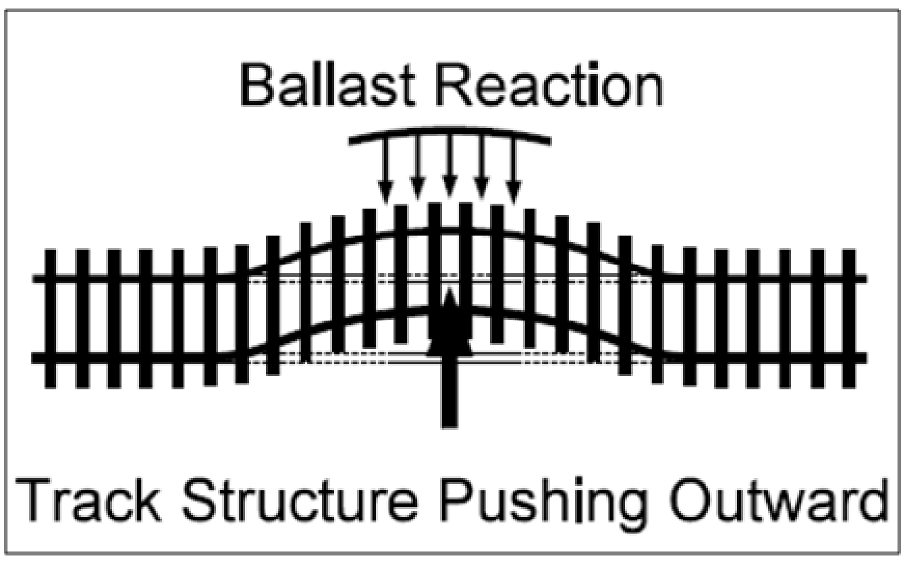


Figure 7-A

Three components make up the lateral resistance of the track structure: friction between the bottom of the tie and the ballast, friction between the side of the tie and the ballast in the crib, and the interaction between the end of the tie and the ballast on the shoulder. See Figure 7-B.

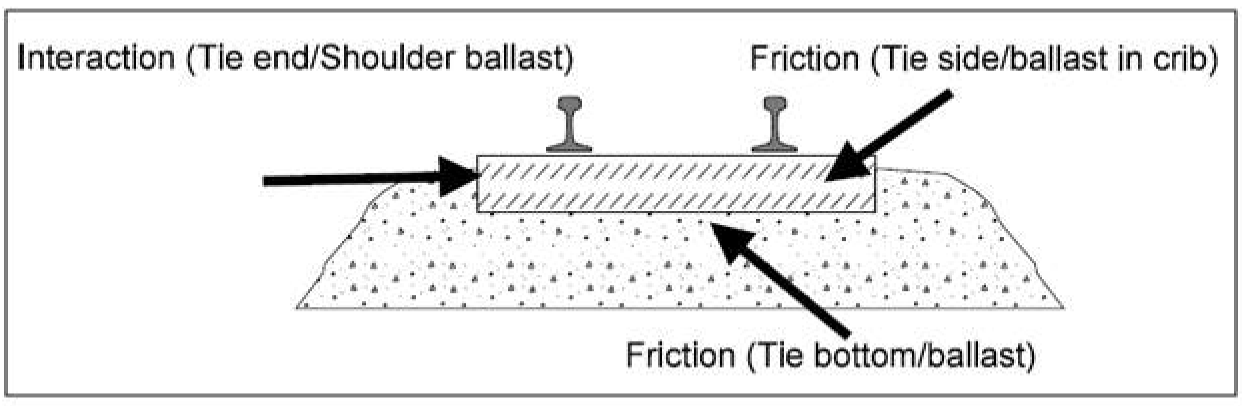


Figure 7-B

For wood ties, the percentage of contribution is: bottom of tie (40%), side of tie (35%) and end of tie (25%). For concrete ties, the percentage of contribution is: bottom of tie (40%), side of tie (30%) and end of tie (30%).

The resistance that the ties and the ballast provide help to keep the rail from moving laterally. The amount of resistance that the ties provide depends on the spacing, dimensions, mass, and geometry. The ballast resistance depends on the type and size of the tie and the profile, density, and consolidation of the ballast.

Lateral Strength is what holds the track structure in place and prevents it from moving laterally.

7.1.2 Critical Parameters That Influence Track Buckling

The critical parameters that influence track buckling are:

- Variation in the rail neutral temperature, which equates to the longitudinal force in the rail. When the rail's neutral temperature is reduced, the longitudinal force in the rail increases causing a reduction in the track's buckling temperature.
- Lateral resistance of the track. The lateral resistance is reduced after the track structure has been disturbed.
- Lateral track alignment deviations.
- Train dynamic loading and dynamic uplift.
- Curvature.

7.1.3 Maintenance Activities and Conditions That Impact Track Buckles

Controlling neutral temperature is a critical component in the maintenance process. There are a number of maintenance processes that are performed that can impact the neutral temperature and set up a condition that is prone to a buckle. Maintenance activities and conditions that impact buckles are:

A. Lowered Neutral Temperature

When maintenance is performed on the track and more rail is added than was taken out, the rail's neutral temperature is lowered. If this reduction in neutral temperature reaches the critical buckling point, where the track structure can no longer resist the stress created by elevated temperatures and train induced forces, the track will buckle.

The rail's neutral temperature is variable, not constant; it can change as conditions change. Maintenance practices can, and do, have an impact on the neutral temperature; this has to be understood when performing maintenance work.

A change in neutral temperature is the same as changing the longitudinal force in the rail. A 40^{o} F to 60^{o} F change in the rail's neutral temperature will change the force in the rail by about 100,000 pounds. A downward shift in neutral temperature from 100^{o} F to 60^{o} F, could lead to a track buckle. If the neutral temperature was increased from 100^{o} F to 130^{o} F, this could have the negative impact of pulling rail apart or a curve chording inward during the winter months.

Field measurements have identified neutral temperature shifts between 30^{o} F and 40^{o} F below the desired rail laying temperature. The problem starts when the neutral temperature of the rail is lower than the desired neutral temperature for the area. The track becomes unstable once the difference between the actual neutral and the desired temperature for the area reaches the critical buckling temperature. The critical buckling temperature would be approximately a difference of 60^{o} F to 80^{o} F between the neutral temperature and the rail temperature.

B. Addition of Rail and Field Welds

Rail can be added without actually installing more rail. When work is performed to correct surface or line deviations, the rail will straighten out and can grow in length. There may be too much rail in the track. This increase in length decreases the neutral temperature.

The most obvious example of when rail can be added in the normal maintenance process is when service failures, detector car failures, or pull-aparts are repaired. If more rail is put back into the track, than was taken out, the neutral temperature is decreased.

When field welds are made during cold weather and no allowance has been made for rail contraction, additional rail is added. The excess rail could decrease the neutral temperature below the desired level.

The longitudinal forces, on a piece of rail, are generally unknown. When making repairs, rail should not be added. If rail is added, it must be removed in the spring.

C. Loss of Longitudinal Resistance

If the rail is allowed to move through the rail anchors or fasteners or the ties are shoving the ballast, there is a reduction in the rail's neutral temperature. At the location where the rail stops moving longitudinally, there is a buildup in compressive forces. Some of the locations that are susceptible to longitudinal rail movement are: at the bottom of a vertical curve on heavy grades, bottom of heavy grades with directional traffic, horizontal curves, turnouts, bridges, railroad crossings, and highway crossings.

D. Reduced Lateral Resistance

The lateral resistance is what helps hold the track structure in place. When the rail is in compression, the track tries to push outward. If ties and ballast are disturbed, the lateral resistance is reduced. This develops a weak spot in the track. As the forces increase in the rail, the track structure looks for a location to relieve the stress that has built up and the weak spot is vulnerable to a buckle.

Testing on U.P. has found that tamping and surfacing reduces the track's lateral resistance by 50%.

In locations that do not have enough shoulder ballast on the inside of the curve, the rail can shift inward due to the high tensile forces caused by cold temperatures. This location may have been at the desired neutral temperature before the rail is chorded in, but now the neutral temperature would be lower because the rail required for the curve is less.

E. Maintenance on Curves

When maintenance is performed on a curve and it disturbs the lateral and longitudinal resistance of the track, the track could shift inward during low temperatures. This happens before the track is fully compacted. This inward shift lowers the neutral temperature and reduces the lateral resistance. As the curve is lined in, less rail is required between the point of the curve and the point of the tangent, thus creating excess rail. The result of this lowers the rail's neutral temperature.

Anytime curves are surfaced or lined during cold temperatures and the curve is thrown inward more than outward, this sets up a potential for a buckle to occur. This imbalance in the throws will lower the neutral temperature. If curves are lined during high temperatures, the curve wants to move outward. Once the temperature gets colder, the tensile forces pull the curve inward, lowering the neutral temperature.

Track consolidation helps control curve movement but does not eliminate it. Curves must be closely monitored in extreme cold and heat for movement.

The following chart provides a rule-of-thumb value for neutral temperature (T_N) change. If the degree of curvature is known and how much the curve was moved or displaced (□), then it can be used to identify the change in neutral temperature. See Figure 7-C.

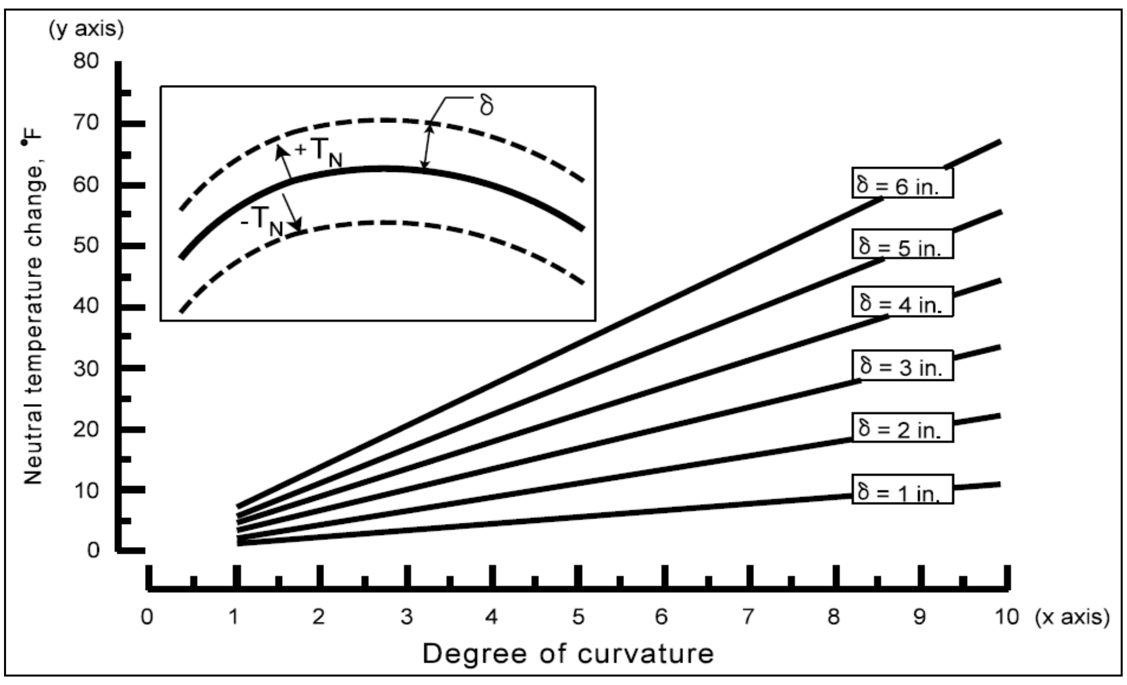


Figure 7-C

Here is an example of how to use this chart. A 6^o curve with a 3" displacement would have approximately 20^o F change in the neutral temperature. If the displacement was inward, then there would have been a decrease in neutral temperature. Find the degree of curvature on the X-axis and at a 90 degree angle from the 6^o curvature move up to the line where it intersects with 3" displacement. Move horizontally to the left from this point to the Neutral Temperature Change on the Y-axis and this gives the neutral temperature change of 20^o F. degrees.

F. Surface and Alignment Deviations

Buckles are more likely to occur in track with poor surface and alignment, than in track with good surface and alignment. Minor surface and alignment defects coupled with lowered neutral temperatures can lead to progressive buckling (a more gradual lateral displacement), particularly in sharp curves and in areas where the rail is corrugated, or has badly chipped joints or engine burns.

G. Dynamic Train Forces

Dynamic forces significantly increase the potential for track buckling. This instability is due to the uplift of the track in front of the train, between the front and rear trucks of a car (the "central bending wave character" of the rail), and the rear of the train. In the uplift area, the lateral resistance is reduced. This magnifies the importance of the lateral resistance between the shoulder ballast and the end of the tie. Illustrated in Figure 7-D.

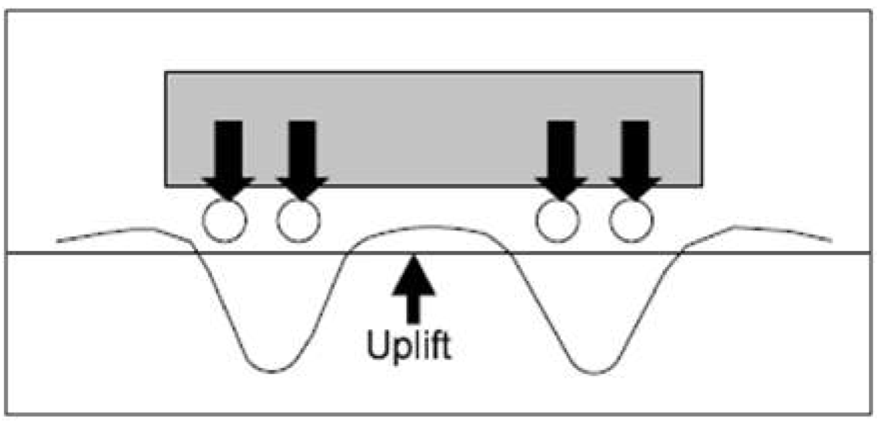


Figure 7-D

Imperfections in the track structure combined with the influence of repeated heavy wheel impacts on the rail produce higher lateral forces. As trains continue to encounter the imperfection, the size will increase. The lateral forces increase as the imperfection increases in size. This situation reduces the lateral resistance of the track.

Locomotives and heavy trains also can contribute to track buckling by pushing and pulling the rail, especially in heavy traction areas or on grades. If the rail is in compression, this can increase compressive stresses. This will lower the rail's neutral temperature. The end result is there will be a reduction in the resistance.

When a train is operating on a segment of track that is near the critical buckling temperature, the added forces that are generated through braking and the heating that is caused by the interaction between the wheel and rail can induce a buckle.

H. Poor Train Handling

Poor train handling contributes to many track buckles. Dynamic, independent, and automatic braking action of a train changes the longitudinal forces in the track and can cause significant shifts in the rail's neutral temperature. If the lateral resistance no longer can resist the longitudinal forces in the rail, the track will buckle. Slack adjustments in the train can produce extremely high lateral forces on the rail.

7.1.4 Locations Where Track Buckles are Likely to Occur

From a maintenance perspective, it is important to understand where track buckles are likely to occur. Table 7-A provides these locations and a description of why these are critical.

Locations where	Description
Lateral resistance has been reduced	Ballast and ties combine to hold the track in place. Maintenance activities such as tie renewals, undercutting, and/or surface and lining can reduce the lateral resistance by at least 50 percent.
Longitudinal holding power has been reduced	Rail has a tendency to bunch when anchors are missing or when an insufficient number of anchors are present or the fastening system is not restraining the rail from movement.
Rail has been added	Rail may be added when repairing service failures, rail defects, or pull-aparts.
Poor surface and alignment conditions are present	Poor surface and alignment conditions reduce lateral resistance.
Under loaded trains	A high percentage of track buckles occur under the rear half a train. Improper train handling where track work was recently performed greatly increases the probability of a track buckle especially on grades or curves.
Curves	Curves are more prone to a track buckle. Analysis of track buckle derailments indicate that there are more incidents that occur on tangent track, but if the data is normalized for the miles of tangent track versus the miles of curves, there are 2.6 times the frequency of derailments on curves versus tangent track. This is attributed to the curvature effects, the imperfection sensitivity that curves have and the dynamic forces that a train has on the curves as it negotiates around the curves.

Table 7-A

7.1.5 Track Buckle Occurrences

From a maintenance perspective it is important to understand when track buckles occur. An eleven year study (between 1995 and 2006) of track buckle derailments provides useful information. These charts are representative of the entire Union Pacific Railroad and not to a specific geographic area.

- The following chart indicates that the months of June, July and August had 75% of the track buckle caused derailment incidents, which are the hottest part of the year. July had the highest number of incidents in the month, which accounted for 36% of the derailments. See Table 7-B.

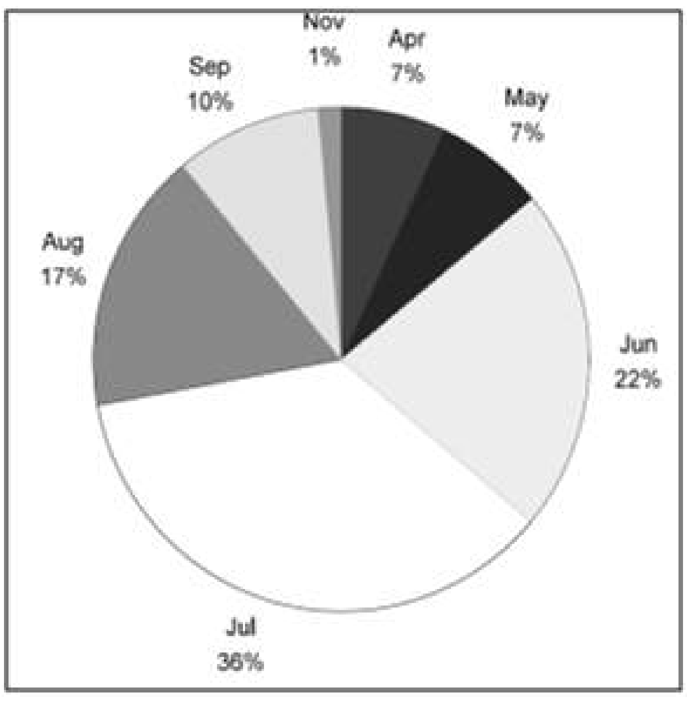


Table 7-B

- The majority of track buckles occur on hot sunny afternoons, usually between 2 P.M. and 6 P.M. when there are large variances between daytime high temperatures and nighttime low temperatures. The following chart indicates that 88% of the derailments that occurred were between 2:00 P.M. and 6:00 P.M. The highest percentage of derailments occurred between 3 PM and 4 PM. See Table 7-C.

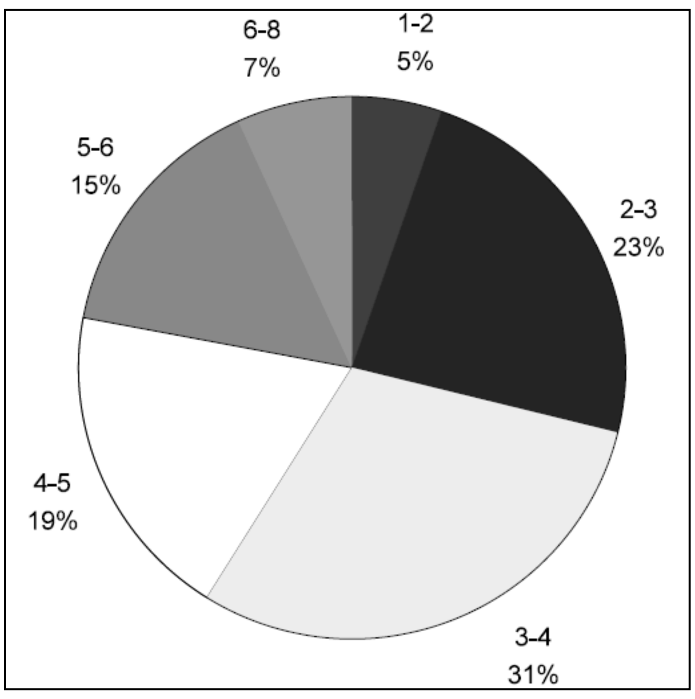


Table 7-C

- From an ambient temperature perspective, the following chart indicates that 49% of the derailments occurred in the 90^{o} F – 100^{o} F temperature range. Another 26% occurred when temperatures were greater than or equal to 100^{o} F. See Table 7-D.

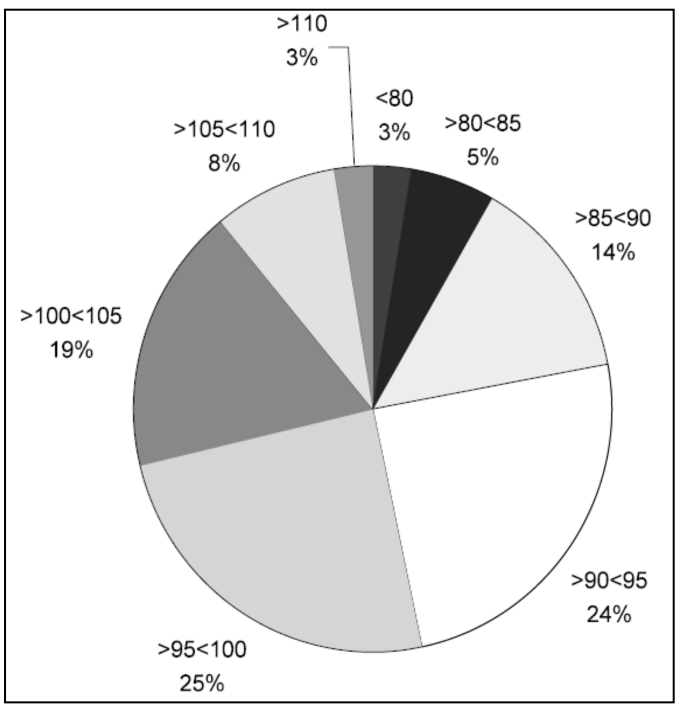


Table 7-D

7.2 Track Buckling Preventive Maintenance Schedule

Track Buckling Prevention is an on-going process. Performing track buckling preventive maintenance throughout the year can reduce the risk of track buckles. Track buckling prevention is achieved through more effective management of CWR. Here in Table 7-E is a Track Buckling Preventive Maintenance Schedule that provides activities and the recommended time of the year these activities should be performed.

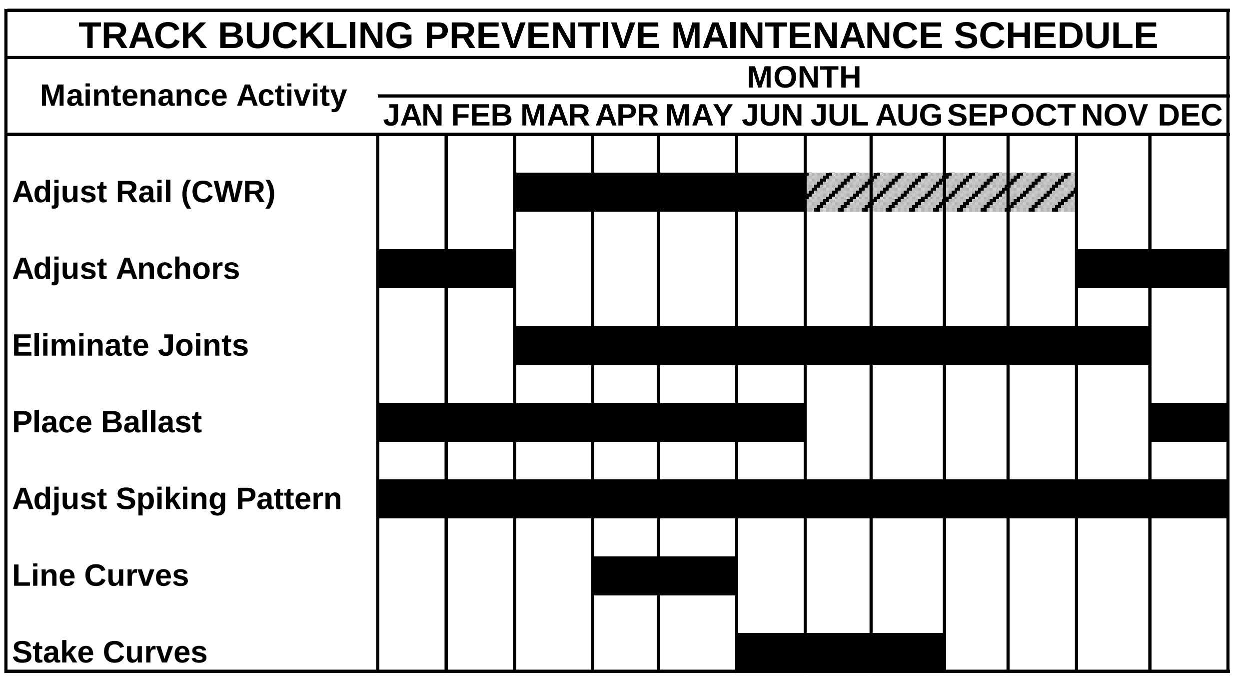


Table 7-E

1. Adjust Rail (CWR) - Remove excess rail from March through June. In the months of July through October, remove excess rail when maintenance work requires the adjustment.
2. Adjust Anchors - Maintaining a standard anchor pattern is important. This provides the resistance necessary to keep the track from moving longitudinally. In locations where the standard pattern is not enough, additional anchors should be applied. The best time to perform this work is when the rail is in tension.
3. Eliminate Joints - Eliminating joints helps reduce the risk of pull-aparts in the winter months. When making welds make sure to adjust for the length of the field weld prior to welding the joint, so no rail is added.
4. Place Ballast (Shoulders Cribs) - A full ballast section is required to provide the lateral resistance necessary to hold the track in place. Optimize the January through May time period and November through December time- frame for placing ballast to address maintenance requirements. Once the production season starts up, the project work will use the majority of the ballast cars.

5. Adjust Spiking Pattern - Adjustment of the spiking pattern can be done throughout the year. The standard spiking pattern helps resist the lateral forces.
6. Line Out Curves - Line out any curve that has inward movement of 2 inches or more prior to rail temperatures above or forecasted above the designated rail laying temperature.
7. Stake Curves - In warm weather curves move outward to relieve the high compressive forces, which makes the warm months an excellent time to stake these mainline curves. Classes 3 through 6 mainline curves are required to be staked in July and August.

Note: Curve staking must also be done in conjunction with cold temperature surfacing/lining in line with Sections 7.9.6, 7.9.10 and 7.9.11.

7.3 Monitoring Temperature

Ambient (air) and rail temperatures should be known when inspecting track and making rail adjustments.

7.3.1 Ambient Temperature

When the possibility of higher temperatures exists special planning must be made in order to ensure proper protection of track. The weather forecast must be monitored daily so appropriate slow orders can be placed with the dispatcher. Listen for weather and temperature forecasts using local or company radios.

7.3.2 Rail Temperature

Recording the rail temperature is important when installing and adjusting rail. Place a rail thermometer on the shady side of the web of the rail. Leave thermometer in place for five minutes before recording temperature. Infrared devices can also be used.

7.3.3 Relationship between Ambient Temperature and Rail Temperature

On a sunny day, the rail temperature will be approximately 30 degrees Fahrenheit higher than the ambient temperature. An ambient temperature of 80 degrees Fahrenheit on a sunny day generally correlates to a rail temperature of approximately 110 degrees Fahrenheit. On cloudy days the rail temperature will be approximately 15 degrees Fahrenheit higher than the ambient temperature. For example if the ambient temperature is 100 degrees Fahrenheit and it is cloudy, the rail temperature would be approximately 115 degrees Fahrenheit.

7.4 Inspecting the Track Structure

Physical inspection of the track structure is a key element of preventing track buckles. This is done in an effort to locate conditions where track buckles could occur and perform the necessary corrective action before they can become a problem. Listed below are areas that require a close inspection:

7.4.1 Where Rail Could Have Been Added

Inspect locations where rail may have been added due to repair of service failures, rail defects, pull-aparts, or where field welding has occurred, particularly in cold weather.

7.4.2 Where Major Track Work Has Been Performed

Inspect locations where track maintenance work, such as tie and rail renewals, undercutting, sledding, plowing, or surfacing and lining was recently performed. Other locations that need to be considered are newly constructed track, derailment sites and washout areas.

7.4.3 Fixed Track Structures

Inspect fixed structure locations, such as highway road crossings, railroad crossings, turnouts, bridges, and platforms where rail may bunch.

7.4.4 Where Trains Could Cause Longitudinal Rail Movement

Inspect locations where the braking action of trains can change the longitudinal forces in the track. Areas include the following:

- On grades, the bottom of grades and vertical curves.
- In advance of speed restrictions.
- Horizontal curves; paying special attention to high degree curves.
- Where train traffic is predominately one direction.
- Fixed track structures as noted in Section 7.4.3.

7.4.5 Track Geometry Problems

When inspecting for substandard track geometry look for the following:

- Track surface deviation.
- Deviations in the super-elevation of the curve.
- Cross-level deviations at joint locations.
- Weakness in sub-grade that may cause a surface deviation.
- Deviations in track alignment.
- Misalignments resulting from curve shifting.

Note: Use care when inspecting curves for line defects. Because the buckle is usually in a C shape, a small buckle in a curve can go unnoticed.

7.4.6 Insufficient Anchors and Fasteners

When inspecting for insufficient anchors and fasteners look for:

- Lack of standard box anchoring for 195 feet in both directions at turnout locations.
- Missing or inadequate anchors at joint locations.
- Lack of a standard anchor pattern on bridges.
- Rail moving through anchors or fasteners (shiny mark).

7.4.7 Ballast Conditions

For wood and composite ties, the standard CWR ballast section is a 12-inch shoulder beyond the end of a tie with a three-to-one slope. A three-to-one (3:1) slope is defined as three feet of horizontal distance for each foot (12 inches) of drop.

For concrete ties, the standard ballast section provides a 12-inch shoulder with a 3:1 slope.

When inspecting the ballast section look for the following:

- Empty ballast cribs.
- Insufficient ballast on the shoulders.
- Fouled ballast.
- Signs of freshly disturbed track. This could also mean that someone has been working at that location.

7.5 Inspecting for Tight Rail Conditions

7.5.1 Lateral Rail Movement

Definition: Lateral movement occurs when rail moves from side to side. When looking down the track, it resembles a snake.

When inspecting for lateral movement look for the following:

- Nervous or kinky rail.
- Clusters of defective ties.
- Voids between the ballast section and the end of the tie.
- Rail touching the opposite corners on the shoulder of the plates.

7.5.2 Vertical Rail Movement

Definition: Vertical movement occurs when the rail moves up or down.

When inspecting for vertical movement look for the following:

- Track appearing to have vertical humps.
- Ties that have pulled up out of the ballast.
- Clusters of high spikes.
- Rail lifting out of the plates.
- Rail that is canted either inward or outward.
- Indications that the rail was moving up and down.

7.5.3 Longitudinal Rail Movement

When the rail is in compression and allowed to move unrestrained longitudinally, the rail can bunch at fixed locations.

When inspecting for longitudinal movement look for the following:

- Ballast bunching on one side of the tie.

Note: This indicates that the ties are moving with the rail and pushing the ballast. A ridge of ballast forms ahead of one side of the tie and leaves a void on the other.

- Skewed ties (one end of the tie moves).
- Anchors that are not tight against the tie.

Note: This indicates that the anchors have lost their holding strength and are moving with the rail.

- Shiny marks on the base of the rail.

Note: These marks are made from the spike heads, anchors or insulator/clips scraping the rail.

- Frogs that appear to be out of line or there is tight gage.
- Improper fit of the switch point to the stock rail.
- Switch rods are binding on the head block ties.

7.5.4 Rail Maintenance Problems

Inspect for corrugated, battered, or engine-burned rail. The presence of these increases the dynamic loading on the track. Sharp curves are especially vulnerable.

When inspecting for rail maintenance problems look for the following:

- Frozen joints.

Note: Frozen joints cause jointed rail to expand similar to CWR.

- Chipped or engine burned rail.
- Corrugated rail.

7.6 Extreme Weather CWR Inspections

7.6.1 Hot Weather Inspections

Heat inspection for tight rail conditions are performed whenever a Level 1 or Level 2 Blanket Heat Restriction is in effect. Each segment of track affected, must be inspected daily, sometime between the hours of 12:00 Noon and 6:00 PM while blanket heat restrictions are in place. When tight rail conditions are present, a speed restriction of 25 mph or less must be placed or track removed from service until repair or adjustment is made.

7.6.2 Cold Weather Inspections

These cold weather inspections thresholds are established to provide a system guideline for track inspections when there are high tensile forces in the rail. Note: These are minimum requirements and more restricted requirements may be required based on track conditions.

Cold weather mainline inspections will be performed as directed by the Director Track Maintenance, when the rail temperature has or is forecasted to:

1. Reach a rail temperature 85° F below the rail laying temperature for the first cold weather event of the season. This temperature is identified in Section 7.10.10 Reporting Track Buckling Activities, Table 7-J; for each subdivision in the “First Event Cold Weather Inspection Temperature” column.
   - This requirement is designed to address the first wave of service failures that are seen with the first significant drop in temperature. Inspect within 12 hours of meeting this threshold.
   - There could be a significant period of time where ambient temperatures warm back-up after this first cold weather event, in this case use the 85° F below the rail laying temperature threshold again. This is somewhat subjective but typically if the temperature drops then rises again for a period of two or more consecutive days, then it is considered a significant period of time.
   - The standard length of duration will be 24 hours, where then the temperature will be re-evaluated and determination if the inspections needs to remain in effect.
2. Reach a rail temperature 100° F below the rail laying temperature. This temperature is identified in Section 7.10.10 Reporting Track Buckling Activities, Table 7-J for each subdivision in the “Cold Weather Inspection Temperature” column.
   - A cold weather inspection will be performed when the rail temperature is 100° F below the rail laying temperature and repeated every 24 hours until such time as the rail temperature does not exceed the 100° F below rail laying temperature.
3. Experience a rapid ambient temperature drop of 40° F or more within a 24 hour period, when the ambient temperature is at or below the “Rapid Temperature Drop of 40° F or More Below Temperature” for the subdivision. See Table 7-J in Section 7.10.10 Reporting Track Buckling Activities for the temperature.
   - A cold weather inspection will be performed during this rapid temperature drop, to be repeated every 24 hours until such time as the ambient temperature exceeds that listed in Table 7-J.

First Time Ambient Temperature Drops 85°F Below Rail Laying Temperature	Ambient Temperature Drops to 100°F Below Rail Laying Temperature	Experience Rapid Ambient Temperature Drop of 40+°F Within 24 Hour Period
Perform cold weather inspection within 12 hours. After 24 hours, re-evaluate to determine if inspections need to continue.	Perform cold weather inspection and repeat every 24 hours until rail temperature is above the threshold of 100°F below rail laying temperature.	Perform cold weather inspection during the rapid temperature drop, and repeat every 24 hours until the ambient temperature exceeds that listed in Table 7-J under the "Rapid Temperature Drop" column.

7.7 Placing Blanket Heat Restrictions

Use this procedure when the ambient (air) temperature reaches or exceeds the temperature shown in the **"Rail Laying Temperature for Continuous Welded Rail Table and Blanket Speed Table "** See Table 7-J.

7.7.1 Level 1 Heat Restrictions

Place a Level 1 heat restriction when the ambient temperature is forecasted to exceed the Level 1 threshold. When the forecast temperature is predicted to reach blanket thresholds, contact the dispatcher and issue the heat restriction the day prior to being needed. Blanket Speed Restrictions for trains are listed in the current System Special Instructions.

7.7.2 Level 2 Heat Restrictions

Place a Level 2 heat restriction when the ambient temperature is forecasted to reach or exceed the Level 2 threshold. Blanket Speed Restrictions for trains are listed in the current System Special Instructions.

7.7.3 Blanket Cold Weather Restrictions

Blanket cold weather restrictions are established to provide system guidelines for placing track speed restrictions, when there are high tensile forces in the rail generated from extreme cold temperatures.

- These speed restrictions will be put out as a Form C bulletin. They may be placed during various times of the day, but not less than 12 hours increments. An example would be “in effect from 9:00 PM until 9:00 AM.”
- Thresholds for subdivision cold weather speed restrictions are based on the cold weather inspection guidelines.
- Cold weather mainline speed restrictions will be issued by the Manager Track Maintenance or the Director Track Maintenance, when the rail temperature has or is forecasted to:

  1. Reach a rail temperature of 85^{o} F below the subdivision rail laying temperature for the first cold weather event.
     - Place a blanket cold weather restriction.
     - This rail temperature is identified in Section 7.10.10, Table 7-J for each subdivision in the “First Event Cold Weather Inspection Temperature” column.
     - There could be a significant period of time, where ambient temperatures warm back-up after the first cold weather event, in this case use the 85^{o} F below the rail laying temperature threshold again.
     - The standard length of duration for the cold order restriction will be 12 hours, when the temperature will be re-evaluated and a determination will be made if the order needs to remain in effect.
  2. Reach a rail temperature of 100^{o} F below the subdivision rail laying temperature for a sustained cold weather event.
     - Place a blanket cold weather restriction.
     - The subdivision rail temperatures are found in Section 7.10.10, Table 7-J in the “Cold Weather Inspection Temperature” column.
     - The standard length of duration for the cold weather restriction will be 12 hours, when the temperature will be re-evaluated and a determination will be made if the order needs to remain in effect.
  3. Experience a rapid ambient temperature drop of 40^{o} F or more is within a 24 hour period and the ambient temperature is at or below the “Rapid Temperature Drop of 40^{o} F or More Below Temperature” column for the subdivision a cold weather speed restriction will be placed. See Table 7-J.
     - This cold weather speed restriction will remain in effect until the track inspection for the subdivision has been completed and track is safe for normal speed.
     - The standard length of duration for the cold order will be 12 hours, where then the temperature will be re-evaluated and determination if the order needs to remain in effect.

First Time Ambient Temperature Drops 85ºF Below Rail Laying Temperature	Ambient Temperature Drops to 100ºF Below Rail Laying Temperature	Experience Rapid Ambient Temperature Drop of ≥ 40ºF Within a 24 Hour Period
Place a blanket cold weather speed restriction (SSI 2-E). The standard duration of the restriction is 12 hours, after which time the temperature will be re-evaluated to determine if the restriction needs to remain in effect.	Place a blanket cold weather speed restriction (SSI 2-E). The standard duration of the restriction is 12 hours, after which time the temperature will be re-evaluated to determine if the restriction needs to remain in effect.	Place a blanket cold weather speed restriction (SSI 2-E). Restriction remains in effect for a minimum of 12 hours, until the track inspection for the subdivision is completed and track is safe for normal speed. Also, re-evaluate the temperature to determine if the restriction needs to remain in effect.

7.7.4 Removal of Blanket Heat Restrictions

The removal time for a blanket heat restriction is 9:01 PM. However, if the ambient temperature cools below the temperature threshold before 9:01 PM, the blanket heat restriction can be removed earlier.

7.8 Placing Temporary Speed Restrictions Account Track Work

A temporary speed restriction account track work should be used anytime undercutting, sledding, plowing, surfacing, lining, tie installation, track construction, or track rehabilitation is performed during hot weather. When any other type of work that disturbs the roadbed or ballast section is performed during hot weather, a slow order needs to be used to protect the track structure.

7.8.1 General Requirements

Speed restrictions ensure safe train operations until the affected track stabilizes. Restrictions need to stay in place to allow the ballast to consolidate, rail compressive forces to equalize, and the sub-grade to compact. Take more restrictive measures when work conditions warrant. For example, work on heavy grades or sharp curves may require more restrictive speeds until the track stabilizes.

A high-use format (F-1, F-2, F-X) will be utilized when issuing automatic step-up speed increases as detailed in Section 7.8.9 through Section 7.8.15 and Table 7-H. CAD will now calculate actual train tonnage moving over the designated restriction. The speed will increase automatically and the final speed restriction will remain in effect until an engineering employee inspects the location and removes the restriction. When an F-X restriction is specified, the speed will automatically increase to maximum speed for that location except when issued for Ordinary Maintenance, at or above the required threshold. When an F-X restriction is specified for Ordinary Maintenance at or above the required threshold, the track must be inspected before resuming maximum speed. This speed increase will change based on tonnage regardless of duration or time of day. Step-up speed restrictions must be issued at the end of the work day immediately prior to releasing the track for service. The engineering employee in charge is responsible for determining if the 45 mph restriction is in place in order to arrange for inspection and removal of the restriction.

If it is determined that the track must be inspected before the speed is increased, a conventional single speed slow order must be used and any additional speed increase must be requested individually.

The local maintenance manager, supervisor, or foreman in charge must notify the dispatcher prior to a scheduled step-up speed increase if he knows of or suspects any reason why the track is not good for the next higher speed. Depending on the type of work performed and the ambient temperature, tight rail conditions may require de-stressing to relieve compression in the rail.

The following activities can also reduce the lateral stability of the track and may require a speed restriction:

- Constructing and rehabilitating tracks and bridges.
- Raising bridges.
- Changing bridge headwalls and installing signal appliances.
- Digging cable under the track.
- Performing any other activity that substantially disturbs the ballast section.

7.8.2 Consolidation of Ballast

Restoring the consolidation and lateral resistance of the disturbed track structure is critical in the operation of trains. Trains and/or dynamic track stabilizers are used to restore ballast consolidation.

Surfacing and lining operations reduce track lateral resistance by 40% to 60%. Traffic consolidation of 0.1 MGT is required to increase lateral resistance to 30% to 50% of the reduced value. A Dynamic Track Stabilizer (DTS), that is set up and operated correctly, can also return track to the 30% to 50% of the reduced value.

Table 7-F contains the system averages for trains required to achieve the 0.1 MGT by train category. This includes the loaded and empty cycles.

Train Categories	Ave. No. of Cars	Ave. Tonnage/Train	# Trains Required
Coal	128.2	10,553	9.5
Grain	94.2	7,862	12.7
Ore	85	6,824	14.7
Manifest	88.7	6,916	14.5
Premium Intermodal	70.7	4,526	22.1
Standard Intermodal	95.8	5,428	18.4
Automotive	61.8	4,147	24.1
Rock	73.4	6,127	16.3
System Average	92.7	7,134	14.0

Table 7-F

The system average for a train is 7,134 tons per train and will require 14 trains to achieve the 0.1 MGT. The system average train is what is being used for the number of trains to return the track consolidation to 30% to 50% of the reduced value. For purposes of consolidation the system average train will be used.

7.8.3 Responsibility for Placing Speed Restrictions

The supervisor or foreman in charge of the work is responsible for placing the appropriate speed restriction when required.

During the work or before returning the track to service, the supervisor or foreman in charge must ensure the following:

- Adequate surface and alignment have been established.
- Sufficient crib and shoulder ballast are in place.
- The rail is properly anchored.

7.8.4 Multiple Maintenance Operations on Same Track

If performing more than one type of work on the same segment of track, place the most restrictive speed on the track. For example, if the same segment of track is being protected for rail relays (30 MPH maximum speed) and surfacing (15 MPH maximum speed); restrict the speed to 15 MPH on the track.

7.8.5 Special Air Brake and Train Handling Requirements

To prevent track buckling and train derailments, the supervisor or foreman in charge will impose special train-handling procedures (Rule 34.2.13 – Disturbed Track/Temporary Speed Restrictions/Heat Restrictions) as outlined in Sections 7.8.9 through 7.8.15. The supervisor or foreman in charge may impose Rule 34.2.13 when deemed necessary, even if not required by theses instructions.

To request that UPRR Rule 34.2.13 be added to the temporary speed restriction, the supervisor in charge or Track Foreman will notify the Train Dispatcher and state "Rule 34.2.13 applies from M.P. ______ to M.P. ______."

Note: When conditions no longer warrant, remove UPRR Rule 34.2.13 from the restriction.

7.8.6 Speed Restriction Length for Disturbed Track

To minimize running rail and other dynamic forces, trains must have time to brake and adjust slack before entering the disturbed track. To ensure trains reach the desired speed before entering the affected track, place speed restrictions at least 1/4 mile in each direction from the outside limits of the affected track.

For heavy grades, sharp curves, or substandard track conditions, extend speed restrictions farther from the work limits if needed.

7.8.7 Rail Temperature Thresholds

The implementation of speed restrictions behind track work is based on the rail laying temperature for a territory plus 10^o F. To determine the requirements for speed restrictions behind track work, compare the high rail temperature or forecasted high rail temperature for the day and the subdivision rail temperature from the column in Table 7-J titled "Rail Temperature for Speed Restrictions Behind Track Work." Then place the required speed restrictions. Table 7-G is a sample highlighting the correct column.

Note: When estimating rail temperature based on ambient temperature, either for speed restrictions behind track work or blanket speed restrictions, a rule-of-thumb that can be used is that rail temperature is generally 30 degrees Fahrenheit above ambient temperature.

Subdivision	Station		Rail Laying Temperature Rail Temp. Deg. (F)	Rail Temperature for Speed Restriction behind Track Work Rail Temp. Deg. (F)	Blanket Heat Speed Restriction (Level 1) Amb. Temp. Deg. (F)	Blanket Heat Speed Restriction (Level 2) Amb. Temp. Deg. (F)	First Event Cold Weather Inspection Temperature Rail Temp. Deg. (F)	Cold Weather Inspection Temperature Rail Temp. Deg. (F)	Rapid Temperature Drop of 40 F or More Below Temperature Amb. Temp. Deg. (F)
Adams	Adams	BJ South	95	105	85	95	10	-5	55
Alameda Corridor	East Redndo	W. Thenard	115	125	105	115	30	15	75
Albert Lea	S St Paul	Mason City	95	105	85	95	10	-5	55
Alexandria	Willow Glenn	Livonia	115	125	100	110	30	15	75
Alhambra	W Colton	Yuma Jct.	115	125	105	115	30	15	75
Altoona	W. Minster	Altoona	95	105	85	95	10	-5	55
Angleton	Algoa	Bloomington	115	125	100	110	30	15	75

Table 7-G

7.8.8 Speed Restrictions for Track Panel Installations

The maximum authorized speed over track with more than 5 consecutive track panels with square joints is 40 MPH on wood ties and 25 MPH on concrete ties until the joints are staggered or removed.

7.8.9 Newly Constructed Track/Switches

Follow these requirements to protect newly constructed track, new track panels, new panel turnouts or switches that have been installed.

A. Rail Temperature is Below or Forecasted Below the "Rail Temperature Required for Speed Restriction Behind Track Work" for the Subdivision

To protect newly constructed track when rail temperatures are below or forecasted below the "Rail Temperature Required for Speed Restriction Behind Track Work" for the subdivision, issue an F-1 speed restriction. An F-1 speed restriction requires trains to:

1. Restrict the maximum speed to 15 MPH for CWR (10 MPH jointed rail) and for 40,000 tons.
2. Increase the maximum speed to 30 MPH for 60,000 tons.
3. Increase the maximum speed to 45 MPH.
4. If the track is safe for higher speeds, release the track for maximum authorized speed.

B. Rail Temperature is At or Above the Forecasted "Rail Temperature Required for Speed Restriction Behind Track Work" for the Subdivision

To protect newly constructed track when rail temperatures are above or forecasted above the "Rail Temperature Required for Speed Restriction Behind Track Work" for the subdivision issue an F-2 speed restriction. An F-2 speed restriction requires trains to:

1. Restrict the maximum speed to 15 MPH for CWR (10 MPH jointed rail) for 50,000 tons.
2. Increase the maximum speed to 30 MPH for 50,000 tons.
3. Increase the maximum speed to 45 MPH.
4. If the track is safe for higher speeds, release the track for maximum authorized speed.

7.8.10 Undercut, Sledded or Plowed Track

Follow these requirements for protecting undercut, sledded, plowed or crane raised track.

When the rail temperature is at or above or forecasted to be above the "Rail Temperature Required for Speed Restriction Behind Track Work " and tight rail conditions, such as lateral rail movement (Section 7.5.1), vertical rail movement (Section 7.5.2), and longitudinal rail movement (Section 7.5.3), are present, the rail must be de-stressed.

A. Rail Temperature is Below or Forecasted Below the "Rail Temperature Required for Speed Restriction Behind Track Work" for the Subdivision

To protect undercut, sledded, plowed, or crane raised track when rail temperatures are below or forecasted below the "Rail Temperature Required for Speed Restriction Behind Track Work" for the subdivision, issue an F-1 speed restriction. An F-1 speed restriction requires trains to:

1. Restrict the maximum speed to 15 MPH for CWR (10 MPH jointed rail) for 40,000 tons.
2. Increase the maximum speed to 30 MPH for 60,000 tons.
3. Increase the maximum speed to 45 MPH.
4. If the track is safe for higher speeds, release the track for maximum authorized speed.

B. Rail Temperature is At, Above or Forecasted Above the "Rail Temperature Required for Speed Restriction Behind Track Work" for the Subdivision

To protect undercut, sledded, plowed, or crane raised track, new panel turnouts, and new track panels installed in grade crossings when rail temperatures at, above or forecasted above the "Rail Temperature Required for Speed Restriction Behind Track Work" for the subdivision issue an F-2 speed restriction. An F-2 speed restriction requires trains to:

1. Restrict the maximum speed to 15 MPH for CWR (10 MPH jointed rail) for 50,000 tons.
2. Increase the maximum speed to 30 MPH for 50,000 tons.
3. Increase the maximum speed to 45 MPH.
4. If the track is safe for higher speeds, release the track for maximum authorized speed.

7.8.11 Tie and Surfacing Operations with Tie Installation

When rail temperatures are at or forecasted above the “Rail Temperature Required for Speed Restriction Behind Track Work” for that subdivision, do not replace more than 50 percent of the cross or switch ties in any rail length or more than two consecutive cross or switch ties. Single pass production tie operations are allowed at rail temperatures at or below the “Rail Temperature Required for Speed Restriction Behind Track Work” for that subdivision. (Reference Table 7-J).

When making additional passes to install ties ensure the following:

- All ties installed in the first pass have been fully spiked and anchored.
- Sufficient ballast is placed to maintain proper surface and alignment.

These tie replacement requirements do not apply when installing ties at the following locations:

- Road crossings.
- Open deck bridges.
- Station platforms.
- Confined track areas.
- Sledding, plowing, or undercutting operation.

When the rail temperature is at, above or forecasted to be above the “Rail Temperature Required for Speed Restriction Behind Track Work” and tight rail conditions, such as lateral rail movement (Section 7.5.1), vertical rail movement (Section 7.5.2), and longitudinal rail movement (Section 7.5.3), are present, the rail must be de-stressed.

Follow these requirements for protecting tie and surfacing operations.

A. Rail Temperature is Below or Forecasted Below the “Rail Temperature Required for Speed Restriction Behind Track Work” for the Subdivision

To protect tie and surfacing operations when rail temperatures are below or forecasted below the “Rail Temperature Required for Speed Restriction Behind Track Work” for the subdivision, issue an F-1 speed restriction. An F-1 speed restriction requires trains to:

1. Restrict the maximum speed to 15 MPH for CWR (10 MPH jointed rail) for 40,000 tons.
2. Increase the maximum speed to 30 MPH for 60,000 tons.
3. Increase the maximum speed to 45 MPH.
4. If the track is safe for higher speeds, release the track for maximum authorized speed.

B. Rail Temperature is At or Above the Forecasted “Rail Temperature Required for Speed Restriction Behind Track Work” for the Subdivision

To protect tie and surfacing operations when rail temperatures are at or above the forecasted “Rail Temperature Required for Speed Restriction Behind Track Work” for the subdivision issue an F-2 speed restriction. An F-2 speed restriction requires trains to:

1. Restrict the maximum speed to 15 MPH for CWR (10 MPH jointed rail) for 50,000 tons.
2. Increase the maximum speed to 30 MPH for 50,000 tons.
3. Increase the maximum speed to 45 MPH.
4. Release the track for maximum authorized speed if it is safe to do so.

C. Hot Weather Instructions for System Tie Gangs

1. When the rail temperature is at or above the forecasted “Rail Temperature Required for Speed Restriction Behind Track Work” for the Subdivision:
   a. Do not replace more than 50% of the cross ties in any rail length at one time.
   b. Do not replace more than two consecutive cross or switch ties at one time.
   c. Tamp all new ties, and any other ties that are hanging, or have been obviously disturbed from the ballast section (hanging/disturbed ties must be identified for tamper operator with paint mark on center of tie).
   d. All cribs must be completely filled, shoulders restored, and all newly installed ties must have all anchors applied and spikes driven prior to resuming train operations.

D. General Instructions for System Tie Gangs

a. Scarifiers must be equipped with digger head extensions to ensure ties are installed without the need to raise the rail significantly for tie plate installation. Scarify the tie bed to a depth that will allow approximately 1” clearance between top of newly installed tie and bottom of rail base. Digger head teeth must be adjusted/replaced in order to allow machine to dig tie holes to proper depth.

b. Regardless of rail temperature, extracting TRIP operator must take special care not to raise the rail more than necessary to extract ties. TRIP operators must not use rail clamps except when necessary to remove plate-cut ties. Foremen and Asst. Foremen must continually monitor extracting TRIPs to ensure that rail raises are kept to an absolute minimum.

c. Rail lifter operators must take care to only make the minimum lift necessary to install tie plates on each individual new tie. This may require continual adjustment of the machine. Foremen and Asst. Foremen must continually monitor rail lifters to ensure that rail raises are kept to an absolute minimum.

d. Regardless of rail temperature, all new ties, and any other ties that are hanging, or have been obviously disturbed from the ballast section, must be tamped.

e. Any misalignments caused by tie gang, that are 4” or less, must be de-stressed unless tamper is able to line track back in one pass without resistance. Any misalignments caused by tie gang that are greater than 4” must be de-stressed.

f. Regardless of rail temperature, Tie Gang MTP or Track Supervisor must coordinate with local MTM for de-stressing of any known areas where tight rail conditions, such as lateral movement, vertical rail movement, and longitudinal rail movement exist. These locations must be de-stressed by Service Unit or Regional welders prior to installation of ties.

g. Do not replace more than 50% of the cross or switch ties in any rail length at one time when the rail temperatures are at or forecasted above the “Rail Temperature Required for Speed Restriction Behind Track Work” for the Subdivision. Do not replace more than two consecutive cross or switch ties at one time. When making additional passes to install ties, ensure the following:

- All ties installed in the first pass have been fully spiked and anchored.
- Sufficient ballast is placed to maintain proper surface and alignment.

h. Regardless of rail temperature, ensure that sufficient shoulder and crib ballast is placed to maintain proper surface and alignment. In addition, ensure that sufficient spikes and anchors are installed to allow for safe train operations.

E. Pull Safe Requirements for Tie Gangs

A. Ramp-up for the following production day can be considerably shortened by working spike pullers past the designated stopping point for the day. The Tie Gang Supervisor and Foreman must conduct a Job Briefing regarding the provisions of these requirements, to ensure that the track structure is not weakened enough to impair safe train operations.

a. On tangent track, spikes may only be pulled from “single” (non-consecutive) ties. On curves, spikes may only be pulled from “single” ties that are followed by a sufficient number of line-spiked ties according to the following table. Do not pull spikes from ties with curve block plates.

Required Number of Line-Spiked Ties Between “Pull-Safe” Ties on Curves:

0˚ to 1˚ 59’	2˚ to 3˚ 59’	4˚ and greater
2 Ties	3 Ties	Do not “Pull Safe”

b. Do not pull spikes from ties at rail joint locations.

c. Ensure that “pull safe” track is protected by the appropriate speed restriction to allow for safe train operations.

d. Do not leave “pull safe” track during the Tie Gang off-cycle days.

e. The Tie Gang Supervisor or Foreman must perform a walking inspection of “pull safe” track, to ensure that the above guidelines have been complied with before releasing the track for train operations.

7.8.12 Track Consolidation with Track Stabilizers

Follow these requirements to protect track that has been stabilized with a Ballast Track Stabilizer regardless of temperature. Issue an F-X speed restriction. An F-X speed restriction requires trains to:

1. Restrict the maximum speed to 30 MPH for 10,000 tons.
2. Release the track for maximum authorized speed if it is safe to do so.

7.8.13 Rail Relays

Follow these requirements for protecting rail relays regardless of temperature. Issue an F-X speed restriction. An F-X speed restriction requires trains to:

1. Restrict the maximum speed to 30 MPH for 10,000 tons.
2. Release the track for maximum authorized speed if it is safe to do so.

Note: If surfacing in conjunction with these relays, restrict train speeds as outlined for surfacing gangs. See Section 7.8.14 Maintenance Surfacing.

7.8.14 Maintenance Surfacing

Maintenance surfacing includes out-of-face surfacing that is equal to or greater than 19 feet 6 inches and does not involve any tie installation.

General Requirements

When performing maintenance surfacing ensure there is sufficient ballast to fill all ballast cribs and establishing the required shoulder. When surfacing across ballast deck bridges, do not shift the track from the center of the deck. Shifting track too far to one side of a ballast deck bridge can create excessive loading to one stringer resulting in premature fatigue to the structure. If needed get a survey to pin the centerline.

Follow these requirements to protect maintenance surfacing..

A. Rail Temperature is Below or Forecasted Below the "Rail Temperature Required for Speed Restriction Behind Track Work" for the Subdivision

When maintenance surfacing is performed and the rail temperatures are below or forecasted below the "rail temperature required for speed restriction behind track work" for the subdivision, issue an F-X speed restriction. An F-X speed restriction requires train to:

1. Restrict the maximum speed to 30 MPH for 40,000 tons.
2. Release the track for maximum authorized speed if it is safe to do so.

B. Rail Temperature is At or Above the Forecasted "Rail Temperature Required for Speed Restriction Behind Track Work" for the Subdivision

To maintenance surfacing is performed and when rail temperatures are at or above the forecasted "Rail Temperature Required for Speed Restriction Behind Track Work" for the subdivision issue an F-2 speed restriction. An F-2 speed restriction requires trains to:

1. Restrict the maximum speed to 15 MPH for CWR (10 MPH jointed rail) for 50,000 tons.
2. Increase the maximum speed to 30 MPH for 50,000 tons.
3. Increase the maximum speed to 45 MPH.
4. Release the track for maximum authorized speed if it is safe to do so.

7.8.15 Ordinary Maintenance

Follow these requirements to protect routine cross and switch tie installations, spot surfacing, and lining operations performed by section gangs or other maintenance forces.

> **Note: Spot surfacing is considered ordinary maintenance when the length of track disturbed is less than 19 feet 6 inches. Surfacing without tie installation equal to or greater than 19 feet 6 inches is considered maintenance surfacing in Section 7.8.14**

General Requirements

When performing maintenance, speed restrictions may be required for these conditions, regardless of the temperature or grade of the track:

- Tight rail.
- Insufficient ballast.
- Unstable sub-grade.
- Sharp curvature.
- Other special conditions.

When the rail temperature is at or above or forecasted to be above the "Rail Temperature Required for Speed Restriction Behind Track Work " and tight rail conditions, such as lateral rail movement (Section 7.5.1), vertical rail movement (Section 7.5.2), and longitudinal rail movement (Section 7.5.3), are present, the rail must be de-stressed.

A. Rail Temperature is Below or Forecasted Below the "Rail Temperature Required for Speed Restriction Behind Track Work" for the Subdivision

When ordinary maintenance consists of installing cross and switch ties and the rail temperatures are below or forecasted below the "rail temperature required for speed restriction behind track work" for the subdivision, issue an F-X speed restriction. An F-X speed restriction requires train to:

1. Restrict the maximum speed to 30 MPH for 10,000 tons.
2. Release the track for maximum authorized speed if it is safe to do so.

To protect all other ordinary maintenance rail temperatures are below or forecasted below the "Rail Temperature Required for Speed Restriction Behind Track Work" for the subdivision.

> **Do not replace more than three consecutive cross or switch ties at one time.**

B. Rail Temperature is At or Above the Forecasted "Rail Temperature Required for Speed Restriction Behind Track Work" for the Subdivision

To protect all ordinary maintenance when rail temperatures are at or above the forecasted "Rail Temperature Required for Speed Restriction Behind Track Work" for the subdivision, issue an F-X speed restriction An F-X speed restriction requires trains to:

1. Restrict the maximum speed to 30 MPH for 50,000 tons.

2. Increase the maximum speed to 45 MPH.
3. Release the track for maximum authorized speed if it is safe to do so.

Do not replace more than two consecutive cross or switch ties at one time.

7.8.16 Summary of Speed Restrictions for Track Work

A. Table 7-H is used for placing speed restrictions when track work has been performed that disturbs the lateral stability of the track structure. This table summarizes the speed restrictions for different track conditions.

B. Table 7-H can also be used to issue a Step Up Speed Restriction.

1. When issuing step up speed restrictions employee will determine the type of work to be performed and whether the actual or forecasted rail temperature is below or at/above that temperature. The employee will request the slow order by designating the type of work performed and the specific format to be issued.

Example: "Dispatcher, this is Track Foreman Smith performing tie and surfacing operations, please issue an F-2 step up speed restriction."

2. The **F-X** format will require the tonnage and speed to be stated to the dispatcher and whether the track needs to be inspected before returning to maximum speed.

Example: "Dispatcher, this is Track Foreman Smith performing tie and surfacing operations, please issue an F-X step up speed restriction, 40,000 tons at 30 mph, no inspection is necessary." OR
Example: "Dispatcher, this is Track Foreman Smith performing ordinary maintenance, please issue an F-X step up speed restriction, 50,000 tons at 30 mph, an inspection is necessary before returning to maximum speed."

3. Computer Aided Dispatching (CAD) will now calculate actual train tonnage over the designated restriction. For example, the increase in speed, from 15 mph to 30 mph and from 30 mph to 45 mph will increase automatically. The 45 mph speed restriction will remain in effect until an engineering employee inspects the location and removes the restriction. This speed increase will change based on tonnage regardless of duration or time of day.
4. Step up speed restrictions must be issued at the end of the work day immediately prior to releasing the track for service.
5. The engineering employee in charge is responsible for determining if the 45 mph restriction is in place in order to arrange for inspection and removal of the restriction.

If it is determined that the track must be inspected before the speed is increased, a conventional single speed slow order must be used and any additional speed increase must be requested individually.

Summary of Speed Restrictions for Track Work				
Type of work being performed is…	**Determine the actual or forecasted rail temp. then refer to Table 7-J to find subdivisions rail temp. threshold for applying speed restrictions behind track work.** **If the actual/forecasted rail temp. compared to the subdivision Table 7-J is . . .**	**Place a 15 MPH speed restriction for CWR (10 MPH for jointed rail) for . . .**	**Then place a 30 MPH speed Restriction for . . .**	**Then place a 45 MPH speed restriction for . . .**
Newly Constructed Track/Switches	Below **(F-1)**	40,000 tons	60,000 tons	Until inspected and removed
	At or above **(F-2)**	50,000 tons	50,000 tons	Until inspected and removed
Undercut, Sledded or Plowed Track	Below **(F-1)**	40,000 tons	60,000 tons	Until inspected and removed
	At or above **(F-2)**	50,000 tons	50,000 tons	Until inspected and removed
Tie or Surfacing Operations with Tie Installation	Below **(F-1)**	40,000 tons	60,000 tons	Until inspected and removed
	At or above **(F-2)**	50,000 tons	50,000 tons	Until inspected and removed
Track Consolidation with Track Stabilizers	Below **(F-X)**	Not applicable	*10,000 tons Employee must state designated tonnage	Not applicable
	At or above **(F-X)**	Not applicable	*10,000 tons Employee must state designated tonnage	Not applicable
Rail Relays	All Temperatures **(F-X)**	Not applicable	*10,000 tons Employee must state designated tonnage	Not applicable
Maintenance Surfacing	Below **(F-X)**	Not applicable	*40,000 tons Employee must state designated tonnage	Not applicable
	At or above **(F-2)**	50,000 tons	50,000 tons	Until inspected and removed
Ordinary Maintenance	Below **(F-X)**	Not applicable	*10,000 tons Employee must state designated tonnage	Not applicable
	At or above **(F-X)**	Not applicable	50,000 tons Employee must state designated tonnage	Until inspected and removed

Table 7-H

Note: These are minimum requirements. More restrictive measures must be taken when conditions warrant additional protection.
***Engineering employee may request a conventional 30 mph speed restriction when they wish to inspect the track before returning to maximum speed or they may authorize the designated speed directly to the train when their Form B track bulletin is still in effect.**

7.8.17 Slow Order Codes

These codes will be used when placing slow orders on a segment of track. These codes are intended to provide a clear definition of the nature of a slow order. See Table 7-H-1.

Description	Code	Description	Code
Bridge Approach	B10	Switch Point Defect	T24
Bridge Repair/Condition	B11	Rail Test Car Defect	T25
Bridge Construction	B12	Geometry Car Defect	T26
Culvert Condition	B20	Gage Defect	T27
Culvert Repair	B21	Rail Crossing Defect	T28
Tunnel Repair/Construction	B30	Insufficient Ballast	T29
Viaduct Repair/Construction	B40	Derailment Site	T30
Signal Gang Work	S10	High Water	T31
Signal System Installation	S11	Sub grade Condition	T32
Signal Crossing Repair	S12	Washout	T33
Signal Out of Service	S13	Maintenance Surfacing	T34
Signal Turnout Repair	S14	Maintenance Tie Installation	T35
Slide Fence Not Working	S15	Bridge Approach	T36
Signal Defect/Insulated Joint	S16	Small Culvert Fail	T37
Behind System Rail Gang	T10	Tie Condition (Concrete)	T38
Behind System Tie Gang	T11	Insulated Joints (Level 1 & 2)	T39
Behind Production Surf Gang	T12	Heat Order (Level 1)	T40
Behind Sled/Undercut	T13	Heat Order (Level 2)	T41
Behind Welding Gang	T14	Cold Order	T42
Track Construction	T15	Blanket Order Ahead DC	T43
Switch Installation	T16	Blanket Order Ahead EC	T44
Road Crossing Repair	T17	Tie pads (Concrete)	T45
Rail Crossing Repair	T18	Tie Condition (Composite)	T46
Crossing Protection	T19	BUC Undercutter	T47
Rail Condition	T20	Passing Outfit Cars	T50
Surface & Line Condition	T21	Work Adjacent Track	T51
Tie Condition Wood	T22	Speed Incrse / Incremt	T60
Switch/Frog Defect	T23	CWR Rail Neutral Temperature (RNT) Adjust	T61

Table 7-H-1

When applying the reason codes above, use the cause code that resulted in placing the slow order on the track.

Example: Codes T43 and T44 may be used ahead of DC and EC inspections, respectively, in order to reduce train dispatcher workload associated with unforeseen speed restrictions. These blanket orders are to be removed within 24 hours of the inspection. At that time, any remaining speed restrictions that are required to be left on should be changed to the appropriate T25 or T26 code. If a speed restriction with a T26 code is still in effect after 7 days, it should be changed to the appropriate code to reflect the underlying condition which caused the geometry defect, i.e., surface and line condition, tie condition, gage defect, etc.

7.9 Track Buckling Preventive Maintenance

Track Buckling Prevention is an on-going process. Performing track buckling preventive maintenance throughout the year can reduce the risk of track buckles. Controlling and maintaining neutral temperature is critical to the track buckling prevention effort. It is important to understand what causes track buckles, control the rail's neutral temperature, inspect the track structure, place speed restrictions, and utilize standard maintenance practices for maintaining neutral temperature.

Controlling the neutral temperature is the most critical component of the track buckling effort. The following processes are used to accomplish this.

- Utilize reference marks when adjusting rail.
- Utilize heat control when installing rail.
- Rail expansion is achieved through use of adjustment tables, match marks and regulating heat.
- Utilize rail expanders and super jacks for stretching rail.
- Repair CWR Adjust* and Cut-in/Cut-out maintenance items.
- Manage curves by staking, monitoring and adjusting as necessary.

Note: CWR-Adjust is a method for adjusting neutral temperature in line with Sections 7.9.7 Cold Weather Rail Neutral Temperature Readjustment and 7.9.8 De-Stressing Rail.

To obtain a track buckling free environment, continued improvement in these maintenance practices is required:

- Comply with existing requirements.
- Improve quality control in the rail installation process.
- Improve quality control in the rail adjustment process.
- Develop more effective rail defect repair practices: cold temperature readjustment and hot weather de-stressing.
- Prevent rail creep by ensuring adequate and effective anchors/fasteners.
- Evaluate curves for movement or shift and make repairs.

Once a condition is found that could lead to a track buckle, the necessary maintenance has to be performed. Place the adequate slow order on the track until repairs or maintenance is completed.

7.9.1 Managing CWR Events

Since controlling and maintaining neutral temperature is critical to the track buckling prevention effort, managing CWR events are necessary. It is considered a CWR event anytime continuous welded rail is cut. Table 7-I has been developed to consolidate the requirements for managing CWR events.

CWR Events	Management Process	Type Reference Marks	Quality
Service failures Pull aparts DC defects Track panels ≤ 80’ Rail change out ≤ 80’	CWR Adjust	Spanning	CWR Adjust ICUT Process Reference Marks VERSE Testing Weld Audits Weld Tags
Rail change out > 80’ ≤ 360’ Track panels > 80’ ≤ 360’	Cut-in/Cut-out	Pull back	ICUT Process Reference Marks VERSE Testing Weld Audits Weld Tags
Rail change out > 360’	CWR Adjustment Table 4-H	Match Marks	Audit Match Marks
Curve shift	Curve Monitoring	Curve staking	In process

Table 7-I

- Service failures, pull-aparts, detector car defects, track panels less than or equal to 80’, rail change out less than or equal to 80’ fall within the first group of CWR Events. CWR Adjust is used for this first group of CWR Events to manage the rail neutral temperature. The reference marks that are used for this first group of CWR Events are spanning reference marks. The quality processes that are used for the first group of CWR Events to check and verify compliance are CWR Adjust, ICUT Process, Reference Marks, VERSE Testing, Weld Audits and Weld Tags. CWR Adjust can be accessed on the UPRR Mobile Web. On a mobile device, enter www.up.com>Employee Mobile>MyUP>log in>CWR Adjust Calc.
- Rail replacement and track panel installation greater than 80’ and less than or equal to 360’fall within the second group of CWR Events. The Cut-in/Cut-out process is used for this second group of CWR Events to manage the rail neutral temperature. This process essentially maintains the rail neutral temperature that was present at the time of the break or cut by not adding additional rail. The reference marks that are used for the second group of CWR Events are pull back reference marks. The quality processes that are used for the second group of CWR Events to check and verify compliance are ICUT Process, Reference Marks, VERSE Testing, Weld Audits and Weld Tags.
- Rail change out greater than 360’ fall within the third group of CWR Events. The CWR Adjustment Table 4-H is used to manage the rail neutral temperature and get it to the designated rail laying temperature. The reference marks that are used for the third group of CWR Events are match marks. The quality processes that are used for the third group of CWR Events is to audit the Match Marks.
- Curve shift falls within its own group of CWR Events. Curve monitoring is used to manage the rail neutral temperature. Curve staking is used as reference marks to manage curve shift CWR Event.

7.9.2 Placing Reference Marks

Placing rail reference marks is a method of controlling the amount of rail added or subtracted in CWR territory. Reference marks must be utilized prior to cutting CWR for any reason.

In the case of a rail separation, pull-apart, defect repair, other rail change out and track panel installation, reference marks should always indicate the original distance between the marks before the rail break or pull-apart occurred.

The types of reference marks that are used to manage the CWR events are:

- ***Spanning reference marks*** are used for service failures, pull-aparts, detector car defects, track panels **less than or equal to** 80’, rail change out **less than or equal to** 80’. Refer to Section 7.9.3 Placing Spanning Reference Marks.
- ***Pull back reference marks*** are used for rail change out greater than 80’ or **less than or equal to** 360’and track panels greater than 80’ or **less than or equal to** 360’. Refer to Section 7.9.4 Placing Pull Back Reference Marks.
- ***Match marks*** are used when rail change out is greater than 360’. Refer to Section 4.5.1.A Monitor Rail Movement.
- ***Curve staking*** is used as reference marks to manage curve shift CWR Events. Refer to Section 7.9.9 Managing Cut-in/Cut-out CWR and 7.9.10 Monitoring Curve Movement.

7.9.3 Placing Spanning Reference Marks

Spanning reference marks are used for service failures, pull-aparts, detector car defects, track panels less than or equal to 80’, rail change out less than or equal to 80’. Spanning reference marks are used with the CWR Adjust management process and must be utilized prior to cutting CWR for any reason.

Record Spanning Reference Mark Information

In an effort to capture and record certain required information pertaining to work performed, it is important that all information be properly placed on the outside web of rail with a paint stick (Item Number 410-4358).

- Write **gang *number, date of repair, actual rail between reference mark without the gap, rail temperature, initial rail gap width and amount of rail added*** on the outside web of the rail with a paint stick (Item Number 410-4358).

- After the final adjustment has been made, write the following completion information**:** ***CMPL, gang number, date of final adjustment and rail removed if any. Record “(0)” if no rail removed.***

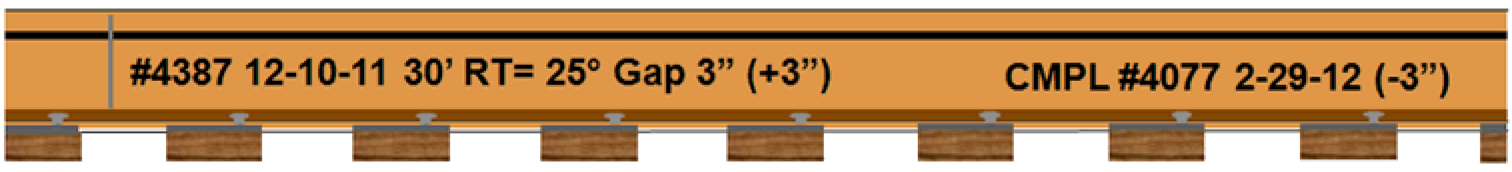


Figure 7-E-1

<u>**Example: Spanning Reference Marks - Replacing Rail Due to Surface Defect**</u>

Here is an example of using spanning reference marks for a rail surface defect rail replacement where temporary joint bars have been applied. Since this is less than 80 feet, this is a CWR Adjust event.

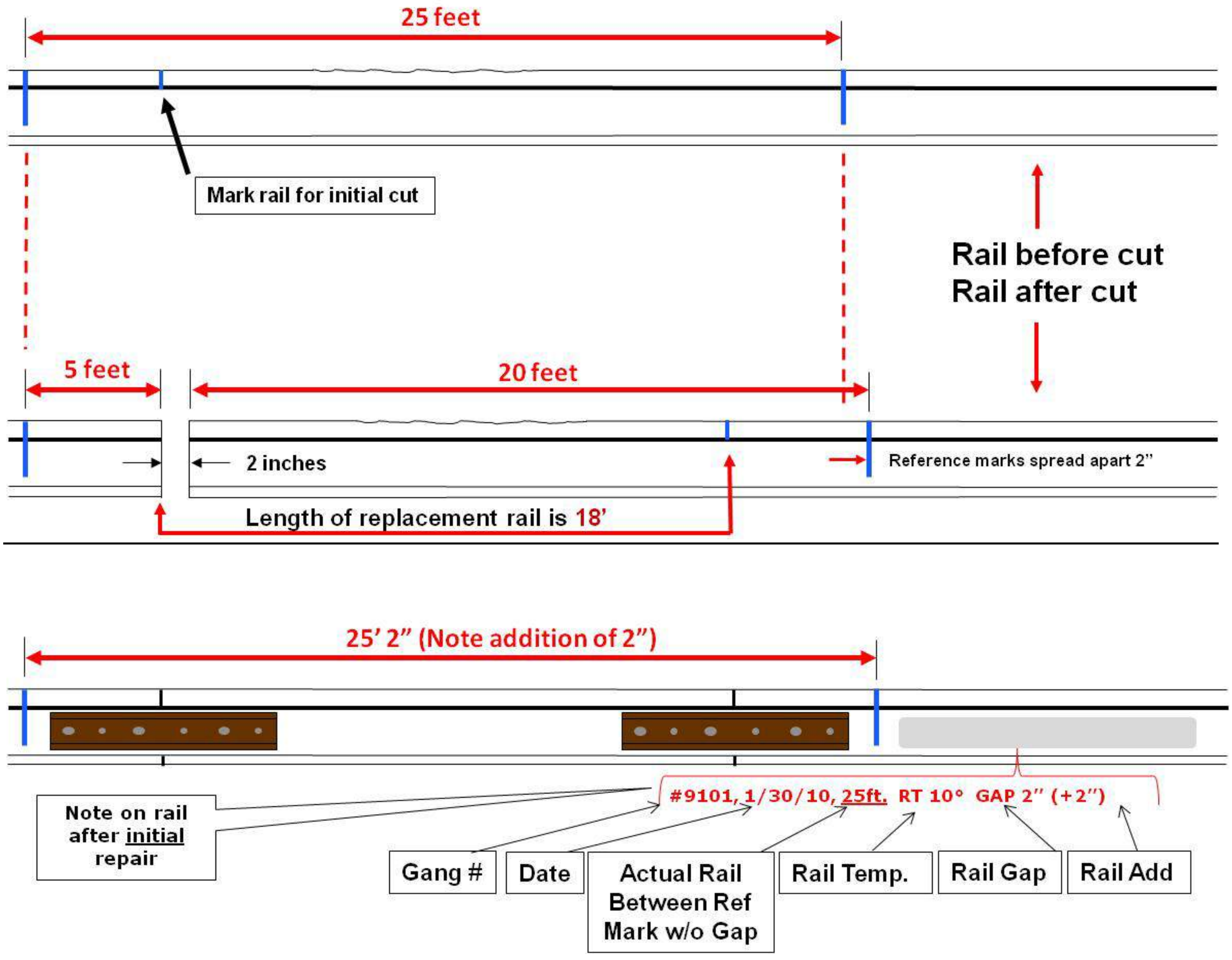


Figure 7-E-2

Example: Spanning Reference Marks – Service Failure

Here is an example of using spanning reference marks for a rail service failure with temporary joint bars. Since this is less than 80 feet, this is a CWR Adjust event.

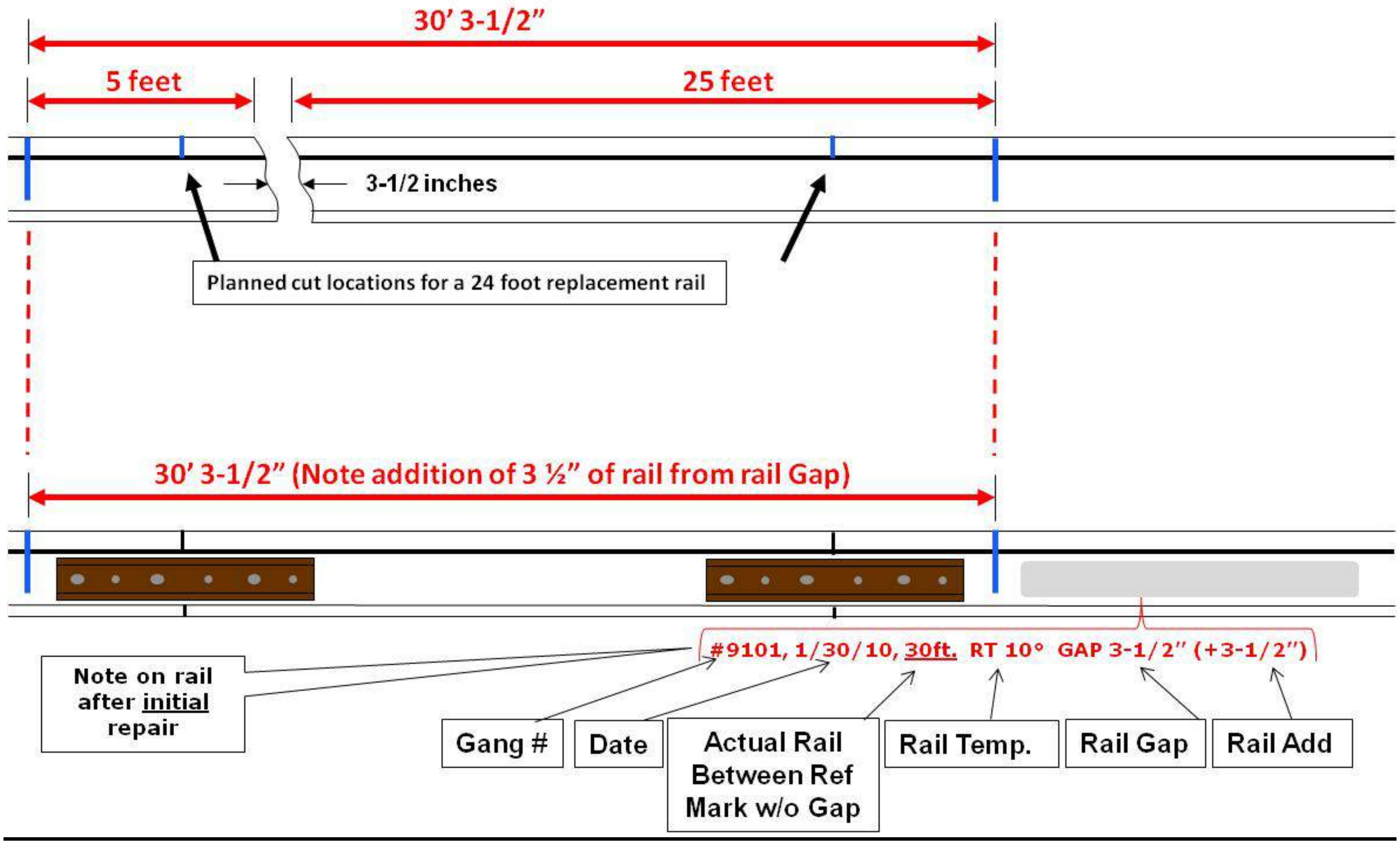


Figure 7-E-3

7.9.4 Placing Pull Back Reference Marks

Pull back reference marks are used for rail changed out that is greater than 80' or less than or equal to 360'and track panels that are greater than 80' or less than or equal to 360' Pull back reference marks are used with the Cut-in/Cut-out process and provides a method of controlling the amount of rail added or subtracted in CWR track. As rail is adjusted in CWR track, pull back reference marks serve as a benchmark to go back and measure against. The intent when performing a cut-in/cut-out is to return the track to the prior neutral temperature. Pull back reference marks must be utilized prior to cutting the CWR.

Use the following guidelines when making pull back reference marks:

1. Place reference marks outside of cuts on outside web of the rail.
   a. Use a permanent white metal marker or paint stick (Item Number 410-4358) to mark rail and tie plate.
2. Place "pull back reference marks" on each end of work area prior to cutting rail or removing joint bars. Mark pull back reference marks on the outside rail base and continue onto the tie plate.
3. De-anchor or de-clip the tie on both rails that the pull back marks are made on.

Record Pull Back Reference Mark Information

In an effort to capture and record certain required information pertaining to work performed, it is important that all information be properly placed on the outside web of rail with a paint stick (Item Number 410-4358).

- After the final adjustment has been made, write the following completion information**:** ***CMPL, gang number, date of final adjustment and rail removed if any. Record "(0)" if no rail removed***

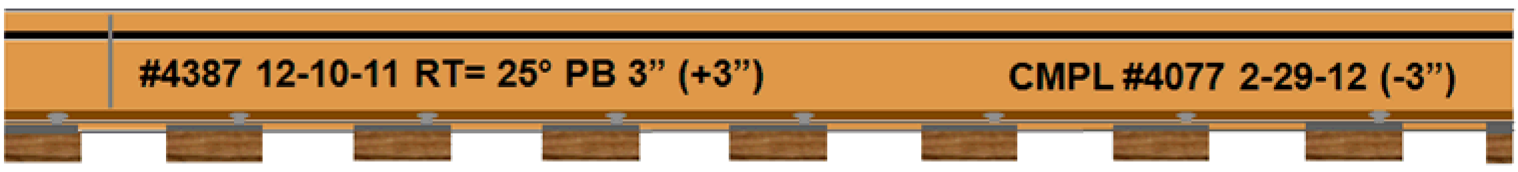


Figure 7-F-1

Example: Pull Back Reference Marks – Rail > 80' and less than 360'

Here is an example of using pull back reference marks for replacing a rail that is greater than 80 foot and less than or equal to 360 foot.

In this example there are 4 inches of pull back on one end and 2 inches of pull back on the opposite end. To get the track back together there was rail added, so there is rail added that will need to be taken out.

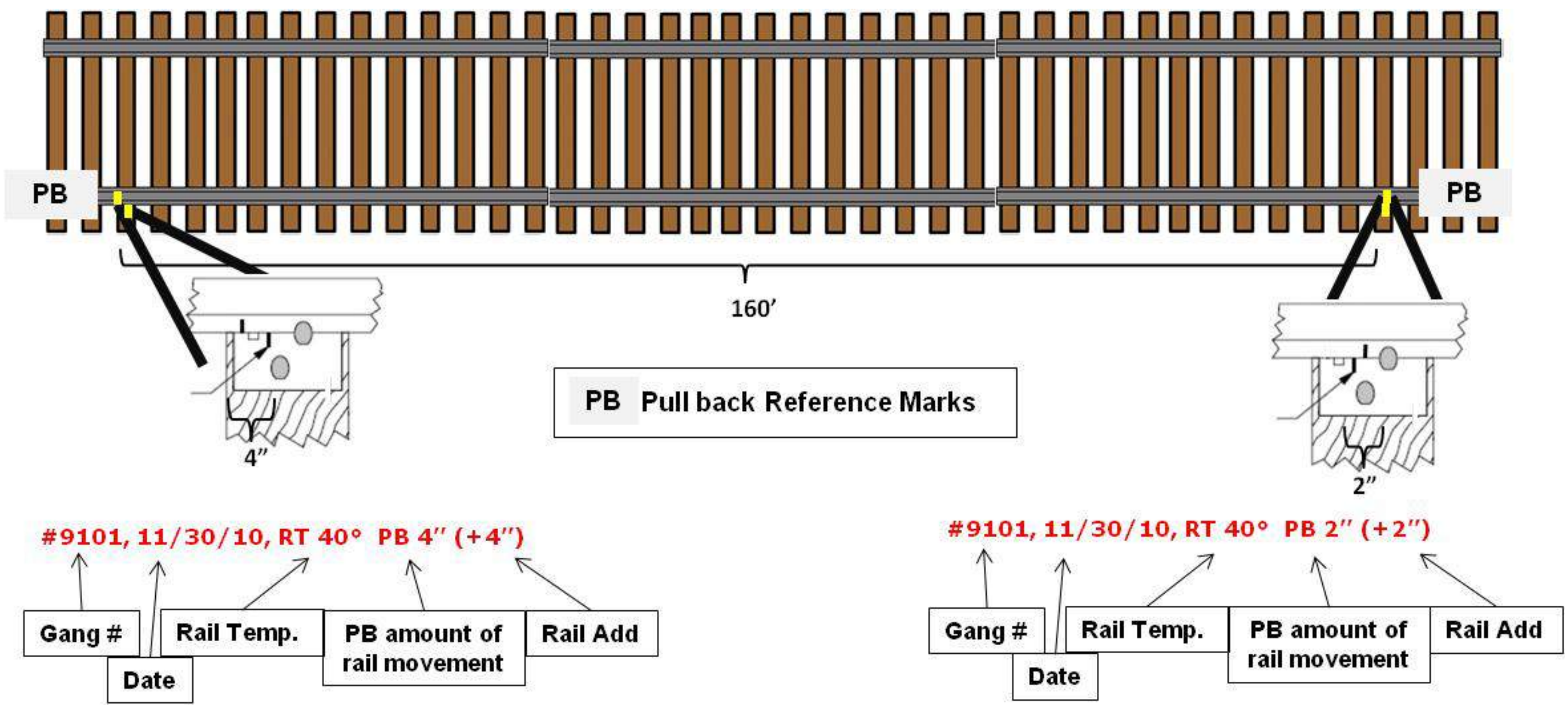


Figure 7-F-2

7.9.5 Maintaining Desired Rail Neutral Temperature Range

A record of rail neutral temperature will be maintained where rail has pulled apart, broken or been cut for defect removal. Because these events are less than 80' they are remediated using CWR Adjust. Required information for reporting service failures (broken rails) are the following:

- Tie type (wood or concrete).
- Anchor pattern (every tie anchored ETA or every other tie anchored EOTA).
- Rail temperature (at time of break upon arrival).
- Initial gap width (measured gap opening between rail ends at break).
- Rail base size (5 ½" or 6").
- Rail Laying Temperature for subdivision (Table 7-J).
- Ballast condition (frozen or not).

Rail that has pulled apart, broken or been cut for defect removal must be readjusted to within the subdivision rail laying temperature minus 10° (RLT-10°) safe range. If the rail has not been readjusted to at least RLT -10° before rail temperatures exceed the values in the Table 7-I-1 below, a speed restriction of 25 mph will be placed, or a speed restriction of 40 mph will be placed with a required daily inspection made during the heat of the day.

Note: At derailment locations where track panels have been installed, Table 7-I-1 may be applied.

Rail break or cut temperature (°F)	Rail temperature (°F) at which to readjust or apply slow order
60	135
50	130
40	125
30	120
20	115
10	110
0	105
-10	100
-20	95
-30	90
-40	85

Table 7-I-1

After October 9, 2009 known rail neutral temperature locations not adjusted to within RLT -10° safety range must ultimately be adjusted within 365 days of installation.

7.9.6 Rail Neutral Temperature Re-adjustment

Section 7.9.5 Maintaining Desired Rail Neutral Temperature Range, requires rail that has pulled apart, broken or been cut for defect removal must be re-adjusted to within the subdivision rail laying temperature minus 10° (RLT-10°) safe range. The two methods for rail re-adjustment are:

- **With CWR-Adjust Calculations (The CWR Adjust method includes the use of the TMP, CWR-Adjust Software or service failure call desk. It also includes the use of the RNT Pull Cards).**

Note: The CWR-Adjust Software is the most accurate rail adjustment tool since it takes into account tie type, anchor condition, rail temperature at the break, amount of gap at rail break, rail size, rail laying temperature and ballast condition. This methodology is accepted by FRA and the industry as accurate, scientific calculations to determine the Rail Neutral Temperature or safe range of the rail. For expedited use in the field, CWR-Adjust Pull Cards were developed from the same software making a few assumptions that re-adjust the rail close to the software. Also note the Pull Cards DO NOT account for rail removal for welds.

- **Without CWR-ADJUST calculations (examples of when this might be the case).**
  - **When rail breaks or defects are clustered in close proximity to each other.**
  - **When rail breaks or defects are near "fixed" structures (i.e. turnouts, diamonds, open deck bridges, road crossings, etc).**
  - **Track panels at derailment sites where multiple track panels have been installed.**

  When re-adjusting rail without the use of CWR-adjust determine the Temperature Differential (the difference between the existing rail temperature and the RLT in Table 7-J) and remove the prescribed rail as outlined in Table 7-I-2 below.

Temperature Differential Table for Maintenance Adjustments

	Amount of Adjustment Required (Inches) for a Length of Unfastened CWR						
Temperature Differential (°F)	390 ft	450 ft	500 ft	550 ft	600 ft	650 ft	700 ft
5	1/4	1/4	1/4	1/4	1/4	1/4	1/4
10	1/4	1/4	1/4	1/2	1/2	1/2	1/2
15	1/2	1/2	1/2	1/2	3/4	3/4	3/4
20	1/2	3/4	3/4	3/4	1	1	1
25	3/4	1	1	1	1-1/4	1-1/4	1-1/4
30	1	1	1-1/4	1-1/4	1-1/2	1-1/2	1-1/2
35	1	1-1/4	1-1/2	1-1/2	1-1/2	1-3/4	2
40	1-1/4	1-1/2	1-1/2	1-3/4	2	2	2-1/4
45	1-1/2	1-1/2	1-3/4	2	2	2-1/4	2-1/2
50	1-1/2	1-3/4	2	2-1/4	2-1/4	2-1/2	2-3/4
55	1-3/4	2	2	2-1/2	2-1/2	2-3/4	3
60	1-3/4	2	2-1/4	2-1/2	2-3/4	3	3-1/4
65	2	2-1/4	2-1/2	2-3/4	3	3-1/4	3-1/2
70	2-1/4	2-1/2	2-3/4	3	3-1/4	3-1/2	3-3/4

Table 7-I-2 (Table 7-I refers to this as CWR Adjustment Table 4-H)

7.9.7 Cold Weather Rail Neutral Temperature Readjustment

When adjusting rail neutral temperature during cold weather, the temperature and track conditions may not allow adequate adjustment. The following procedures provide some guidelines when making cold temperature rail repairs and subsequent rail neutral temperature (RNT) readjustments. The following cold weather readjustment procedures are based on the measured rail gap width and the rail temperature at the time of the break. Remember to record all pertinent information as outlined in Section 7.9.5 Maintaining Desired Rail Neutral Temperature Range.

The pre-break/cut RNT is in the RLT-10°F range or above.

- Use the measured gap width along with the measured rail temperature to determine the RNT at the time of the break. This is done by using CWR Adjust (**CWR Adjust includes the use of the TMP, CWR-Adjust Software, RNT Pull Cards or Service Failure Reporting Call Desk**).
- If the calculated RNT from the pull-card is within **RLT-10°F** you can pull the rail back together making your permanent repair. Make sure you account for the rail gap with the weld.

The pre-break/cut RNT is below RLT-10°F.

- Use the measured gap width along with the measured rail temperature to determine the RNT at the time of the break. This is done by using CWR Adjust (**CWR Adjust includes the use of the TMP, CWR-Adjust Software, RNT Pull Cards or Service Failure Reporting Call Desk**).
- If you are not within the safe range of **RLT-10°F** you need to make additional rail adjustments.
- Use CWR Adjust (TMP, CWR Adjust software, Pull Cards or Service Failure Reporting Call Desk) to acquire the prescribed rail adjustment needed.
- If performing final repair, make the prescribed rail adjustment needed plus the rail gap needed for the weld.
- If performing a temporary repair by installing a plug rail or using joint bars, then it would be required to return to make final repairs. Refer to Section 7.9.5 Maintaining Desired Rail Neutral Temperature Range and Table 7-I-1 to determine the temperature at which to have the repair made or applicable slow order applied. When performing final repair, use CWR Adjust and make the prescribed rail adjustment plus the rail gap needed with the weld.

Special cases when CWR-Adjust or Pull-Cards are not applicable

There are special cases and conditions when CWR-Adjust or Pull-Cards are NOT applicable. These include:

(1) Breaks/defects proximity to each other.

- If the defects/breaks are 800 feet or more apart, apply CWR-Adjust or Pull-Cards.
- If the defects/breaks are closer than 800 ft, CWR-Adjust or Pull-Cards do not apply. In this case apply the second bullet "**Without CWR-Adjust calculations"** from Section 7.9.6 Rail Neutral Temperature Re-adjustment to each location independently.

(2) Breaks/defects are near "fixed" structures.

- When breaks/defects occur within 400 feet of a rigid structure (switches, crossings, bridges, etc.), CWR-Adjust or Pull-Cards do not apply. In such cases apply the second bullet "**Without CWR-Adjust calculations"** from Section 7.9.6 Rail Neutral Temperature Re-adjustment. When adjusting rail "without CWR-Adjust" the 195 ft of unfastening requirement in the direction of the rigid structure can be relaxed (i.e. unfasten the maximum length of rail available on that side, but retain the 195 ft on the other side).

7.9.8 De-Stressing Rail

De-stressing is a procedure that is used to reduce high longitudinal stress in CWR which readjusts the neutral temperature to the specified value. This procedure is followed when high compressive forces (as exhibited by tight, wavy, kinky or running rail conditions) exist or as a preventive measure. This procedure typically involves cutting rail out, unfastening a prescribed length of rail, refastening and welding. This activity should be performed from March through June as preventive maintenance, and from July through October as maintenance dictates. When de-stressing rail at any location, generally *both* rails should be de-stressed unless otherwise noted.

There are two different conditions that warrant de-stressing rail:

A. When broken rail service failures were repaired or detector car defects were removed during cold weather and a temporary repair required adding rail.
B. When high compressive forces exist in the rail as evidenced by tight, wavy, kinky or running rail.

If Condition A applies, refer to Sections 7.9.5 Maintaining Desired Rail Neutral Temperature Range and 7.9.6 Rail Neutral Temperature Readjustment.

If Condition B applies, follow the procedures below. In this case both rails need to be de-stressed, unless instructed otherwise.

Note: The recommended de-stressing temperatures should not be more than 40°F below the territory's laying temperature.

Procedure

1. Apply reference marks, see Section 7.9.2 Placing Reference Marks.
2. Cut rail, refer to Section 4.12 Field Welding for torch cutting rail to relieve compression.
3. Remove anchors or fasteners for a minimum of 120 ties (195') both directions from the location that are to be de-stressed.

Note: Remember, this is a minimum. The distance depends on how much rail needs to be adjusted.

4. Wait until the rails stops moving. (The rail ends may need to be trimmed more than one time to allow for expansion).
5. Take the rail temperature.
6. Use the "Rail Laying Temperatures for Continuous Welding Rail" (Table 7-J) to compare the rail temperature with the rail laying temperature for the territory. This is known as the temperature differential.
7. If the actual rail temperature is lower than the rail laying temperature for the territory, determine the rail length to be removed based on the total distance the anchors have been removed. Use the "Continuous Welded Rail Adjustment Table" (Table 7-I-2).
8. If the rail temperature is above the rail laying temperature, no additional adjustments are needed.
9. Proceed to de-stress the other rail.

7.9.9 Managing Cut-in/Cut-out CWR

The Cut-in/Cut-out process is used to manage the neutral temperature of rail replacement and track panel installation greater than 80' and less than or equal to 360'. Pull back reference marks are used with the Cut-in/Cut-out process and provide a method of controlling the amount of rail added or subtracted in CWR track. As rail is adjusted in CWR track pull back reference marks serve as a benchmark to go back and measure against. The intent when performing a cut-in/cut-out is to return the track to the prior neutral temperature, when the CWR occurred. Pull back reference marks must be utilized prior to cutting the CWR.

Reviewing the Cut-in/Cut-out database provides a resource to identify locations where rail has been added during the winter and needs to be removed before warm temperatures occur.

7.9.10 Monitoring Curve Movement

Track buckles are more likely to occur in track with poor surface and line.

Lining and surfacing of curves can lead to a track buckle if not done properly. On Class 2 main tracks or higher, curves 3 degrees and greater must be staked. These stakes must be clearly marked and must be used to monitor any curve movement. For reference stakes use 5/8” diameter x 18” long rebar. The rebar should be painted fluorescent green in order to be easily spotted.

The following examples are to be used to identify when, where and how to stake these curves.

A. Surveyors

1. Stake curves on Class 2 main tracks and above before performing program concrete and/or undercutting projects.
2. Stake other curves as directed by the Chief Engineer.
3. When complete ballast renewals or track shifts occur, place offset stakes or offset measurements to adjacent track if applicable.
4. Stake curves, at a minimum, at the curve control points: Point of Spiral (PS), Point of Spiral Curve (PSC), Point of Curve Center (PCC), Point of Curve Spiral (PCS), and Point of Tangent (PT) with no more than 200 ft. between stakes throughout the curve as shown in Figure 7-F-3 and described in Table 7-I-3.

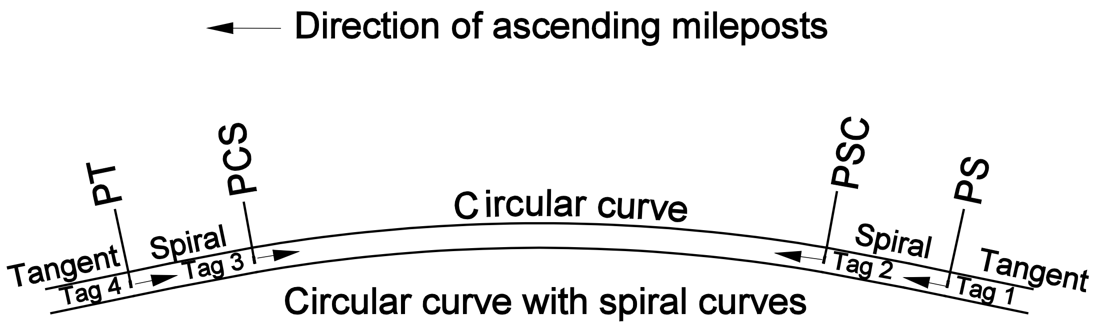


Figure 7-F-3

Curve Marker Identification		
Abbreviation	**Full Name**	**Description**
PS	Point of Spiral	Tangent ends and spiral begins
PSC	Point of Spiral to Curve	Spiral ends and full body begins
PCC	Point of compound curve	Curves that change degree of curvature
PCS	Point of Curve to Spiral	Full body ends and spiral begins
PT	Point of Tangent	Spiral ends and tangent begins

Table 7-I-3

5. Follow instructions in Standard Drawing No. 0015.
6. Record necessary information into the curve database.

B. System Gangs

1. If a curve has been staked by surveyors, line the track to those stakes.
2. If curve is already staked for monitoring of movement, record measurements from stakes to corresponding base of rail prior to and after track work.
    - In locations of complete ballast renewals it is not necessary to record measurements prior to work.
3. If curve is not already staked, center - stake curves 3 degree and over when the rail temperature is more than 50 degrees F. below the designated rail laying temperature or expected to be in the next 24 hours, before surfacing track.

    Example: A curve requires surfacing due to irregular cross level. It is 3 degree 30 minute curve with a rail laying temperature of 105 degrees. Immediately prior to surfacing, the rail temperature is measured to be 48 degrees. Since the curve is over 3 degrees and the rail temperature is more than 50 degrees less than the rail laying temperature for that area (57 degree difference), the curve would require the use of stakes to monitor curve shifting.
4. All curves must be staked after relaying rail. Place at least three stakes in each curve, with one stake in the middle of the curve and the remaining stakes at each heat station.
5. Behind final surfacing pass following program concrete and undercutting work, all curves will be center staked at intervals of 200 feet throughout the entire curve.
6. Behind final surfacing and de-stressing operation following new track construction, all curves will be center staked at intervals of 200 feet throughout the entire curve.

C. Maintenance Forces

1. Ensure all curves in Class 2 Main tracks or higher and 3 degrees and over are staked, either center or offset.
2. When surfacing and lining is performed in a curve already staked, record measurements from stakes to corresponding base of rail prior to and after track work.

3. When surfacing and lining is performed in a curve not already staked, then follow the procedures as set forth in # B-3 above.
4. If a curve has been staked by surveyors, line the track to those stakes.
   a. Inspect for movement during cold temperatures. Additional focus should be given to curve movement during the first 2 weeks after track work especially during periods of large temperature changes.
5. Line out any curve that has inward movement of 2 inches or more prior to rail temperatures above or forecasted above the designated rail laying temperature. If curve is not lined out or destressed and the inward movement is more than 3 inches, a speed restriction of 40 mph or less must be placed.
6. Report when corrections are made through the TMP.

D. Procedures to Place Maintenance Stakes around Curves

1. For center staking (preferred method), use a minimum of five reference stakes.
   - Place one reference stake at the Point of Spiral (PS), Point of Spiral Curve (PSC), Point of Curve Center (PCC), Point of Curve Spiral (PCS), and Point of Tangent (PT).

   Note: Additional stakes may be required due to the overall length of the curve; the spacing between the stakes should be no more than 200'.

   - Mark the rail per Figure 7-G.
2. For offset staking, use a minimum of five reference stakes with 10 to 15 foot offsets.
   - Place reference stakes at the PSC and PCS of the curve.
   - Place at least 3 reference stakes around the curve, uniformly spaced, offset a distance between 10 and 15 feet from the field side of the line rail. The stakes should be spread equally around the curve with one stake placed in the middle of the curve.

   Note: Additional stakes may be required due to the overall length of the curve; the spacing between the stakes should be no more than 200'.

   - Mark the offset and location per Figure 7-H.

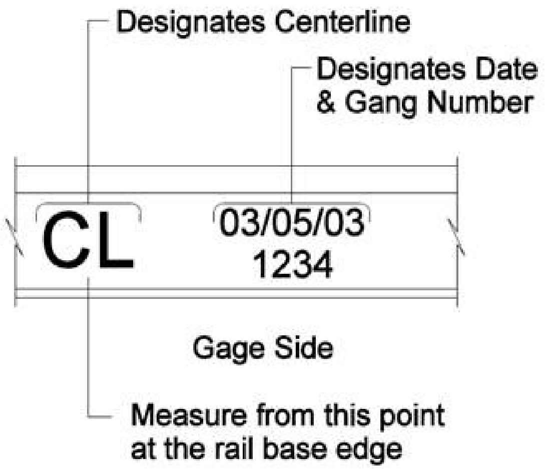


Figure 7-G

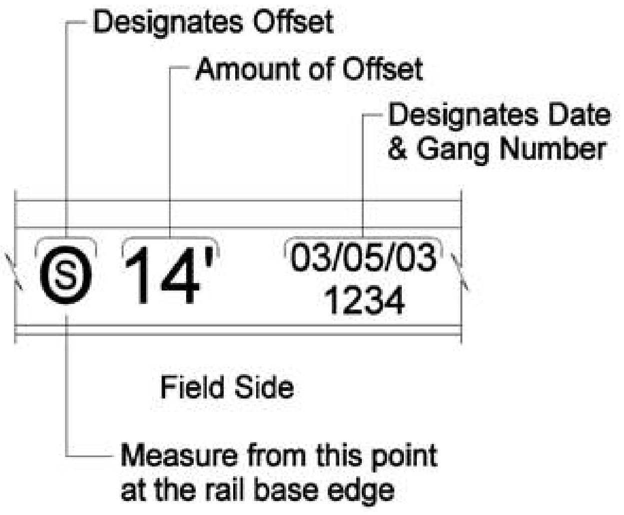


Figure 7-H

E. Non Pre-staked Curves and Cold Weather

For curves that have not been pre-staked, before lining a curve on main tracks, stake curves if the curvature is more than 3 degree and the rail temperatures is more than 50^{o} F below the designated rail laying temperature (or is forecasted to be in the next 24 hours).

7.9.11 Inspecting for Curve Movement

On main tracks, Class 2 tracks and higher, all 3 degree curves and sharper must be inspected for curve movement. Curves should be inspected for curve movement periodically after work and during periods of large temperature changes.

Best Practice: Draw a line from the base of the rail onto the tie plate as a reference mark to monitor rail movement and to aid in track inspection.

7.9.12 Adjusting Curve or Placing Speed Restriction Account of Curve Movement

When a curve has shifted inward more than a maximum of 2 inches, the curve must be lined out prior to rail temperatures above or forecasted above the designated rail laying temperature Refer to 7.10.10 Rail Laying Temperatures for Continuous Welded Rail Table and Blanket Speed Restrictions (Table 7-J) and refer to the column titled Rail Laying Temperatures.

If a curve is not lined out or de-stressed a speed restriction of 40 mph or less must be placed and governed by Section 7.6.1 Hot Weather Inspections.

7.9.13 De-stressing Curves

When a curve has to be realigned or de-stressed, the question of how much rail to cut out of the curve arises. This is a good procedure for adjusting curves. This procedure is dependent on the degree of curvature, curve movement and the length of the curve. The procedure can be used when multiple stations have to be de-stressed.

When curves are aligned back to the pre-movement geometry or adjusted to de-stress the curve, this is not necessarily the target rail neutral temperature. This is the amount of rail to cut out to restore rail neutral temperature to what is was before being aligned or pulled in. De-stressing is required on both rails.

To find the effective amount of rail added to the curve use the following table. This table is based on 1,000 feet of curve length and adjustments are necessary based on the length of the curve. To use the table determine the degree of curvature, curve movement and the length of the curve. When determining the maximum distance that curve has chorded inward, it is necessary to use the maximum central inward movement from the stakes.

		Effective Rail Length Added to Curve/1,000 Feet of Curve (Inches)											
		Distance Curve Has Chorded Inward (Inches)											
		1/2	**1**	**1 1/2**	**2**	**2 1/2**	**3**	**3 1/2**	**4**	**4 1/2**	**5**	**5 1/2**	**6**
Degree of Curvature	**0° 30'**	1/4	1/8	1/8	1/8	1/4	1/4	1/4	3/8	3/8	1/2	1/2	1/2
	1° 00'	1/8	1/8	1/2	3/8	1/2	1/2	5/8	3/4	3/4	7/8	1	1
	1° 30'	1/8	1/4	3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 3/8	1 1/2	1 5/8
	2° 00'	1/8	3/8	1/2	3/4	7/8	1	1 1/4	1 3/8	1 5/8	1 3/4	1 7/8	2 1/8
	2° 30'	1/4	1/2	5/8	7/8	1 1/8	1 3/8	1 1/2	1 3/4	2	2 1/4	2 3/8	2 5/8
	3° 00'	1/4	1/2	3/4	1	1 3/8	1 5/8	1 7/8	2 1/8	2 3/8	2 5/8	2 7/8	3 1/8
	3° 30'	1/4	5/8	7/8	1 1/8	1 1/2	1 7/8	2 1/8	2 1/2	2 3/4	3 1/8	3 3/8	3 5/8
	4° 00'	3/8	3/4	1	1 3/8	1 3/4	2 1/8	2 1/2	2 3/4	3 1/8	3 1/2	3 7/8	4 1/8
	4° 30'	3/8	3/4	1 1/8	1 5/8	2	2 3/8	2 1/2	3 1/8	3 1/2	4	4 3/8	4 3/4
	5° 00'	1/2	7/8	1 3/8	1 3/4	2 1/4	2 5/8	2 3/4	3 1/2	4	4 3/8	4 3/4	5 1/2
	5° 30'	1/2	1	1 1/2	1 7/8	2 1/2	2 7/8	3 3/8	4	4 3/8	4 7/8	5 1/4	5 3/4
	6° 00'	1/2	1	1 5/8	2 1/8	2 3/4	3 1/8	3 5/8	4	4 3/4	5 1/4	5 3/4	6 1/4
	6° 30'	1/2	1 1/8	1 3/4	2 1/4	2 3/4	3 3/8	4	4 1/2	5 1/8	5 3/4	6 1/4	6 7/8
	7° 00'	1/2	1 1/4	1 7/8	2 1/2	3	3 5/8	4 1/4	5	5 1/2	6 1/8	6 3/4	7 3/8
	7° 30'	1/2	1 3/8	2	2 5/8	3 1/4	4	4 5/8	5 1/2	5 7/8	6 5/8	7 1/4	7 7/8
	8° 00'	1/2	1 3/8	2 1/8	2 3/4	3 1/2	4 1/4	4 7/8	5 1/2	6 1/4	7	7 3/4	8 3/8
	8° 30'	1/2	1 1/2	2 1/4	3	3 3/4	4 1/2	5 1/4	6	6 3/4	7 1/2	8 1/8	8 7/8
	9° 00'	1	1 5/8	2 3/8	3 1/8	4	4 3/4	5 1/2	6 1/2	7 1/8	7 7/8	8 5/8	9 1/2
	9° 30'	1	1 5/8	2 1/2	3 3/8	4 1/4	5	5 7/8	6 1/2	7 1/2	8 3/8	9 1/8	10
	10° 00'	1	1 3/4	2 5/8	3 1/2	4 1/2	5 1/4	6 1/8	7	7 7/8	8 3/4	9 5/8	10 1/2
	10° 30'	1	1 7/8	2 3/4	3 5/8	4 1/2	5 1/2	6 3/8	7 1/2	8 1/4	9 1/4	10 1/8	11
	11° 00'	1	1 7/8	2 7/8	3 7/8	4 3/4	5 3/4	6 3/4	7 1/2	8 5/8	9 5/8	10 5/8	11 1/2

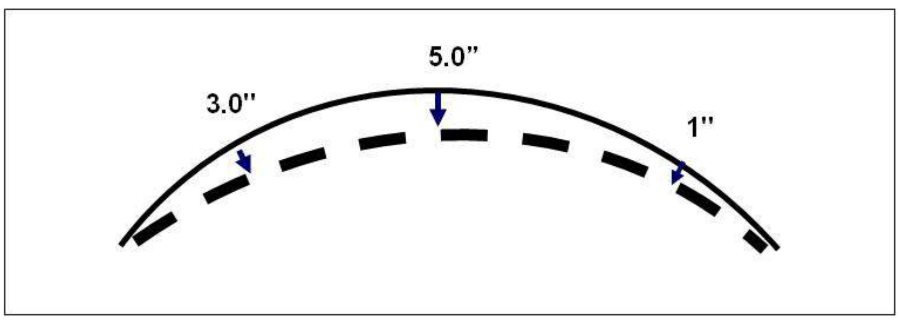
ΔS (in) = δ (in) x Deg x 0.0175 x curve length(ft)/100(ft)
ΔS (in) = Effective rail length added to curve (inches)
δ (in) = Maximum distance curve has chorded inward (inches)
Deg = Degree of curvature

Here are some examples for using this table.

Example

A 5 degree curve that measures 1,000 ft in length and has a measured distance that the curve chorded inward is 5 inches.

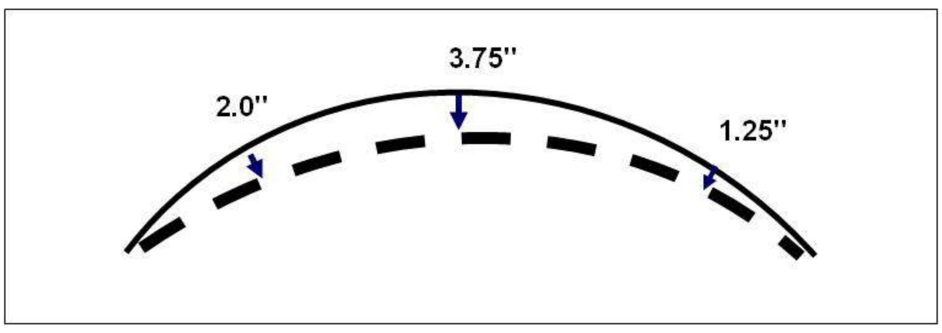
- Rail length added is 4.375 inches.



Example

A 5 degree curve that measures 600 ft in length and has a measured distance that the curve chorded inward of 3.75 inches.

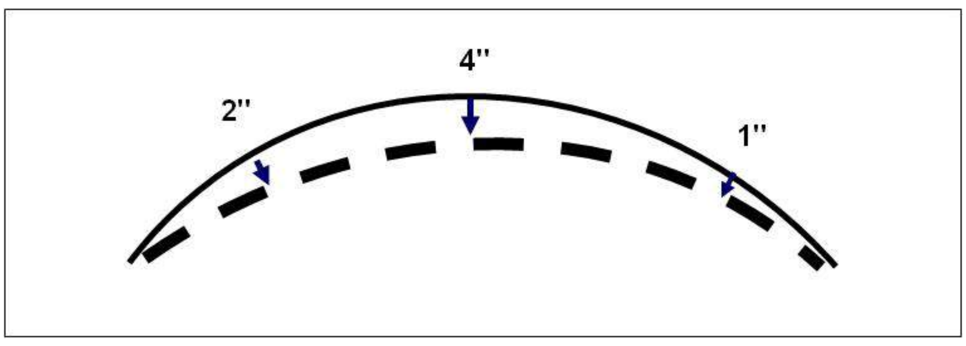
- Since the measured distance that the curve chorded inward falls between the two 3.5 inches and 4.0 inches. Then 3.25 inches can be used.
- Since the table is based on a1,000 foot curve length and the curve is 600 feet, it is necessary to multiply the 3.25 inch by .6.
- Rail length added is 1.95 inches.



Example

A 5 degree curve that measures 2,000 ft in length and has a measured distance that the curve chorded inward of 4.0 inches.

- The table shows a 3.5 inches of rail length added.
- Since the table is based on a 1,000 foot length and the curve is 2,000 foot long, it is necessary to multiply the 3.5 inch by 2.
- Rail length added 7.0 inches.



7.9.14 Adjusting Anchors

The best time to adjust anchors is when it is cold and the rail is in tension. The recommended months to adjust anchors are: November, December, January or February.

The U.P. standards for anchoring are found on Standard Drawing Nos. 0460 and 0461 or in Section 4.17 Rail Anchors.

Adjust anchors by following these guidelines:

- Bring the track up to standard by installing the correct number of anchors.
- Replace the missing anchors.
- Adjust the anchor so it is bearing tight against the tie.

7.9.15 Eliminating Joints

Eliminate joints by following these guidelines:

- Use reference marks.
- Cut out the length of field weld that will be added: If using a standard gap weld, cut out 1 inch of rail to allow for the field weld. If using a wide gap weld, cut out 2 ¾ inches of rail.
- Refer to Section 4.12 Field Welding for minimum required spacing between field welds and plant welds.

7.9.16 Gauging Track

The increased lateral forces caused by wide gage can contribute to causing a track to buckle. Use caution in the summer months when the rail is in compression and could buckle if a large section of rail is gauged at one time. In winter months, use caution when gauging high side of curve as rail will tend to pull down.

7.10 Reporting Track Buckling Activities

7.10.1 Reporting Maintenance Work in CWR

Track maintenance can disturb the lateral and longitudinal resistance of the track structure, records must be kept until corrections or adjustments are made for the follow maintenance events:

- Repair of service failed rail, defective or damaged rail that has been removed, rail that has been cut for detector car defect repair, pulled apart rail, or welding of rail joints.
- Curves that have experienced inward movement more than a maximum of 2 inches from the curve reference stakes.

A record of CWR adjustment will be maintained for locations that experience: service failed rail, defective or damaged rail that has been removed, rail that has been cut for detector car defect repair, pulled-apart rail, or welding of rail joints.

Director Track Maintenance and Manager Track Maintenance must monitor these records to ensure necessary corrections and adjustments are made.

7.10.2 Report Rail Service Failed Broken Rail

A. Service Failure Broken Rail Reporting

Definition: A service failed broken rail is defined as an unexpected break in the rail, usually in two or more pieces with separation **OR** rail with a substantial portion of the rail head, web or base missing.

When service failed broken rails occur, collect information contained in Engineering OE Production Log ***(Form: PB-24021)***. Following repair or replacement of the broken rail, report the service failure by one of the following means:

1. **TEP (Time Entry Portal) – OE Production Reporting** using the correct Work Codes for each failure type.
2. **Track Maintenance Planner (TMP)**, – Web base reporting, *Go to: **Engineering > Track Maintenance > Manage > Service Failure (Broken Rail)***

Using a digital camera, capture pictures of the rail while still in track and pictures of each full rail end. Email photos to: sfdesk@up.com. When sending pictures, include: Fail date, Subdivision, Track, milepost (including decimal) and rail side (Left or Right). Provide a contact with phone number for follow-up questions.

When broken rail failures occur within 30 days or within 1 MGT of the last detector car test, secure and store fractured rail ends. Using a permanent metal marker, write the following information on the rail: Fail date, Subdivision, Track, milepost (including decimal) and rail side (Left or Right). Store rail at a location designated by Manager Track Maintenance until inspected by Rail Assessment Group manager, or Rail Test Operator.

B. Broken Rail Derailment Reporting

When a derailment is being investigated and the cause is not readily apparent and a broken rail cannot be ruled out immediately, collect and include the following information in derailment reporting.

1. Rail section (weight), Manufacture, Year/Month rolled, Standard/Premium, and rail heat number (including ingot number, “A” rail etc.).
2. Rail profile, head width and height. (Approximate gage face loss and height loss).
3. Rail condition, running surface. (shell, head checks, slivers, grease, rust or recently ground).
3. If broken rail is entered as the cause of the derailment, rail shall be sent to the: R & D Lab; 5697 N. 13th St.; Omaha, NE 68110. In addition, a SERVICE FAILURE report must be completed in the TMP, within 7 days, *Go to: **Engineering > Track Maintenance > Manage > Service Failure (Broken Rail)*** to find report form.

7.10.3 Report Rail Pull-aparts

When two rails pull-apart (separate) at a joint location, this is reported as a pull-apart. When pull-aparts occur, collect all information required on Engineering OE Field Reporting Log PB-24021. Use this information and complete a Service Failure report via one of the following means:

- Service Failure Reporting Call Desk – via a phone call to desk personnel. Reference Section 4.17.11 Broken Rail Derailment Reporting.
- OE Production - TEP production reporting, using EPM174 (UNPLANNED OE MAINTENANCE TASK(S) and: Work code: M60B (Depending on defect class: DF, BH, VSH, etc.).
- Track Maintenance Planner (TMP), – Engineering Website base reporting. Select the Manager tab and then select the Pull-apart Defect (Stripped Joint), located in the center column, under the label Defect Management Create Defects.

Pull-aparts are to be reported by only one employee.

7.10.4 Report Maintenance Rail Replacement

When rail has been cut to repair a detector car defect, report via the TEP, OE Production reporting system.

- Report using EPM174 (Repairing Detector Car Defects) and Maintenance Work code: M50 when defect is UNPLANNED (Same day as detector car, defect not yet uploaded by the detector car).
- Report using EPM173, when defect repair is PLANNED and task has been assigned to the gang by the manager.

7.10.5 Report Cut-in/Cut-out Maintenance Rail

Rail change out or track panels changed out that are greater than 80’or less than or equal to 360’ should be reported through the cut-in/cut-out process. All rail that has been either added or subtracted from the track should be recorded using the Engineering OE Production Log Form PB-24021, and then reported using Gang OE Production Reporting or Go to: TMP > Manage > Defect Management. Select the Manage tab. In the center column under the label Defect Management Create Defects, select the Create Rail Cut-Ins, Cut-Outs and left click the mouse.

7.10.6 Welding Gangs

Welders performing other than normal maintenance welding will refer to CWR Adjust or Cut-in/Cut-out procedures depending on the CWR event. Refer to 7.9.1 Managing CWR Events.

7.10.7 Report Curve Movement

Because maintenance performed on curves disturbs the lateral and longitudinal resistance of the track, the track could shift inward during cold weather. To monitor the impact of these curves that have moved inward and correct them, use the following guidelines:

- Report inward lateral curve movement through TMP, TI System or Production Reporting.

Note: This is the measured deviation in inches from the reference stakes. See Section 7.9.10 Monitoring Curve Movement.

- Line out any curve that has inward movement of two inches or more prior to hot weather.
- Report corrections through the TMP, TI System or Production Reporting.

7.10.8 Reporting Track Buckling Incidents

When a track buckle occurs, this information needs to be reported through the Engineering Track Maintenance Planner (TMP). Select the Manage tab. In the center column under the label Defect Management Create Defects, select the Track Buckle and left click the mouse.

For Reporting Purposes:

A track buckling incident occurs when rail temperatures are relatively high and there are high longitudinal compressive forces present in the rail, which results in:

- A lateral misalignment of > 5" on tangent and curve track.
- An upward vertical misalignment of > 2" on all tracks.

Do not report the following:

- Track buckles that occur at a location where gangs are actively working.

Note: If a buckle occurs after the gang gives the track back it should be reported.

- Curves moving inward or outward as a track buckle, unless there is an actual lateral misalignment.

7.10.9 Required CWR Documentation

Required to have the following current revision of CWR procedures available for installation, maintenance, adjustment and inspection of CWR:

- Updated Engineering Track Maintenance Field Handbook – ***Chapter 7 Track Buckling Prevention, Chapter 4 Rail and Joints and Chapter 8 Track Inspection Requirements***.
- Procedures for the ***Installation, Adjustment, Maintenance and Inspection of CWR*** as required by 49 CFR 213.119 - This document details the Railroad's policy on installing, adjusting, maintaining and inspecting Continuous Welded Rail (CWR) track. Each chapter details how the Railroad applies its standards and procedures to comply with FRA standards. The following requirements apply to CWR on all main tracks and sidings. These requirements also apply to all tracks other than main tracks or sidings operating at speeds above Class 1. The effective date of this document is October 09, 2009. The item number is PB-21968.

7.10.10 Rail Laying Temperature for Continuous Welded Rail Table and Blanket Speed Restrictions

Use Table 7-J for blanket speed restrictions and rail laying (neutral) temperatures for subdivisions with maximum speed greater than 40 MPH. If subdivision is not listed in Table 7-J, refer to latest revision on Standard Drawing No. 0045 to determine appropriate rail laying temperature.

Subdivision	Station		Rail Laying Temp. Deg. (F)	Rail Temperature for Speed Restriction behind Track Work Deg. (F)	Blanket Heat Speed Restriction (Level 1) Deg. (F)	Blanket Heat Speed Restriction (Level 2) Deg. (F)	First Event Cold Weather Inspection Temp. Deg. (F)	Cold Weather Inspection Temp. Deg. (F)	Rapid Temperature Drop of 40 F or More Below Temp. Deg. (F)
Aberdeen	Aberdeen	Aberdeen Jct	95	105	85	95	10	-5	55
Adams	Adams	BJ South	95	105	85	95	10	-5	55
Alameda Corridor	East Redondo	W. Thenard	115	125	105	115	30	15	75
Albert Lea	S St Paul	Mason City	95	105	85	95	10	-5	55
Alexandria	Willow Glenn	Livonia	115	125	100	110	30	15	75
Alhambra	W Colton	Yuma Jct.	115	125	105	115	30	15	75
Alton & Southern Gateway	Valley Jct	Lennox	105	115	95	105	20	5	65
Altoona	W. Minster	Adams	95	105	85	95	10	-5	55
Anchorage	Livonia	Anchorage Jct	115	125	100	110	30	15	75
Angleton	Algoa	Bloomington	115	125	100	110	30	15	75
Athens	Athens Jct	Regency Gas	115	125	100	110	30	15	75
Austin	Hearne	Tower 105	115	125	100	110	30	15	75
Avondale	W Bridge Jct	BNSF Conn	115	125	100	110	30	15	75
Avoyelles	Addis	Lobdell Jct	115	125	100	110	30	15	75
Ayer	Fish Lake	Hinkle	100	110	90	100	15	0	60
Baird	Ft Worth	Sweetwater	115	125	100	110	30	15	75
Beaumont	Livonia	Glf. Coast Jct	115	125	100	110	30	15	75
Bell Line at Houston	House	Baer Jct	115	125	100	110	30	15	75
Belvidere	W Chicago	End of Track	100	110	90	100	15	0	60
Black Butte	Klamath Falls	Dunsmuir	100	110	90	100	15	0	60
Blair	E MO Valley	Fremont	100	110	90	100	15	0	60
BMI	Boulder Jct	Henderson	125	135	110	120	40	25	85
Boone	Boone	E. Mo. Val.	100	110	90	100	15	0	60
Brinkley	Briark	Brinkley	110	120	100	110	25	10	70
Brooklyn	Portland	Oakridge	100	110	90	100	15	0	60
Brownsville	Bloomington	Brownsville	120	130	105	115	35	20	80
Bryan	Bush Jct	Hearn UP Xing	115	125	100	110	30	15	75
Cache Valley	Cache Jct	Preston	100	110	90	100	15	0	60
Calexico	Niland Jct	Calexico	125	135	110	120	40	25	85
Cane Creek	Brendel	Potash	105	115	95	105	20	5	65
Caliente	Stine	Kyle	105	115	95	105	20	5	65
Caliente	Milford	Brown	100	110	90	100	15	0	60
Caliente	Brown	Stine	105	115	95	105	20	5	65
Caliente	Kyle	Las Vegas	110	120	100	110	25	10	70
Canyon	Portola	Sloat	100	110	90	100	15	0	60
Canyon	Sloat	James	105	115	95	105	20	5	65
Canyon	James	Mitchell Ave	120	130	100	110	35	20	80
Carrizozo	W Vaughn	Ancho	105	115	95	105	20	5	65
Carrizozo	Ancho	Otero	110	120	100	110	25	10	70
Carrizozo	Otero	Tower 47	115	125	105	115	30	15	75
Cascade	Oakridge	Klamath Falls	100	110	90	100	15	0	60
Cedar City	Lund	Cedar City	100	110	90	100	15	0	60
Cherokee	Parsons	Chetopa	105	115	95	105	20	5	65
Cherokee	Chetopa	McAlester	110	120	95	105	25	10	70
Chester	Valley Jct	Charlestn Jct	105	115	95	105	20	5	65
Chippewa Falls	Yukon Jct	Norma	95	105	85	95	10	-5	55
Choctaw	McAlester	Denton	110	120	95	105	25	10	70
Choctaw	Denton	N. Tower 55	115	125	100	110	30	15	75
Cima	Las Vegas	Yermo	125	135	110	120	40	25	85
Clinton	Clinton	Boone	100	110	90	100	15	0	60
Clyman	Ft Atkinson	Clyman Jct	95	105	85	95	10	-5	55
Coast	S.Luis Obispo	Mulford	110	120	100	110	25	10	70
Coffeyville	Leeds Jct	Coffeyville	105	115	95	105	20	5	65
Columbus	Fremont	Grand Island	100	110	90	100	15	0	60
Col Springs	Denver	Pueblo	100	110	90	100	15	0	60
Corpus Christi	Sosan	Corp. Christi	120	130	105	115	35	20	80
Corsicana	Big Sandy	Corsicana	115	125	100	110	30	15	75

Subdivision	Station		Rail Laying Temp. Deg. (F)	Rail Temperature for Speed Restriction behind Track Work Deg. (F)	Blanket Heat Speed Restriction (Level 1) Deg. (F)	Blanket Heat Speed Restriction (Level 2) Deg. (F)	First Event Cold Weather Inspection Temp. Deg. (F)	Cold Weather Inspection Temp. Deg. (F)	Rapid Temperature Drop of 40 F or More Below Temp. Deg. (F)
Craig	Phippsburg	Axial	90	100	80	90	5	-10	50
Cuero	West Point	Placedo	115	125	100	110	30	15	75
Dallas	Longview	Centen.Yd	115	125	100	110	30	15	75
Del Rio	Del Rio	San Antonio	120	130	105	115	35	20	80
Dequincy	Dequincy	Livonia X-Over	115	125	100	110	30	15	75
Desoto	St Louis	4th Street	105	115	95	105	20	5	65
DFW	6th St Jct	JFK Jct	115	125	100	110	30	15	75
Dry Valley	Soda Springs	Dry Valley	95	105	85	95	10	-5	55
Duncan	Chickasha	Sunray	110	120	100	110	25	10	70
Duncan	Sunray	Tower 60	115	125	100	110	30	15	75
Eagle Pass	Spofford	Eagle Pass	120	130	105	115	35	20	80
El Centro	Plaster City	El Centro	125	135	105	115	40	25	85
El Dorado	El Dorado Jct	El Dorado	115	125	100	110	30	15	75
El Reno Freight Line	El Reno	El Reno	110	120	100	110	25	10	70
Elko	Elko	Winnemucca	105	115	95	105	20	5	65
Energy Line	West Adams	Energy	90	100	80	90	5	-10	50
Enid	Caldwell	Chickasha	110	120	95	105	25	10	70
Enid	Caldwell	Wichita	110	120	95	105	25	10	70
Ennis	Miller Yd	Hearne	115	125	100	110	30	15	75
Estherville	Goldfield	Superior	95	105	85	95	10	-5	55
Evanston	Green River	Ogden	95	105	85	95	10	-5	55
Eureka	Eureka	Navasota Jct.	115	125	100	110	30	15	75
Fairmont	Butterfield	Mason City	95	105	85	95	10	-5	55
Falls City	Offutt	Hiawatha	100	110	90	100	15	0	60
Falls City	Hiawatha	Edgewater	105	115	95	105	20	5	65
Fort Collins	La Salle	Harmony	100	110	90	100	15	0	60
Fort Dodge	Mooreland	Belmond	95	105	85	95	10	-5	55
Giddings	Hearne	West Point	115	125	100	110	30	15	75
Fresno	Bakersfield	Elvas	120	130	105	115	35	20	80
Ft Worth	Midlothian Jct	Valley Jct	115	125	100	110	30	15	75
Galveston	GH & H Jct	Galveston	115	125	100	110	30	15	75
Geneva	Chicago	Clinton	100	110	90	100	15	0	60
Gila	PPE Yard	Naviska	120	130	105	115	35	20	80
Gila	Naviska	Yuma	125	135	105	115	40	25	85
Glenwood Spr.	Bond	Glenwd Spr.	90	100	85	95	5	-10	50
Glenwood Spr.	Glenwd Spr.	Grand Jct	100	110	90	100	15	0	60
Glidden	W. Jct.	Kirby	115	125	100	110	30	15	75
Greeley	Speer	Pullman	100	110	90	100	15	0	60
Green River	Maxwell	Helper	95	105	85	95	10	-5	55
Green River	Grassy	Maxwell	100	110	90	100	15	0	60
Green River	Grand Jct	Grassy	105	115	95	105	20	5	65
Hallam	Fairbury	Sheldon Station	100	110	90	100	15	0	60
Hardy St. Connetion			115	125	100	110	30	15	75
Harlingen	Harlingen Jct	Palo Alto Jct	120	130	105	115	35	20	80
Harrisburg	Harrisburg Jct	W. Jct.	115	125	100	110	15	30	75
Harvard	End of Subd.	Chicago	100	110	90	100	15	0	60
Hearne	Marquez	Hearne	115	125	100	110	30	15	75
Herington	Herington	Pratt	105	115	95	105	20	5	65
Hiawatha	Hiawatha Jct	Upland	100	110	90	100	15	0	60
Houston East Belt	Belt Jct	East Belt Yd	115	125	100	110	30	15	75
Houston West Belt	N. Belt Jct	T&NO Jct	115	125	100	110	30	15	75
Hoxie	Charleston Jct	Corning	105	115	95	105	20	5	65
Hoxie	Corning	N Little Rock	110	120	100	110	25	10	70
Hulbert	Marion	Hulbert	110	120	100	110	25	10	70
Huntington	Oxman	Union Jct	95	105	85	95	10	-5	55
Huntington	Nampa	Oxman	100	110	90	100	15	0	60
Huntington	Union Jct	La Grande	100	110	90	100	15	0	60
Jefferson City	Gratiot St	River Jct	105	115	95	105	20	5	65
Jewell	West Ames	North Burt	95	105	85	95	10	-5	55
Joliet	Chicago	Bloomington	100	110	90	100	15	0	60
Joliet Intermodal Terminal			100	110	90	100	15	0	60
Jonesboro	Dexter Jct	Greenway	105	115	95	105	20	5	65
Jonesboro	Greenway	Pine Buff	110	120	100	110	25	10	70
Julesburg	Julesburg	Union	100	110	90	100	15	0	60
Kansas	West Yard	Upland	105	115	95	105	20	5	65
KCT	All Main Trks		105	115	95	105	20	5	65
Kearney	Grand Island	Platte River	100	110	90	100	15	0	60
Kerrville	San Antonio Jct	Beckmann	115	125	100	110	30	15	75
Kenosha	St Francis	Chicago	95	105	85	95	10	-5	55

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Lake Charles	Willow Glenn	Iowa Jct	115	125	100	110	30	15	75
La Grande	La Grande	Duncan	95	105	85	95	10	-5	55
La Grande	Duncan	Hinkle	100	110	90	100	15	0	60
Lafayette	Iowa Jct	Dawes	115	125	100	110	30	15	75
Lakeside	Ogden	Alazon	100	110	90	100	15	0	60
Laramie	Borie/Speer	Laramie	90	100	80	90	5	-10	50
Laramie	Cheyenne	Borie/Speer	95	105	85	95	10	-5	55
Laramie	Laramie	Rawlins	95	105	85	95	10	-5	55
Laredo	Sosan	Laredo	120	130	105	115	35	20	80
Lincoln	Valley	Lincoln	100	110	90	100	15	0	60
Little Rock	N Little Rock	Texarkana	110	120	100	110	25	10	70
Little Rock	Texarkana	Longview	115	125	100	110	30	15	75
Limon	Pullman	Boyero	100	110	90	100	15	0	60
Limon	Boyero	Sharon Springs	105	115	95	105	20	5	65
Livonia	Livonia	Algiers	115	125	100	110	30	15	75
Lockhart	Smithville	AJAX	115	125	100	110	30	15	75
Lone Pine	Mojave	Searles	120	130	105	115	35	20	80
Lordsburg	El Paso	Vail X-Over	115	125	105	115	30	15	75
Lordsburg	Vail X-Over	PPE Yard	120	130	105	115	35	20	80
Los Angeles	Yermo	Daggett	120	130	105	115	35	20	80
Los Angeles	W. Riverside	Bridge Jct	115	125	105	115	30	15	75
Lost Springs	Herrington	Wichita	105	115	95	105	20	5	65
Lufkin	Shreveport	Tower 210	115	125	100	110	30	15	75
Lynndyl	Salt Lake	Milford	100	110	90	100	15	0	60
Malad	Brigham City	Malad	100	110	90	100	15	0	60
Mankato	St Paul	St James	95	105	85	95	10	-5	55
Marion	Benton	Vienna Jt	105	115	95	105	20	5	65
Martinez	Martinez	Shellmound	110	120	100	110	25	10	70
Martinez	Roseville	Martinez	120	130	105	115	35	20	80
Marysville	Upland	Gibbon Jct	100	110	90	100	15	0	60
Mason City	Mason City	Des Moines	95	105	85	95	10	-5	55
McGehee	S Pine Bluffs	Bonita	110	120	100	110	25	10	70
McGehee	Bonita	Monroe	115	125	100	110	30	15	75
McHenry	Ringwood	Cryl. Lake J.	100	110	90	100	15	0	60
Memphis	Memphis	Bald Knob	110	120	100	110	25	10	70
Mesquite Line			120	130	105	115	35	20	80
Midlothian	Garrett Jct.	Midlothian Jct.	115	125	100	110	30	15	75
Milwaukee	St Francis	Grand Ave	95	105	85	95	10	-5	55
Mina	Hazen	Fort Churchill	105	115	95	105	20	5	65
Mineola	Longview Jct	SP Jct	115	125	100	110	30	15	75
Modoc	Perez	Texum	100	110	90	100	15	0	60
Moffat Tunnel	Winterpark	Phippsburg	90	100	85	95	5	-10	50
Moffat Tunnel	Plain	Winterpark	95	105	85	95	10	-5	55
Moffat Tunnel	Denver	Plain	100	110	90	100	15	0	60
Mojave	Cameron	Marcel	105	115	95	105	20	5	65
Mojave	Mojave	Cameron	110	120	100	110	25	10	70
Mojave	Marcel	Caliente	110	120	100	110	25	10	70
Mojave	W Colton	Mojave	120	130	105	115	35	20	80
Mojave	Caliente	Bakersfield	120	130	105	115	35	20	80
Monroe	Monroe	Willow Glenn	115	125	100	110	30	15	75
Montana	Pocatello	Dubois	95	105	85	95	10	-5	55
Montana	Dubois	Barretts	90	100	85	95	5	-10	50
Montana	Barretts	Silver Bow	95	105	85	95	10	-5	55
Monterey	Nilwood	Monterey Jct	100	110	90	100	15	0	60
Montgomery	Merriam	Montgomery	95	105	85	95	10	-5	55
Mt Vernon	Salem	Chap	105	115	95	105	20	5	65
Nampa	Pocatello	Nampa	100	110	90	100	15	0	60
Navasota	Valley Jct	Spring Jct	115	125	100	110	30	15	75
Nevada	Wesco	Sparks	105	115	95	105	20	5	65
Niles	Newark	Elmhurst	110	120	100	110	25	10	70
N. Fork	Grand Jct.	Hawksnest	100	110	90	100	15	0	60
N Platte T	Platte River	Hindman	100	110	90	100	15	0	60
Oakland	Altamont	Melrose	110	120	95	105	25	10	70
Oakland	Stockton	Alamont	120	130	105	115	35	20	80
Ogden	McCammon	Ogden	100	110	90	100	15	0	60
Oklahoma City	Midwest	El Reno	110	120	100	110	25	10	70
Omaha	Mo Valley	Fremont	100	110	90	100	15	0	60
Orin	Donkey Creek	Orin Jct	95	105	85	95	10	-5	55
Oskaloosa	Marshalltown	Bridgeport	100	110	90	100	15	0	60
Palestine	Longview	Belt Jct	115	125	100	110	30	15	75

Subdivision	Station		Rail Laying Temp. Deg. (F)	Rail Temperature for Speed Restriction behind Track Work Deg. (F)	Blanket Heat Speed Restriction (Level 1) Deg. (F)	Blanket Heat Speed Restriction (Level 2) Deg. (F)	First Event Cold Weather Inspection Temp. Deg. (F)	Cold Weather Inspection Temp. Deg. (F)	Rapid Temperature Drop of 40 F or More Below Temp. Deg. (F)
Pana	Villa Grove	Findlay	100	110	90	100	15	0	60
Pana	Findlay	Lenox	105	115	95	105	20	5	65
Pana	Lenox	St. Louis	105	115	95	105	20	5	65
Parsons	Parsons	KC	105	115	95	105	20	5	65
Peoria	Nelson	Barr	100	110	90	100	15	0	60
Pequot	Pequot	Mazonia	100	110	90	100	15	0	60
Perry	Shortline Yd	W. Des Moines	100	110	90	100	15	0	60
Phoenix	Picacho	Wellton	125	135	105	115	40	25	85
Pickneyville	Chester	Mt Vernon	105	115	95	105	20	5	65
Pine Bluff	Pine Bluff	Stamps	110	120	100	110	25	10	70
Pine Bluff	Stamps	Big Sandy	115	125	100	110	30	15	75
Pleasant Valley	Colton	Clear Creek	95	105	85	95	10	-5	55
Pocatello	Granger	McCammon	95	105	85	95	10	-5	55
Pocatello	McCammon	Pocatello	100	110	90	100	15	0	60
Portland	Hinkle	Troutdale	100	110	90	100	15	0	60
Portland	Troutdale	E. Portland	100	110	90	100	15	0	60
Portland	Fir	Kenton	100	110	90	100	15	0	60
Port Lavaca	Placedo	West Point	115	125	100	110	30	15	75
Powder River	Horse Creek	Shawnee Jct	100	110	90	100	15	0	60
Pratt	Pratt	Meade	105	115	95	105	20	5	65
Pratt	Meade	Dalhart	110	120	100	110	25	10	70
Provo	Helper	Nar. Xover	95	105	85	95	10	-5	55
Provo	Nar. XOver	Grant Tower	100	110	90	100	15	0	60
Rake	Bricelyn	Esterville	95	105	85	95	10	-5	55
Rawlins	Rawlins	Green River	95	105	85	95	10	-5	55
Reisor	Marshall Jct	Texmo Jct	115	125	100	110	30	15	75
River	River Jct	Rock Creek	105	115	95	105	20	5	65
Rockport	Tower 112	Elmendorf	115	125	100	110	30	15	75
Rockwell	Rockwell Jct	Canal St	100	110	90	100	15	0	60
Rosenberg	Rosenberg	Victoria	115	125	100	110	30	15	75
Roseville	Roseville	New Castle	120	130	105	115	35	20	80
Roseville	New Castle	Switch 9	100	110	90	100	15	0	60
Roseville	Switch 9	Vista	105	115	95	105	20	5	65
Sacramento	Mitchell Ave	Stockton	120	130	105	115	35	20	80
Salem	Findlay Jct	Salem	105	115	95	105	20	5	65
Salina	Menoken	Salina	105	115	95	105	20	5	65
Salt Lake	Ogden	Salt Lake	100	110	90	100	15	0	60
San Pedro	San Pedro Jct	Manuel Yd	115	125	100	110	30	15	75
Sanderson	Langtry	Alpine	115	125	100	110	30	15	75
Sanderson	Del Rio	Langtry	120	130	105	115	35	20	80
Santa Barbara	Moor Park	Oxnard	110	120	95	105	25	10	70
Santa Barbara	Oxnard	S.Luis Obisp.	105	115	95	105	20	5	65
Scoville	Aberdeen Jct	Scoville	95	105	85	95	10	-5	55
Seattle	Seattle	Portland	100	110	90	100	15	0	60
Sedalia	River Jct	KC Un. Sta.	105	115	95	105	20	5	65
Shafter	Smelter	Elko	100	110	90	100	15	0	60
Sharon Spring	Salina	Sharon Sprg.	105	115	95	105	20	5	65
Sharp	Provo	Lynndyl	100	110	90	100	15	0	60
Shreveport	Lewisville	Shreveprt	115	125	100	110	30	15	75
Sidney	Hindman	Cheyenne	100	110	90	100	15	0	60
Sikeston	Tyson Foods	Hunterville	105	115	95	105	20	5	65
Sioux City	Cal Jct East	Sioux City	100	110	90	100	15	0	60
Smithville	Smithville	Sealy	115	125	100	110	30	15	75
South Morrill	Ofallons	Horse Creek	100	110	90	100	15	0	60
Sparta	Gage Jct	Coulterville	105	115	95	105	20	5	65
Springfield	Bloomington	Church	100	110	90	100	15	0	60
Spokane	Spokane	Eastport	95	105	85	95	10	-5	55
Strang	S. Tower 68 X-Over	Strang X-Over	115	125	100	110	30	15	75
Tara	E. Grand Jct X-Over	Mallard	95	105	85	95	10	-5	55
Tennessee Ps.	Brown Cnyn	Dotsero	90	100	80	90	5	-10	50
Tennessee Ps.	Spikebuck	Brown Cnyn	100	110	90	100	15	0	60
Tennessee Ps.	Na Jct	Spikebuck	105	115	95	105	20	5	65
Terminal	Dawes	West Jct	115	125	100	110	30	15	75
Topeka	SJ Jct	Herington	105	115	95	105	20	5	65
Toyah	Sweetwater	Sierra Blanca	115	125	100	110	30	15	75
Tracy	Lathrop	Ferry	120	130	105	115	35	20	80
Trenton	Des Moines	Sheffield	100	110	90	100	15	0	60
Tucumcari	Pastura	W Vaughn	105	115	95	105	20	5	65
Tucumcari	Dalhart	Pastura	110	120	100	110	25	10	70
Tulsa	Broken Arrow	Chase	110	120	100	110	25	10	70
Valentine	Alpine	El Paso	115	125	100	110	30	15	75
Valley	Dunsmuir	Lakehead	110	120	95	105	25	10	70
Valley	Lakehead	Roseville	120	130	105	115	35	20	80

Subdivision	Station		Rail Laying Temp. Deg. (F)	Rail Temperature for Speed Restriction behind Track Work Deg. (F)	Blanket Heat Speed Restriction (Level 1) Deg. (F)	Blanket Heat Speed Restriction (Level 2) Deg. (F)	First Event Cold Weather Inspection Temp. Deg. (F)	Cold Weather Inspection Temp. Deg. (F)	Rapid Temperature Drop of 40 F or More Below Temp. Deg. (F)
Van Buren	Van Buren	N Little Rock	110	120	95	105	25	10	70
Villa Grove	81st Street	Villa Grove	100	110	90	100	15	0	60
Waco	Waco Jct	Smithville	115	125	100	110	30	15	75
Wagoner	Coffeyville	Van Buren	110	120	95	105	25	10	70
Walsenburg	Pueblo	Walsenburg	105	115	95	105	20	5	65
Warm Springs	Niles Jct	San Jose	110	120	100	110	25	10	70
White Bluff	LR Jct	S Pine Bluffs	110	120	100	110	25	10	70
Wilmington	West Redondo	Alameda	115	125	100	110	30	15	75
Winnemucca	Herlong	Portola	100	110	90	100	15	0	60
Winnemucca	Winnemucca	Herlong	105	115	95	105	20	5	65
Worthington	St James	Sioux City	95	105	85	95	10	-5	55
Wynne	Jonesboro Jct	N Wynne	110	120	100	110	25	10	70
Yakima	Wallula	Villard Jct	100	110	90	100	15	0	60
Yoder	Horse Creek	Egbert	100	110	90	100	15	0	60
Yuma	W. Palm Springs	W Colton	120	130	105	115	35	20	80
Yuma	East Yard	W. Palm Springs	125	135	110	120	40	25	85

Table 7-J

8.0 TRACK INSPECTION REQUIREMENTS

TRACK INSPECTION REQUIREMENTS

These are the minimum track inspection requirements necessary for inspecting Union Pacific owned track, roadbed and other facilities. Compliance with FRA and Union Pacific policies and procedures is vital to the safety of all employees and the general public.

8.1 Scope

This requirement applies to all Union Pacific owned main tracks and sidings, yard tracks, and industry trackage. Unless a prior agreement concerning the maintenance and inspection is in place, privately owned industry tracks and leased trackage do not fall under Union Pacific inspection responsibility. Private tracks should be identified and inspections must be made up to the clearance point, property line, or gate leading into that industry.

8.2 Standards and Compliance

Compliance with UPRR and FRA standards regarding track safety is mandatory. All Engineering employees must comply with the following standards:

- Union Pacific Engineering Standards (PB-22003).
- Union Pacific Engineering Track Maintenance Field Handbook binder and insert (PB-22000HB & 22000H2).
- FRA Track Safety Standards Subpart A to F, Class of Track 1-5 (PB-22009).
- FRA Track Safety Standards Subpart G, Class of Track 6 (PB-24123).

These requirements include standards, practices and procedures, which MUST be followed to ensure safety and/or to comply with regulations. Track conditions must meet, at a minimum the FRA Track Safety Standards for the associated class of track.

Where track conditions do not comply with these requirements, action must be taken to:

1. Repair - Perform minor repairs or arrange for repairs to bring the track into compliance;
2. Restrict - Slow order the track to the class of track, for which it does comply; or
3. Remove -Take the track out of service until repairs can be made.

In addition, inspection frequencies and traversal of all tracks and switches must be performed at a minimum, to meet all FRA requirements.

8.3 FRA Qualified Personnel

8.3.1 FRA 213.7 Qualification (Class of Track 1-5)

Each employee responsible for the inspection of (213.7 b) and/or repair of track (213.7 a) and/or installation/inspection/repair of CWR (213.7 c) owned and maintained by UPRR must be trained and designated as qualified per FRA 213.7. The basis for the qualifications consists of one year's supervisory experience or a combination of work experience and track inspection training. More importantly, managers must ensure that employees know and understand the regulations, are able to identify defects, and can prescribe the appropriate remedial actions before 213.7 designations are made. Employees must demonstrate the ability to make accurate track geometry measurements using the proper measuring devices and determine remedial actions using the FRA Track Safety Standards. All employees responsible for the inspection, installation, adjustment or maintenance of CWR track must complete training on CWR procedures every calendar year. In addition, they shall be provided a copy of these procedures and accompanying documents. Engineering **Directors and Managers** will maintain lists of those employees qualified to supervise restorations and inspect track in CWR territory. The qualified employee lists will be made available to the FRA upon request. Training programs will address the following:

- CWR installation procedures.
- Rail anchoring requirements when installing CWR.
- Preventive maintenance on existing CWR track.
- Monitoring curve movement following track surfacing and lining.
- Placing temporary speed restrictions account track work.
- Rail joint inspections.
- Insufficient ballast.
- Extreme weather inspections.
- Recordkeeping.

Signal and Track employees designated as 213.7(d) are required to receive broken rail pull-apart training every 2 years. Completing this training will serve as the qualification for this requirement provided the employee has at least one year of M/W or signal experience.

Engineering Directors and Managers will maintain lists of those employees designated as qualified per 213.7 (a) (b) (c) and (d). The list is maintained in the Track Maintenance Planner (TMP) under the Track Inspect tab (Application for FRA 213.7 Qualified persons). The qualified employee lists will be made available to the FRA upon request.

Newly promoted Track Inspectors must be scheduled to attend UPRR's Track Inspection training within 30 days of being awarded the position.

Any person who has been designated as a 213.7 (a) (b) or (c) qualified employee is required to receive track inspection refresher training every 3 years.

8.3.2 FRA 213.305(a) Qualification (Class of Track 6)

Employees may be qualified to perform restorations and renewals, 213.305(a), in one of three ways:

1. The employee may combine five or more years of responsible supervisory experience in track maintenance for Class 4 track or higher and the successful completion of a training course specifically developed for high speed track supplemented by special on-the-job training emphasizing the techniques to be used in the supervision, restoration, and renewal of high speed track.
2. The employee may be qualified by a combination of at least one year of responsible supervisory experience in track maintenance of Class 4 track or higher and 80 hours of specialized training or in a college level program supplemented by special on-the-job training with emphasis on the maintenance of high speed track.
3. As a third option, an employee with at least two years of experience in track maintenance in Class 4 track or higher can achieve qualification status by completing 120 hours of specialized training in the maintenance of high speed track provided by the employer or by a college level engineering program, supplemented by special on-the-job training with emphasis on the maintenance of high speed track. All or part of the experience required may be non-supervisory.

Employees must pass a recorded examination on high speed track maintenance and inspection procedures as part of the qualification process.

8.3.3 FRA 213.305(b) Qualification (Class of Track 6)

Employees may be qualified to perform track inspections, 213.305(b), in one of three ways:

1. The employee may combine five or more years of responsible experience inspecting track for Class 4 track or higher and the successful completion of a training course specifically developed for high speed track supplemented by special on-the-job training emphasizing the techniques to be used in the inspection of high speed track.
2. The employee may be qualified by a combination of at least one year of responsible experience in track inspection of Class 4 track or higher and 80 hours of specialized training supplemented by special on-the-job training with emphasis on the inspection of high speed track.
3. As a third option, an employee with at least two years of experience in track maintenance in Class 4 track or higher can achieve qualification status by completing 120 hours of specialized training in the inspection of high speed track supplemented by special on-the-job training with emphasis on the inspection of high speed track.

Employees must pass a recorded examination on high speed track maintenance and inspection procedures as part of the qualification process.

8.3.4 FRA 213.305-Additional Qualification Requirements

Managers must ensure that employees know and understand the regulations, are able to identify defects, and can prescribe the appropriate remedial actions before 213.305 designations are made. Employees must demonstrate the ability to make accurate track geometry measurements using the proper measuring devices and determine remedial actions using the FRA Track Safety Standards (TSS).

All employees responsible for the inspection, installation, adjustment or maintenance of CWR track must complete training on CWR procedures every calendar year**.** In addition, they shall be provided a copy of these procedures and accompanying documents**.** Engineering **Directors and Managers** will maintain lists of those employees qualified to supervise restorations and inspect track in CWR territory. The qualified employee lists will be made available to the FRA upon request.

Signal and Track employees designated as 213.305(d) are required to receive broken rail pull-apart training every 2 years. Completing this training will serve as the qualification for this requirement provided the employee has at least one year of M/W or signal experience.

8.4 Track Inspection Responsibilities

8.4.1 Chief Engineer

The Chief Engineer is responsible for monitoring inspection compliance.

8.4.2 Director Track Maintenance

The Director Track Maintenance (DTM) is responsible for the quality of all inspections on his territory. Those responsibilities include:

1. Coaching and mentoring Manager Track Maintenance (MTM) to ensure that quality maintenance practices, repairs and track inspections are performed.
2. Monitor inspection activities to ensure compliance.
3. Periodic inspections of jointly operated track on which Union Pacific operates but another railroad owns or maintains. This inspection must ensure that proper maintenance procedures are being followed.

8.4.3 Director Track Maintenance Inspection Guidelines

1. Spend at least 5 days per month conducting hy-rail and walking inspections of main tracks, sidings, industry leads, and yard tracks.
2. Once every 4 months inspect all FRA Class 3 through 6 main tracks.
3. Once every 6 months, ride passenger trains, freight trains or geometry car over all main tracks.
4. Once each year, inspect all Class 1 and 2 main tracks, industrial leads and critical switching leads.

See Table 8-A for schedule of DTM inspections:

FRA Class Main Track		**6/5**	**4**	**3**	**2/1**
Director Track Maintenance	Passenger Train, Geometry Car or Freight Train	6 Mo	6 Mo	6 Mo	6 Mo
	Hy-rail/Walk	4 Mo	4 Mo	4 Mo	1 Yr
	*Switches	*Exception based inspection process			

Table 8-A

8.4.4 Managers Track Maintenance

The Manager Track Maintenance is responsible for the quality of all inspections on his territory. Those responsibilities include:

1. Ensuring that existing track conditions that do not comply with FRA regulations are properly protected.
2. Coaching and mentoring Track Inspectors and maintenance personnel to ensure the quality maintenance practices, repairs and track inspections are performed.
3. Manage situations that would prevent a Track Inspector from meeting inspection frequencies, writing defects, or initiating remedial actions.
4. Understanding the UPRR electronic track inspection process.
5. Manage territory/playbook by assigning tracks to inspectors in the TMP. See Section 8.5.6 Track Inspection Playbooks.

Do not assign other duties that would prevent Track Inspectors from conducting their required inspections to meet frequency compliance without the prior approval of the Director Track Maintenance.

8.4.5 Manager Track Maintenance Inspection Guidelines

1. Once each month cover entire mainline by hy-rail, walk, Evaluation Car, Detector Car or any combination thereof.
2. Once every 90 days, ride passenger trains, freight trains or geometry car over territory.
3. Once every 90 days, accompany Track Inspectors on their entire main and industrial leads track inspections.
4. One each year, conduct hy-rail or walking inspections of all yard and industry tracks.
5. Ensure critical leads are walked every 2 weeks. Refer to 8.6.23 for Critical Leads.

A monthly Track Inspector evaluation can be conducted during any of the aforementioned inspections, if performed with the Track Inspector.

See Table 8-B for schedule of MTM inspections.

FRA Class Main Track		**6/5**	**4**	**3**	**2/1**
Manager Track Maintenance	Passenger train, Geometry Car or Freight Train	3 Mo	3 Mo	3 Mo	3 Mo
	Hy-rail/Walk/EC/DC	1 Mo	1 Mo	1 Mo	1 Mo
	Switches	1 Yr			

Table 8-B

8.4.6 Inspector Evaluations

Track Managers must ensure the overall quality of track inspections by performing a monthly Track Inspector evaluation during a hy-rail or walking inspection with each assigned inspector. Inspectors are to be evaluated as Satisfactory or Needs Coaching. Track Inspector Evaluation Form is found by: MyUP > Track Maintenance > Track Maintenance Planner > TRK INSP tab > Track Inspector Evaluation.

Items to be evaluated include:

- Overdue reports to ensure proper inspection frequencies.
- Inspection schedules/playbooks.
- Reports reflecting actual track conditions.
- Remedial actions taken to protect defects.
- Track Maintenance Planner (TMP) maintenance items.
- Vehicle and inspection tool audits.

Substandard inspections, remedial actions or failures to comply with the items shown on the evaluation form need to be documented and rated. Managers should include feedback in the form of comments to reinforce expectations and to improve the Track Inspector's performance. Track Inspector evaluations will be submitted electronically using the Track Maintenance Planner/ Manage Tab/ Inspector Evaluations.

8.5 Track Inspector Responsibilities

The Track Inspector's primary responsibility and duty is to inspect track for defects and protect all defects found according to UPRR and FRA Track Safety Standards.

1. Track Inspectors will perform inspections on foot or by riding in a vehicle that allows visual inspection of the track. Track Inspectors must be allowed to complete inspections of all assigned track and switches to at least meet FRA minimum frequency for each calendar month.
2. The Track Inspector has both the authority and responsibility to slow order the track or remove tracks from service as conditions warrant.
3. Track Inspectors are also expected to perform minor repairs, but at no time will the scope of running repairs prevent the inspector from completing scheduled inspections.
4. Track Inspectors will complete required reports.

8.5.1 Track Inspection Frequencies

All tracks and switches must be inspected to meet minimum FRA frequencies. If a Track Inspector is not afforded the opportunity or time to inspect the tracks at the required frequency, the Track Inspector is to advise that the track will be removed from service until inspection can be made. If more inspection days are needed to achieve compliance, conduct inspections on rest days.

1. Track Inspectors will, at a minimum, inspect using Table 8-C-1.
2. Track Inspectors responsible for the inspection of concrete tie track with more than 40 MGT annually are required to traverse the track every month by passenger trains, freight trains or geometry car.

Track Type	Class of Track	Frequency of Inspection
Main Track and Sidings	1, 2, 3	1) Inspect weekly with at least 3 calendar days between inspections. Exceptions: If the track is used less than once per week, inspect before use. **or** 2) Inspect twice weekly with at least 1 calendar day between inspections, if passenger trains operate or more than 10 MGT of traffic during the previous year.
	4, 5	Inspect twice weekly with at least 1 calendar day between inspections.
	6	Inspect twice weekly with at least 2 calendar day between inspections.
	1,2,3,4,5,6	On lagged screw curves ≥ 3° perform a walking curve inspection every 90 days or operate a GRMS in lieu of walking.
Industry leads Industry tracks Yard tracks	1-3, Excepted	Inspect monthly with at least 20 calendar days between inspections. Exceptions: If the track is used less than once per month, inspect before use.
Connecting tracks		Inspect weekly with at least 3 calendar days between inspections.
		On lagged screw curves ≥ 3° perform a walking curve inspection every 90 days or operate a GRMS in lieu of walking.
Turnouts and crossover tracks	1-5	Inspect monthly on-foot
	6	Inspect weekly on-foot
Traverse Mains		Once every 2 weeks
Traverse Sidings		Monthly
Test Spring Frogs	2 - 6	Every 90 days with 60 days between inspections

Table 8-C-1

These are minimum inspection requirements. Perform additional inspections when directed by the MTM or whenever the safety of train operations is in question.

Automated cant inspections (Geometry Car Cant Inspection System) of track constructed with concrete ties must be inspected at the frequencies in the following chart.

Class of Track and Service	Frequency of Inspection	Type of Inspection
4, 5 or (3 with Regularly Scheduled Passenger Service) and > 40 MGT	2 times each calendar year with no less than 160 days in between inspections	Automated Inspection
4, 5 or (3 with Regularly Scheduled Passenger Service) and <= 40 MGT	1 time each calendar year	Automated Inspection
3, 4, 5 Main Line that is Exclusively Passenger Service	1 time each calendar year	Automated Inspection or Walking
4, 5 or (3 with Regularly Scheduled Passenger Service) with train operation interruption	1 time within 45 days after train operation has resumed	Automated Inspection or Walking
Less than 600 feet of tangent track constructed of Concrete Ties in 4, 5 or (3 with Regularly Scheduled Passenger Service)	None	None

Table 8-C-2

Multiple tracks can be inspected by hy-rail using the following methods:

1. One Inspector. Inspect up to two tracks at one time, provided the inspector's visibility remains unobstructed and the adjacent track being inspected is not more than 30 feet from the center of the track on which the inspector is riding.
2. Two Inspectors. Inspect up to four tracks at one time, provided the inspectors' visibility remains unobstructed and the adjacent tracks being inspected are not more than 39 feet from the center of the track on which the inspectors are riding.

8.5.2 Other Inspection Requirements

Follow these other inspection frequency requirements:

1. If an assigned Track Inspector is absent, or if no Track Inspector is assigned, assign the inspection to a FRA-qualified person.
2. In the event a track is used less than once every month, the track may be taken out of service and then inspected on foot before it is returned to service. Inspectors must tag, lock, clamp or spike the switch, and use the Engineering Track Management System (ETMS) to change the status of these tracks to out of service until such time that it is needed.
3. A switch may not be taken out of service if any movement occurs over any part of that switch and will be required to be inspected at normal FRA frequency.
4. Walk tracks, switches and joints whenever possible.

8.5.3 Track Inspector Documents

Track Inspectors must carry the following documents:

- FRA 213.7 qualification card. (24204)
- FRA 213.305 qualification card (24204G) Class 6 track only.
- Engineering Track Maintenance Field Handbook binder and insert. (PB-22000HB & 22000H2)
- Written CWR Procedures (PB-21968)
- FRA Part 213 Subpart A-F Track Safety Standards. (PB-22009)
- FRA Part 213 Subpart G Track Safety Standards. (PB-22095) Class 6 track only.
- OTS/RMM Manuals. (PB-20510)
- Job Briefing book. (24318)
- Lone Worker Job Briefing book. (24327)
- Timetable/General Orders/SSI. (PB-27015)
- GCOR/MW Rule Books. (PB-20396)
- Track Bulletins.
- Condensed Profile and ZTS (TMP).
- Hy-Rail Inspection Log (Form-24126)

This is a minimum requirement for track inspection, local polices may require other documentation.

8.5.4 Track Inspection Vehicles

1. Track Inspectors are responsible for the safe operation and condition of assigned hy-rail inspection vehicles used for track inspection. At a minimum, vehicle must have annual hy-rail inspection and daily inspection log filled out before vehicle is set on the track.
2. Inspectors will operate hy-rails at speeds slow enough to allow a thorough inspection of the entire roadbed and track structure. Vehicles used for track inspection must not exceed 5 MPH when passing over track crossings or turnouts.

8.5.5 Track Inspector Tools

Track Inspectors must have access to the following inspecting tools to perform a proper inspection:

1. Tape Measure
2. Level Board
3. 62 ft. String Line
4. 124 ft. String Line for Class 6 Inspections
5. Taper or Step Gauge
6. 6”, 24” and/or 36” straight edge
7. Highly Visible Ribbon (to mark defects)
8. Rail wear gauge
9. GPS Unit
10. Portable Track Loading Fixture (PTLF)
11. Paint Sticks /soapstone/ lumber crayon

The following is a list of recommended tools to assist Track Inspectors to make quality track inspections:

1. 2 lb. hammer
2. Counters
3. Engine inspection mirror.
4. Track geometry strip charts
5. Spring frog testing devices

Track Inspectors should also carry the proper tools and materials to make minor repairs.

8.5.6 Track Inspection Playbooks

To ensure that FRA inspection frequencies are met, Track Inspectors and managers will designate tracks and switches for each Inspector territory. Once the territory is defined, Track Inspectors will develop a daily inspection plan (setups). On main lines, inspectors must define the territory limits and designate days to inspect specific turnouts within that range. Yard Inspectors may group tracks and switches, as conditions and operating plans change. Managers and Inspectors will monitor the inspection progress against this plan, and adjust accordingly. Managers assign tracks in TMP under Manage or Track Inspect tab (Manage Track Inspector Territories & Playbooks).

Playbook compliance is only achieved when all the inspection requirements for tracks and switches are performed on a monthly basis.

8.5.7 Track Inspection Reporting

Track Inspectors must create an inspection report whenever an inspection is performed. Assigned Track Inspectors will use the electronic track inspection system to report FRA inspections of UPRR owned track.

Track Inspectors will use their USER ID and password as their electronic signature. Track Inspectors must not use USER ID’s to access and report FRA track inspections. See Section 8.10.8 FRA Requests for Information.

Track Inspectors must ensure the accuracy of the following items:

1. A complete list of the tracks and switches inspected.
2. Main and siding track traversals.
3. Defects found with remedial actions listed for each defect.

All track inspection reports must be completed on the day of the inspection using the Engineering Track Management System or temporarily on paper. Electronic Reports must be uploaded within 24 hours of the closing of the report. In the event the inspector is unable to use the electronic system, paper copies may be used. All paper copies must be converted into electronic form as soon as possible. Paper copies that are entered into the electronic system within 72 hours of the day of inspection (with required comments) can be discarded and the electronic copies are considered the copies of record. Any paper copies that are not entered in that time frame will be considered the copy of record and must be kept at the Service Unit headquarters for viewing by the FRA.

8.5.8 Relief Track Inspections

Relief inspectors will use either the Engineering Track Management System, UPRR Web Based FRA Inspection Reporting, or paper copies to document FRA required inspections.

8.5.9 Track Inspection FRA Defect Reporting

All track conditions that do not comply with the FRA 213 Safety standards must be identified and appropriate remedial action taken. Track Inspectors will record defects and the appropriate remedial action for every non-compliant FRA condition, even if it was **repaired immediately.**

8.5.10 Track Inspection Reporting - TMP

Various track conditions can be documented using the Electronic Track Inspection System.

Track conditions that require TMP documentation include:

1. Conditions at joint locations in CWR territory.
2. Insulated Joints.
3. Road Crossing Conditions.
4. Any conditions that are approaching FRA thresholds.

8.5.11 Remedial Action Definitions

Repaired Before Traffic - Inspectors will use the remedial action of “Repaired before Traffic” when a defect is corrected before the passing of a train. Complete the date and type of corrective action to close the defect. Do not assign gangs to defects that are or will be corrected the same day of the inspection.

Slow Orders - Inspectors will use slow orders to protect locations that do not meet the Class of track standards set forth in 213 Track Safety Standards (TSS). Whenever a slow order is placed, inspectors will arrange to place yellow boards in advance of the restriction, unless the inspector knows that the defect will be repaired before the end of that working day.

Schedule for Repair - This remedial action can only be used for non-class specific defects. Once “Schedule for Repair” is used, defects must be repaired as soon as possible, with the understanding that all defects will be repaired within 30 days. All “Schedule for Repair” defects that exceed 30 days are in violation of FRA regulations.

213.9(b) - When a defective condition exists that does not meet the FRA requirements for Class 1 track, inspectors may still allow operation at Class 1 speeds over that defect for a period of not more than 30 days if the inspector determines that operations may safely continue. If the track has not been repaired before the 30 day period has expired the track will be taken out of service.

Out of Service - When Track Inspectors take tracks out of service, no operation is to take place over that track until repairs have been made and the track is restored to service.

Exception: **Out of Service Tracks can be operated over only in cases of emergency and only if a qualified person visually supervises each move.**

8.5.12 Excepted Track

Follow these requirements for designating a track as excepted status:

1. The designated track must be identified as a yard track, industry track or industrial lead.
2. The track must be identified as “Excepted Track” in the timetable, special instructions or general order.
3. The identified segment of track must not be located within 30 feet of an adjacent track which can be subjected to simultaneous use at speeds in excess of 10 mph.
4. The identified segment of track must not be located on a bridge including the track approaching the bridge for 100 feet on either side, or located on a public street or highway, if railroad cars containing commodities required to be placarded as hazardous material are to be operated on the track.

Train operations on a track designated as excepted are limited by the following requirements:

1. No train shall be operated at speeds in excess of 10 mph.
2. No occupied passenger train shall be operated on the track.
3. No freight train shall be operated on the track if it contains more than five cars required to be placarded as hazardous material.

Follow these requirements for inspection of excepted track:

1. Gage exceeding 57 ¾ inch requires remedial action or removed from service.
2. Excluding gage defects, all other defects will be reported using the remedial action “Excepted Track.”
3. Excepted track is to be inspected monthly with at least twenty (20) days between inspections. If a track is used less than once per month the track need only be inspected prior to use.
4. Unsafe track conditions require the track to be removed from service immediately.

Follow these requirements prior to removal of a track from excepted status:

1. The Manager Track Maintenance must inspect the track to ensure the condition of the track meets the requirements for the desired class of track.
2. The Manager Track Maintenance shall advise the Director Track Maintenance prior to the removal of a segment of track from excepted status.
3. The Manager Track Maintenance shall advise the appropriate FRA Regional Office at least ten (10) days prior to removal of a track from excepted status.

8.5.13 Track Inspection Defect Management

Managers Track Maintenance are responsible for the overall monitoring of track defects reported by Track Inspectors and other automated detection systems. Defects must be corrected in a timely manner consistent with FRA and UPRR requirements. These defects include those found by:

- Track Inspectors
- FRA Inspectors
- Detector Cars
- Geometry Cars
- Vehicle Track Interaction (VTI) Equipped Vehicles
- Gage Restraint Measuring System Vehicles

Defects can be closed in the following manner:

- Production Reporting by the gang making repairs.
- Track Inspectors using the Engineering Track Management System.
- Track Maintenance Planner (which includes MTM's).
- System Gang work through the Track Maintenance Planner.

8.6 Track Inspection Guidelines

These are basic guidelines, when making inspections, and initiating remedial actions, refer to the Engineering Track Maintenance Field Handbook and the FRA 213 Track Safety Standards.

8.6.1 Ballast

Good ballast and proper drainage are necessary to maintain good surface and line throughout the track structure. Ensure that muddy conditions and standing water in the track structure are reported. Monitor the amount of ballast present off the shoulders and in the cribs, especially when there is potential for tight rail conditions. Ballast defects (insufficient and fouled) are non-class specific.

8.6.2 Drainage

Drainage is a sometimes neglected yet important aspect of track inspections. Check for any condition that prevents water from flowing freely away from the track. Culverts, bridges and ditches need to be inspected once every three years and defects reported where problems exist. Note any standing water along the tracks because it may indicate a blocked culvert. Drainage defects are non-class specific.

8.6.3 Vegetation

Vegetation defects occur over time and need to be remedied before they become a safety hazard to employees and trains. A "Form C" stumbling hazard can be issued whenever "schedule for repair" is used as a remedial action, if the vegetation condition is in walkways. Repairs must be made as soon as possible within a 30 day time period. Refer to Section 8.6.20 Road Crossings for road crossing vegetation remedial actions. Refer to section 6.2 and Standard Drawing No. 0025 Rail Markings for Engines, Cars and Equipment Clear of Road Grade Crossings.

8.6.4 Gage

Wide gage is responsible for more track caused derailments than any other defect. Inspectors must regularly monitor gage conditions in curves and turnouts and at joint locations. Add lateral under load movements to existing measurements to determine remedial actions. When inspecting yard tracks, industry leads and industry tracks, once gage measurements reach 57 ¾", the track must be taken out of service.

The Portable Track Loading Fixture (PTLF) is a tool that is designed to test track gage, lateral strength of railroad crossties and fastening systems. The PTLF applies 4,000 pounds of lateral force providing the ability to simulate a lateral load on the track to get the full track movement. The PTLF provides the ability and flexibility to find potential gage locations that would not normally be measured with just a track gage. The PTLF is best used in locations where:

- Track movement is indicated on the fastenings and/or ties, and the need develops to measure the full movement.
- Static track gage measurements exceed 57-1/4".
- PTLF and light gage trucks find .75" movement.
- Wide gage has been found behind the evaluation cars.
- Wide gage has been found behind the Gage Restraint Measurement System (GRMS) vehicle.
- Ahead of yard & industry switch points checking for any gap that may occur under load.

8.6.5 Geometry

Geometry defects include alignment and surface defects such as runoff, profile, cross level, and warp. Geometry defects are class specific. Accurate measurements must be taken and entered into the report. All measurements must include movement under loaded conditions.

8.6.6 Crossties

1. Minimum non-defective ties over any 39 foot section (0109B4 – FRA TSS Defect Code) have remedial actions based on the number of non-defective ties. Include the number of non-defective ties when reporting the minimum number of ties per 39 feet.
2. Joint Tie Defects (0109B3) also have remedial actions based on distance measured to the first non-defective tie. If a joint tie defect exists where the distance from the centerline of a joint measures over 24 inches to the first non-defective tie in both directions, then the only remedial action is 10 mph per 213.9(b) if the defect is not repaired. Include the distance to the first non-defective tie when writing a joint tie defect.
3. Tie Cluster Defects 0109B1 and 0109B2 do not have specific remedial actions, therefore, crosstie clusters may be written as non-class specific defects. The following criteria for tie clusters may be written as a TMP item, or as an FRA defect; however, consider geometry when determining any remedial action concerning tie clusters. Inspectors must use good judgment when writing tie cluster defects.
   - When FRA geometry deviations exist at tie cluster locations, be governed by the remedial action table shown in TSS 213.63.
   - Use more restrictive actions for turnouts and curves.

8.6.7 Rail Defects

There are 2 main categories of rail defects; Transverse (percent of railhead) and Longitudinal (length of defect). Transverse defects are usually found by detector cars. Track Inspectors need to always be on the lookout for:

1. Unusual appearances on the rail running surface.
2. Bleeding and discoloration below the rail head.

Joint locations are prone to various rail defects. (Bolt Hole Breaks, Head Web separations, and Horizontal Split Heads).

A crack across the running surface requires the remedial action for “breakout”. Those rails must be either replaced, removed from service or movements across visually supervised.

The remedial action of 213.9(b) cannot be used for rail defects.

8.6.8 Rail End Mismatch

Mismatch is found where new rail has been installed against old. Mismatch also is found at loose joints or improperly installed compromise joints. There are two types of mismatch, Tread (top) and Gage (side). Gage mismatch is a serious condition which can lead to a derailment.

8.6.9 Rail Joints

Joint bar requirements are class specific in that certain requirements must be met to operate at certain speeds. Because of the wide range of defects, care must be used in determining the remedial action shown.

Remedial action for TSS 213.121(e) – Less than two bolts in a rail end in CWR territory if not repaired – 10 mph per 213.9(b) or out of service.

8.6.10 Joint Bar & Insulated Joint (IJ) Inspection Frequency

Table 8-D1 shows the required inspection frequency.

Territory	Track Class	Track Type	Frequency
CWR	Class 6	All tracks	Every 30 days
CWR	Class 3-5	Main tracks	Every 30 days
CWR	Class 2	Main tracks	Every 90 days
CWR	Class 2-5	Sidings, industrial leads, and connecting tracks	Every 90 days
CWR	Class 1	All tracks	Yearly
Jointed Rail	Class 2-5	Main tracks, sidings, industrial leads and connecting tracks with annual tonnage exceeding 10 MGT	Every 90 days
Jointed Rail	Class 2-5	Main tracks, sidings, industrial leads and connecting tracks with annual tonnage greater than 5 MGT and less than 10 MGT	Every 6 months
Jointed Rail		All other tracks	Yearly

Table 8-D-1

For all Class 6 tracks, rail joint bars and insulated joints must be inspected on foot and inventoried every 30 days and documented in the Track Inspection System.

For CWR main Class 3-5 tracks, rail joint bars and insulated joints must be inspected on foot and inventoried every 30 days and documented in the Track Inspection System.

For CWR main Class 2 tracks, rail joint bars and insulated joints must be inspected on foot and inventoried every 90 days and documented in the Track Inspection System. The Director Track Maintenance is responsible for arranging more frequent inspections if conditions warrant.

For Sidings, industrial leads and connecting Class 2-5 tracks, rail joint bars and insulated joints must be inspected on foot and inventoried every 90 days and documented in the Track Inspection System.

When snow prevents the inspection of joint bars and insulated joints for a particular territory within the required frequency, the inspection interval may be extended by up to 30 calendar days from the last day that the extreme weather condition prevented the required inspection.

Track inspectors or assigned employees conducting inspections and inventory of joints bars and insulated joints must mark the field side joint bar. Mark TOP of joint bar per Figure 8-A with a single line at the lower mile post end in sequential order per the schedule in Table 8-D-2. Lumber crayons item numbers for e-procurement are in Table 8-D-2.

The automated joint inspection car traversing the track is considered an inspection.

NOTE: Do not use paint sticks, spray paint, etc. that will result in permanent marks left on joint bars.

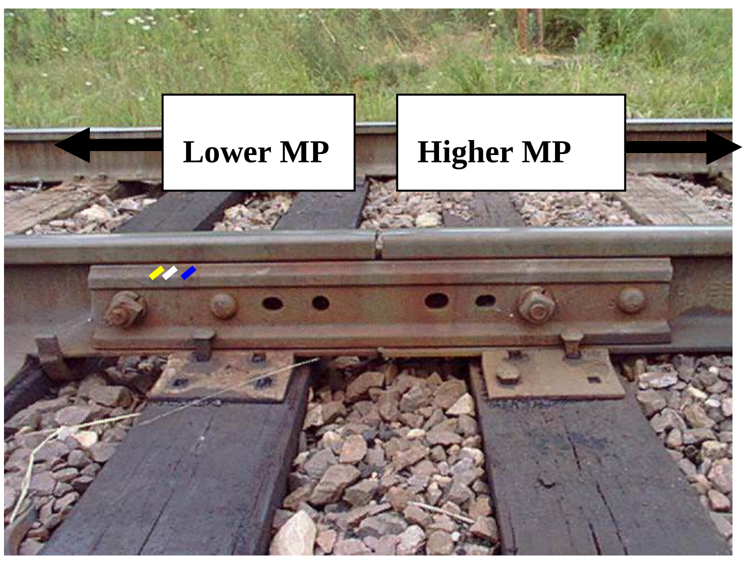

Figure 8-A

Table 8-D2 shows the required marking schedule.

Track Type	Month	Chalk Color	Lumber Crayon Item Number
Main	**January, April, July, October**	Yellow	410-1448
	February, May, August November	White	410-4025
	March, June, September, December	Blue	410-4020
Siding	**March, June, September, December**	Blue	410-4020

Table 8-D-2

8.6.11 CWR Joint Bar Inventory

Refer to ETMFH Chapter 4, Section 4.10.4.

8.6.12 Joint Bar Fracture Reporting in CWR

Whenever a broken or cracked joint bar is found on main tracks and sidings in CWR territory during designated inspections, a fracture report must be completed electronically. The Fracture Report shall be prepared on the date the cracked or broken joint bar is discovered.

When reporting joint bar fractures, look for the following conditions that require repair:

- Cracked or broken joint bars.
- Battered, mismatched or broken rail ends.
- Cross-level deviations.
- Lack of support to the joint due to defective ties.
- Broken or missing tie plates.
- Broken, bent, loose or missing bolts.
- Lateral movement on curved track.

Joint bars that are cracked or broken between the middle two bolt holes must be replaced. On the occasion that the bars cannot be immediately corrected, and if safe to do so, a remedial action of 10 mph per 213.9b can be used to protect the location.

8.6.13 CWR Joint Bar Conditions

Locations in CWR territory where conditions exist that could contribute to broken joint bars must also be recorded. If any of the joint bar conditions are not corrected, the inspection frequency increases to once every two weeks until repairs are made. Since these conditions are non-FRA defects, they will be written as a TMP CWR joint condition. Each CWR joint bar watch location shall be identified with a highly visible marking, such as a ribbon. Do not use paint or paint sticks.

These include:

- Loose, missing or bent bolts - A minimum of 2 bolts per rail must be in place at each joint.
- Rail end batter (More than 3/8" in depth and more than 6" in length measured with a 24-inch straight-edge).
- Joint vertical movement that exceeds 75 percent of the allowable threshold for the designated class of track. Joint lateral and vertical movement is the apparent visible movement measured at the joint.

Use Table 8-E to determine if action is needed:

Visible Vertical Movement Table	
Class of Track	**Measurement**
2	2”
3	1 ¾”
4	1 ½”
5	1”
6	¾”

Table 8-E

- Gap between rail ends greater than 1.5 inches.
- Longitudinal rail movement greater than 2 inches.
- Tie(s) not effectively supporting joint.
- Broken or missing tie plate(s).
- Joint lateral movement (in a curve or spiral) that reaches ¾ inch.
- Fouled ballast present in conjunction with joint vertical movement (profile) that exceeds 75% of the allowable threshold for the designated class of track.

Using FRA defects codes and remedial actions removes the re-inspection requirement.

8.6.14 CWR Joint Inspections at Turnout Locations

Joint bars will be inspected at turnout locations during the monthly switch inspection. Turnout locations are defined as:

- At Control Points and signalized switches – All joints up to and including the insulated joint for the signal governing movement over the switch. In the event the insulated joint plug is not welded in track, include both joints on each end of the plug.
- Other turnouts in CWR territory – include all joints 50 feet in front of the switch points and 50 feet behind the heel of frog.
- At cross-overs all joints in track between switches.

At track crossings

- All joints from the crossing up to and including the insulated joints at the signals governing movement entering and leaving the control point or interlocking.
- If there are no signals at the track crossings, include as a minimum all joints that are between or connected to the crossing frogs.

At lift rail assembles or other transition devices on movable bridges.

- All joints immediately attached to the rail assembly or transition device.

  If a cracked or broken joint bar is discovered during the monthly inspection of any of the above locations, the required reports must be completed.

Embedded Joints

Permanently Embedded Locations:

- Where such locations exist, it is not necessary to disassemble or remove the track structure (e.g., remove pavement or crossing pads) to conduct an inspection of CWR joints. Make every effort, to the extent practicable, to inspect the visible portion of joints in these structures.

Temporarily Buried Locations:

- Joints may sometimes be temporarily buried (e.g., where ballast or similar material is in the middle of the track and along the track) and therefore unavailable for inspection. Where CWR joints are buried (e.g., by ballast), wait for the completion of the track work before conducting joint bar inspections.

It is not necessary to record joint bar conditions shown in Section 8.6.13 CWR Joint Bar Conditions at turnout locations.

8.6.15 Insulated Joint Bar Inspections

Insulated joint bar inspections are to be included as part of the FRA joint bar inspections. When an insulated joint is found to be defective as described in Table 8-F, take the following actions to protect the safety of train operations:

Level	Defective Conditions	Action
3	Insulation/glue stripped out from center of joint past the 2nd bolt hole on the top of the joint bars, evidence of joint slippage at the end of the joint bars or rail ends touching.	Schedule for repair (replacement) within 30 days. If only defect is rail ends touching, remedial action is slotting.
2	Any of the conditions described in level 3 plus any broken bolts.	30 MPH until replaced
1	Insulation/glue stripped out on both top and bottom of bars. The bars will not fit tight and will allow rail movement and bolts to break.	10 MPH until replaced

Table 8-F

Insulated joints must be kept tamped up with good tie support to avoid the conditions described above. Signal maintainer must be immediately notified of any of the conditions noted above so that the Insulated Joint can be tested for compliance with signal standards.

Actions required for Defective Insulated Joints

When necessary to test one IJ, both insulated joints in the pair must be tested. If an insulated joint fails electrically, the Signal Maintainer must take the following actions to protect the safety of train operations.

1. If only one IJ fails electrically, work with track maintenance personnel to replace the IJ within 30 days. If the joint fails electrically because the rail ends are touching, the action is grinding or slotting the joint.
2. If both joints fail electrically, the following actions must be taken - based on the type of relay or devices in use:
   - BIASED relays or devices (on both sides of the IJ) - work with track maintenance personnel to replace at least one IJ within 24 hours unless slotting the rail ends will fix the problem.
   - NEUTRAL relays (on one or both sides of the IJ) - place track shunt to disable signal system until at least one IJ is replaced unless slotting the rail ends will fix the problem.
3. If a switch polarity joint fails, work with track maintenance personnel to replace the IJ within 24 hours unless slotting the rail ends will fix the problem.

8.6.16 Compromise Rail Joint Inspections

Compromise joint bars must be inspected more frequently than standard joint bars. Track Inspectors should note their location and visually inspect them frequently.

8.6.17 Torch Cut Rail

Torch cutting rail ends or bolt holes is prohibited in any track, except in the case when making an emergency repair. Trains must be supervised across rail ends with torch cut bolt holes until the torch cut bolt holes are removed. If torch cut rail ends are found in main track place a 25 MPH slow order until torch cut rail ends are removed.

8.6.18 Tie Plates

Place a 25 MPH speed restriction where spikes or other objects are between the base of rail and the tie plate causing a concentrated load.

8.6.19 Rail Fastenings

Rail fastenings are components that maintain gage (lag screws, spikes, clips, bolts). Where areas of gage widening are found, insufficient or defective fasteners can be considered as a contributing cause. Fastener defects are non-class specific. When inspecting cut spike or lag screw rail fastenings, ensure cut spikes or lag screws securely hold the plate to the tie by tapping, pulling and/or reseating the fastener.

A single plate with 2 or more broken, loose, or missing spikes or lag screws is considered a defective fastening system; refer to Section 3.5.6, Defective Fastener Repair.

For road crossings in curves ≥ 3 deg, use geometry assessment data, approach conditions and static gauge to determine if crossing panels must be pulled for inspection and/or repair.

8.6.20 Road Crossings

The condition of all public road crossings must be monitored. Refer to UPRR Standard Drawing No. 0529 for design and installation requirements for passive public crossing signage (crossbucks with yield sign, or crossbuck with stop sign) and MofW Rule 53.1.1 Road Crossing Condition.

Items include:

- Signage.
- Crossing surfaces.

- Gates.
- Impaired visibility due to vegetation, OTM, ballast piles, or equipment on the railroad right-of-way.

Immediately report any condition that does not comply with Union Pacific Rules and/or Standards. Employees will notify the dispatcher and issue a 15-MPH (XI) track bulletin for the affected crossing whenever the following conditions are found.

- Improper sight clearances to comply with local regulations.
- Vegetation on the right-of-way that obstructs the view of the crossing.
- Vegetation that obstructs the view of warning signs or signals on railroad property.
- Material placed on the right-of-way that obstructs the view of the crossing.
- Broken crossbuck posts.
- Missing/damaged crossbuck signs.
- Missing/wrong multi-track number plates.
- Missing/damaged stop signs attached to the crossbuck post.
- Missing/damaged yield signs attached to the crossbuck post.
- Missing/damaged private crossing sign (other than field to field locations).
- Missing/damaged stop signs attached to private crossing post.
- Missing whistle posts (public crossings).

Note: Signs are considered damaged if they no longer fulfill their intended function.

Document road crossing conditions using the Engineering Track Management System (ETMS).

8.6.21 Bridges

Conditions on bridges that do not comply with FRA TSS require remediation. In addition, the following bridge conditions shall be reported to the appropriate Manager Bridge Maintenance:

- Marginal tie conditions that exist at an open deck bridge.
- Any geometry condition on a bridge could be an indicator of a more severe condition.
- Combustible materials in or around any bridge structure.
- Any drift built up on the up-stream side of bridge.
- Excess silting of water channel.
- Any missing or loose ballast retainers.
- Any damage seen on the superstructure.
- Any evidence of scouring of back wall and piers.

If there is any concern as to the safety of train operations place a slow order or if necessary, remove from service.

8.6.22 Main Line Curves

Track Inspectors must conduct frequent walking inspections of main line curves. Follow these guidelines:

1. Prioritize curves to be walked by using geometry car reports.
2. Document the walking of curves using the Electronic Track Inspection System.
3. Advise the Manager Track Maintenance of all serious track defects requiring prompt corrective action.
4. Inspect for curve movement periodically, especially during periods of large temperature changes. Where the curve has shifted inward more than an average of 2 inches, the curve must be lined out prior to rail temperatures above or forecasted above designated rail laying temperature. If curve is not lined out or de-stressed a speed restriction of 40 MPH or less must be placed.
5. On mainline, siding and connecting track lagged screw curves ≥ 3 deg. perform a walking inspection every 90 days or operate a GRMS in lieu of walking.

8.6.23 Critical Lead Inspection and Maintenance Criteria

Table 8-G contains the critical lead inspection criteria that are used for inspecting critical leads. The first column has the *Type of Inspection* that is required. The second column has the *Inspection Frequency*, which is how often the critical lead should be inspected. The third column has the *Inspection Method* that is required to perform the inspection. The last column is the *Inspection Threshold* that is used for the inspection.

All critical leads will be maintained to Class 2 standards. A list of critical leads can be found at the following address:

https://home.www.uprr.com/emp/engineering/apps/efms/trk_inventory/index.cfm

On this page choose “Y” as the option in the “Critical Lead Track Over 50’” dropdown to access a list of critical leads.

Critical leads are defined as "any track / lead in a switching yard either, hump or flat switching, or critical support yard where a derailment would result in a major disruption to customer service or operation of our transportation plan". These critical yards are ones that have high importance to the operation. For example hump leads, trim leads, inbound/outbound leads, flat yard switching leads and power leads.

Critical Lead Inspection Criteria			
Type of Inspection	**Inspection Frequency**	**Inspection Method**	**Inspection Threshold**
Critical lead track inspection	Bi-monthly	Visual	Track Class 2
Gage & crosslevel	Annually	Light track geometry inspection vehicle	Track Class 2
Rail flaw inspection	Annually	Ultrasonic inspection	Track Class 2

Table 8-G

8.7 Turnout Inspection Guidelines

Turnout inspections must ensure that the track is safe for operation at currently authorized speeds. All defects must be recorded. All unsafe conditions found during inspection must be remediated. Standard Work Management on the UPRR Website contains instructions for performing switch inspections. MyUP> UP Way> Standard Work.

8.7.1 Switch Stand

Inspect the following items:

- Operate the switch to ensure correct tension on the stock rails and that throw forces are not excessive. The connecting rod and switch rods shall not contact switch plates or ties.
- Check the switch lock or keeper. If a lock is required, ensure that it is present and operates easily. Replace it as necessary.
- Ensure that the switch latch is fastened down tightly and holds the handle securely in place. The handle should not be able to be raised out of the latch in the locked position. Replace the latch as needed.
- Check the condition of the head block ties.
- Check that the stand is securely fastened.
- Ensure that mast is securely attached to the stand.
- Ensure the stand displays the proper target aspect.
- Check the condition of reflectorized targets. Refer to Section 5.2.2 Switch Targets.
- Refer to Section 5.2.4 Switch Stand Adjustment for adjustment procedures.

8.7.2 Connecting Rod

Inspect the following items:

- Check to see that connecting rod does not contact the head block ties.
- Inspect the connecting rod for excessive wear of bolts and bolt holes.
- Ensure that the switch and connecting rod bolts are inserted with the nut on top of the rods with cotter pins in place.
- Check the condition of the eyebolt, its position in the mast barrel and the condition of the connecting rod and all switch rods.
- Ensure the jam nut is tight against the clevis.
- Refer to Section 5.3.1 Connecting Rods for additional information.

8.7.3 Switch Points

Inspect the following items:

- Ensure that points and stock rails are of the same rail section.
- Check points for chipping at the point end. Unusually chipped or worn switch points must be repaired or replaced.
- Ensure that rail stops are in place and securely fastened.
- Points should have full bearing on the switch plates to prevent the points from pumping under train movement.
- Check that rail braces are tight and well driven, but not overdriven to the extent that rail is canted inward.
- Check all cotter keys.

A recommended monthly practice to monitor switch point and stock rail fit is to apply white spray paint to the location where the switch point contacts the stock rail. Paint 12 inches of the point and of the stock rail. As trains pass over that location, observe the paint wear locations. If the paint is worn off within the first 1 inch of the point, a thorough inspection of the switch area must be made to determine the necessary maintenance required to correct the condition. After repairs are made, repaint and monitor the switch point.

8.7.4 Switch Point Throw

Make sure the switch point throw meets these parameters:

1. Verify the proper switch point throw between the stock rail and the switch point using Table 8-H for specified switches. Use Standard Drawings to reference other switch

lengths.

Proper Switch Point Throw Between Stock Rail and Switch			
	39-foot Switch	**30-foot Switch**	**24-foot Switch**
At Point of Switch	4-15/16"	5"	5"
At No. 1 Rod	4-3/4"	4-3/4"	4-3/4"
At No. 2 Rod	4-1/2"	4-1/2"	4-1/2"
At No. 3 Rod	3-7/8"	3-5/8"	3-1/2"
At No. 4 Rod	3-1/6"	2-13/16"	2-3/4"
At No. 5 Rod	2-1/4"	N/A	N/A

Table 8-H

2. On a No. 20 turnout with 39-foot switch points, verify that the switch point fully mates against the stock rail so full head separation occurs approximately 9 inches behind the last switch rod.

8.7.5 Switch Point Fit

Inspect the following items:

- Observe if the points are closing properly. Advise the Signal Maintainer to make any adjustments that are necessary on the power-operated switches.
- Check to see that switch points are not skewed. They must be installed directly opposite each other.
- When switch points are thrown ensure that stock rails do not move when the point makes initial contact.
- Check the throw of the switch points. The correct throw is 4-3/4 inches for hand operated and power switches.

8.7.6 Switch Point Wear

Refer to Section 5.6.2 Switch Points.

8.7.7 Switch Point Guards

Where authorized, measure switch point guards for wear as shown in the standard drawings. If wear is more than the wear limit allowed, the guard can be adjusted or replaced.

8.7.8 Stock Rails

Inspect the following items:

- Check that metal flow on the gage side of stock rails is not more than 1/8 inch.
- Check that stock rail on the turnout side is properly bent to provide a good fit for the switch point.
- Ensure that the stock rail is not curve worn more than 3/16 inch anywhere within 24 inches ahead of the point.

8.7.9 Switch Rods

Inspect the following items:

- Repair or replace transit clips, helper rods, connecting rods and switch rods that are bent or broken.
- Check switch rods for excessive wear in bolt hole areas. Check insulation in insulated rods. Check for excessive wear on rod clips, rod clip bolts and connecting rod bolt.
- Ensure that all bolts are in place. Do not over tighten the bolts connecting the switch rods and transit clips. This connection must be allowed to pivot as the switch is thrown for proper operation.
- Check clearance to avoid contacting ties or ballast. Clean ballast and foreign material out from the connecting rod and switch rod cribs for a distance of 2 inches below the rod.

8.7.10 Switch Plates

Inspect gage plates, riser slide plates, turnout plates, hook-twin tie-plates, frog plates, guard rail plates and tie plates. Inspect for the following items:

- Broken, bent or missing plates.
- Ensure riser plates are securely seated and all braces are tight.
- Gage plates with defective insulation. These must be reported to the Signal Maintainer.
- Riser slide plates and spring frog plates for proper lubrication to permit free movement of switch points and spring wing rail.

8.7.11 Heel Blocks

Inspect the following items:

- Ensure that the heel of the switch point is fully tamped and secure.
- Check the heel block assembly to ensure that the bearing of the switch point is correct in relation to the heel block and to the bent joint bar.
- Check the block assembly for a broken shoulder bolt. Replace bolts where required and maintain them in a tight condition.

8.7.12 Frogs

Inspect the following items:

- Ensure that all bolts and fastenings are of the proper length and diameter and are kept tight. Check for loose bolts in the frog and in the rail joint connections.
- Check each switch, frog, and guard rail for obstructions that may interfere with wheel passage. (snow, ice and other items).
- Keep frog wear within the limits prescribed in FRA 213.137. If the tread portion of the frog casting is worn down 3/8 inch or more below the original contour, the frog should be slow ordered to 10 MPH until repaired. If the frog is located in Class 1 track, note the defect as severe frog condition not otherwise provided (0137E) to facilitate repairs.
- Care should be taken to measure conformal top frogs using the appropriate gages to account for the 1:20 slope. For further details see 5.5.4 – Frog Wear Conformal Frogs.
- Wheel marks in the flangeway indicate a worn frog that needs to be repaired or replaced. Per FRA limits, flangeway depth cannot be less than 1-1/2” (Class 2-5 track) and less than 1-3/8” for Class 1 track.
- Check the frog for alignment and lateral movement, and check for signs of wheel flange contact on the point.
- Check whether the frog point is worn vertically to the maximum wear limit allowed by FRA 213.137. If the point is worn to the maximum wear limit, the frog should be slow ordered to 10 MPH until repaired. If the frog is located in Class 1 track, note the defect as severe frog condition not otherwise provided (0137E) to facilitate repairs.

8.7.13 Spring Frogs

Refer to Chapter 5 for instructions for the inspection and maintenance of Spring Frogs.

8.7.14 Self-Guarded Frog

Inspect the following items:

- Check the wear measurement on raised guards of a self guarded frog. If it exceeds 3/8 inch of original measurement remove from service or if it is deemed safe to operate a 213.9B is required to continue operations, the frog must be repaired or replaced.

8.7.15 Guard Rails

Inspect the following items:

- Check to see that guard rails are properly located in their longitudinal position in relation to the frog point. Also check that guard rails are correctly placed in terms of their lateral position in relation to the gage line of the frog per UPRR Standards.
- The guard check gage for 5/8 inch frog points is 54-5/8 inches from the point of the frog gage line. On heavy point frogs, the check gage is 54-7/16 inches. Heavy point frogs must have 3 welded gage plates in Class 5 track and must be inventoried using the Electronic Track Inspection System.
- Flangeway clearance cannot be less than 1-3/4 inches throughout the guard rail.
- Verify that the guard rails are fully and securely spiked or lagged.

8.7.16 Gage

The standard gage throughout the entire turnout will be 56-1/2 inches. Measure track gage throughout the entire turnout at locations from 4 to 6 ties apart. Look for evidence of movement of the tie plates and calculate the gage under load.

- Two rail lengths ahead of the switch points and behind the frog.
- Check gage at the point of the switch, through to the heel of the switch (checking for movement at rail stops).
- Check gage through the entire length of the frog.
- Check the gage through the turnout on the turnout track and through the turnback curve.

8.7.17 Cross Level

Inspect the following items:

- Measure cross level throughout the turnout at locations from 4 to 6 ties apart.
- Check the turnback curve to ensure that the proper elevation is maintained. Do not allow reverse elevation in the turnback curve.

8.7.18 Surface

Inspect the following items:

- Sight down along the railhead and observe any high or low spots along the track, especially in the switch and frog area. Pay particular attention to surface in the switch area and the toe area of spring frogs.
- Check spots with string line and level board.

8.7.19 Alignment

Inspect the following items:

- Standing ahead of the switch looking toward the frog, look for kinks or line swings.
- Observe the curved closure rails for uniformity of curvature.
- Measure defects by stretching a 62-foot cord along the gage side of the outer rail and

measuring the offsets at the center of the cord.

8.7.20 Inspect Switch Ties

Inspect switch ties as follows:

- Check ties, especially head blocks under the switch heel and under the frog, to ensure they are not defective.
- Ensure that there are a sufficient amount of non-defective ties.

8.7.21 Rails

Inspect the following:

- Measure rails for gage face and for vertical head wear, in accordance with the current rail wear limit charts. Also, examine rails for surface defects and signs of internal defects especially at guard rails and stock rails.
- Use an inspection mirror to closer inspect rail in guard rails and tight switch areas.

8.7.22 Rail Anchors

Check that track is properly anchored adjacent to and through turnouts. If ¾ inch or more movement is evident at the switch point, add more anchors to restrain movement.

8.7.23 Ballast

Inspect the following locations to ensure that no loose ballast is present to obstruct closing:

- Between the point and stock rail up to the heel block.
- Around connecting rods and switch rods.
- Spring frog wing rails.
- Point rails of moveable point frogs.

8.8 Annual Switch Inspections

The Annual Switch Inspection is a partnered inspection that Managers and Track Inspectors will perform on all switches in Classes 3 to 6 tracks. Signal personnel will perform similar switch inspections.

8.8.1 Switch Health Rating

Each switch will be assigned a numbered health rating (using a scale of one through three with one being the best rating) based on a 90 day rolling history (that is updated every 30 days) using:

1. Track and Signal inspection defects.
2. Signal Remedy Tickets.
3. Rail Detector Car Defects.
4. Geometry Car Exceptions.

The switch health rating will be used to prioritize the Annual Switch Inspections.

8.8.2 Annual Switch Inspection Responsibilities

MTM\Manager Signal Maintenance (MSM) – Manages and conducts follow-up inspections and quality assurance based on continued poor health ratings. Makes short-term maintenance recommendations. MSM will conduct joint inspections with MTM\TI as required.

DTM\Director Signal Maintenance (DSM) – Monitors process and insures that quality inspections are completed. Provides resources to support maintenance requirements & upgrades.

DTM\MTM\Signal – Inspections will be driven by the health ratings, and will only be required when data indicates critical conditions or to support program planning.

8.8.3 Switch Inspection Guidelines

Annual switch inspections will be made using the following guidelines:

1. MTM and Track Inspector will inspect all Switches in FRA Class 3 through 6 once per year.
   a. Inspection will be documented using the Track Management System (TI) or TMP. (Form 24159 can be used to record field notes).
   b. Any FRA defects found must be recorded and remediated.
   c. A Track Inspector evaluation will be performed during this switch inspection.
2. DTM and MTM joint inspections will be driven by the Health Rating of the Switch.
   a. Switches with a rating between 2 and 3 should be reviewed by the DTM and MTM.
   b. The DTM and MTM will determine if a joint field inspection is required.
3. Joint MTM and MSM inspections will be driven by the Health Rating of the Switch.

Follow-up inspections will target locations where switches have the poorest health ratings.

8.9 Special Inspections

In case of fire, flood, severe storm, earthquake, or other occurrence that might have damaged track structure, conduct a special inspection of the involved track as soon as possible and, if possible, before operating any train over that track.

8.9.1 Special Inspector Qualifications

Employees who perform special inspections of structures and track must meet the qualification requirements of the Federal Railroad Administration (FRA) Track Safety Standards, Sub-part A, Section 213.7 (a or b) and (c) or for Class 6 track Subpart G 213.305(a or b) and (c).

8.9.2 Training

Employees designated as Special Inspectors must successfully complete special inspection training and follow-up refresher training once each calendar year.

- Perform inspections (including applying UPRR Rules 46.2 Storm Conditions and 46.2.1 Patrolling Track).
- Recognize potential unsafe conditions.
- Protect the safe operation of the railroad.

8.9.3 Identification of Structures

In addition to formal training, each Manager Track Maintenance and Manager Bridge Maintenance must perform a joint inspection on Class 3-6 tracks over assigned territories once each calendar year. The objective of each joint inspection is to:

- Locate vulnerable structures. (These structures are found at Engr. Home Page>Structures>Vulnerable Structures).
- Observe conditions on and adjacent to the right-of-way (such as drainage, vegetation, etc.).
- Observe and discuss any roadbed issues which might be candidates for new drainage structures.
- Note changes that should be included in the list of vulnerable structures.
- Discuss precautions to take if structures and track are affected by severe weather, earthquakes, and other conditions that may jeopardize safe train operations.

After completing the joint inspections, the Manager Track Maintenance and the Manager Bridge Maintenance will review their findings with the other Special Inspectors. When possible, they will complete additional joint inspections with other Special Inspectors.

8.9.4 Notification Procedures

When conditions warrant special inspections to protect the safety of train operations, the Dispatching Center will notify critical railroad personnel. The roles and responsibilities for key personnel in the notification process are described below.

When conditions warrant, the Special Inspector may immediately conduct special inspections without waiting for notification from the Dispatching Center.

8.9.5 Initial Notification

The Dispatching Center receives information from four primary sources:

- National Weather Service.
- National Earthquake Information Service/Regional Reporting Sources.
- Mechanical devices (slide warnings, high water detectors, etc.).
- Reports from field personnel/civilians.
- When Dispatching Center personnel receive a warning, they will immediately notify the appropriate Corridor Manager. The Corridor Manager will in turn immediately notify the affected train dispatcher(s).

8.9.6 Notifying Train Crews

The train dispatcher(s) are responsible for notifying train crews operating in the affected areas and for providing crews with the associated time limits of the warning. When contacting train crews, the train dispatcher(s) will advise the crew of the appropriate operating rules in effect to protect train crews and locomotives. These rules may include one or more of the following:

- Rule 6.21 Precautions against Unusual Conditions.
- Rule 6.21.1 Protection against Defects.
- Rule 6.21.2 Water above Rail.

8.9.7 Notifying Maintenance-of-Way Employees

The Corridor Manager, after notifying the train dispatcher(s), will immediately contact the appropriate Manager Track Maintenance in the affected area to arrange for special inspections.

When the Corridor Manager cannot establish contact, for any reason, with the Manager Track Maintenance:

- The Corridor Manager will advise the Maintenance-of-Way Operations Control (MWOC) Desk at the Harriman Dispatching Center of the warning.
- The MWOC Desk will then assume responsibility for notifying an alternate Special Inspector to perform the inspections.
- After contacting an alternate Special Inspector, the MWOC Desk will advise the Corridor Manager that a Special Inspector has been contacted and assigned to perform

the special inspections.

8.9.8 Special Inspections—General Requirements

When a Special Inspector is notified that conditions warrant an inspection of track and structures for potential damage from severe weather, earthquakes, and other conditions, the inspector must:

- Begin the inspection when it is safe on the affected territory.
- Refer to the list of vulnerable structures and components on the territory during the inspection.
- Give highest priority to Class 4-6 track, and track carrying passenger trains.

When necessary, directors and managers designated as Special Inspectors may appoint another qualified Special Inspector to perform inspections.

8.9.9 Performing Special Inspections

When performing special inspections, the inspector must:

- Evaluate the condition of track and structures to ensure compliance with FRA Track Safety Standards or Union Pacific Standards, whichever is more restrictive.
- Follow established safety rules and procedures during the inspection.
- Take every precaution to ensure personal safety, regardless of the time required to safely complete the inspection.
- When conditions warrant, immediately initiate special inspections without waiting for Dispatching Center notification.
- Provide the Dispatching Center with frequent status reports on the condition of track and structures in the affected area.
- If the condition of track or structures is questionable, immediately report the location to the Dispatching Center and the immediate Engineering Department Supervisor.
- When required, the affected track will receive the appropriate speed restrictions or be removed from service until repairs are completed. The inspector will determine the frequency of the inspections if the nature and the intensity of the threat to track and structures persist.
- The inspector will determine the condition of the track and structures and report findings to the Dispatching Center before removing the speed restriction or placing the track back into service.

8.9.10 Special Inspections-Storms, Floods, Washouts, Mud/Rock Slides

Violent winds and heavy rains associated with tornadoes and hurricanes pose a potential hazard to track and structures. When a storm, an indication of a storm, or high water may cause an unsafe condition in and around the right-of-way, the inspector must:

- Keep informed of current weather forecasts and conditions.
- Notify the immediate supervisor and Dispatching Center of actions.
- Determine the flood stage and how high the water will crest above or below flood stage in relation to track and structures in the affected area.
- Notify the Dispatching Center and immediate supervisor of potential hazards.
- Continue performing inspections until the hazard no longer exists.

When conducting a special inspection of track and structures, the inspector will check the following:

- Alignment, cross level, and profile of the track.
- Bridge piers, abutments, and bulkheads for signs of scouring.
- Substructure and superstructure for damage from large objects washed into structures.
- Piers, bents, and bridge members for missing components.
- Materials fouling the track, such as trees, pole lines, wires, etc.
- Volume of excessive drift and debris under bridges and in culverts obstructing water flow.
- Slide fences, where installed, for physical damage.
- Signal pole lines for physical damage.

8.9.11 Special Inspections—Right-of-Way Fires

When a fire is reported on or near the right of way that may pose a threat to track and structures, the inspector must conduct a special inspection as follows:

- Obtain the milepost location of the fire from the Dispatching Center.
- Determine whether local fire authorities have been notified and are on the scene or are en route.
- Determine the extent of track and bridge structure involvement in the fire, or risk of involvement if the fire were to spread.
- Immediately notify the Dispatching Center and immediate supervisor when track or structures are on fire.

Assess fire damage to track and structures by checking the following:

- Alignment, cross level, and profile of the track.

- Cross ties, bridge ties, bridge pier supports, and abutments.
- Bridge substructure and superstructure.
- Piers, bents, and bridge members.
- Signal pole lines.
- Slide fences (where applicable).

Continue performing inspections and provide frequent status reports to the Dispatching Center and immediate supervisor until the hazard no longer exists.

8.9.12 Special Inspections—Earthquakes

When an earthquake occurs, each quake's magnitude—or inherent strength—is measured and reported by the National Earthquake Information Service operated by the U.S. Geological Survey in Golden, Colorado.

The Richter scale gauges the energy released by an earthquake, as measured by the ground motion recorded on a seismograph. The magnitude of an earthquake is the same no matter where one is located. Its intensity—or the degree to which it is felt in a specific location—varies depending on one's distance from the earthquake's epicenter, or focus.

When an earthquake is reported, the Dispatching Center notifies the Maintenance-of-Way Special Inspectors to begin inspections and to indicate the boundaries of the inspection area. Use the criteria in Table 8-I to determine whether a special inspection is warranted.

Magnitude	Initiate Inspection	Criteria/Action
Unknown	Yes	Field reports ground shaking in a geographic area. Trains stop within 50-mile radius of reported shaking.
0.0 to 4.9	No	No action required.
5.0 to 5.4	Yes	When track is within a 30-mile radius of the epicenter, trains in affected area slow to restricted speed.
5.5 to 5.9	Yes	When track is within a 50-mile radius of the epicenter, trains stop in the affected area.
6.0 to 6.9	Yes	When track is within a 100-mile radius of the epicenter, trains stop in the affected area.
7.0 and above	Yes	When track is within a 150-mile radius of the epicenter, trains stop in the affected area.

Table 8-I

When notified, inspectors must be prepared to perform special inspections to identify hazards and take precautions to protect the safety of trains operating in the affected areas.

When conducting a special inspection, check the following:

- Materials fouling the track, such as trees, pole lines, wires, etc.
- Alignment, cross level, and profile of the track.
- Bridge piers, abutments, and bulkheads for signs of structural damage.
- Substructure and superstructure for damage from large objects falling into structures.
- Piers, bents, and bridge members for missing components.
- Signal outages and malfunctions.
- Slide fences, where installed, for physical damage.

8.9.13 Special Inspections - Hot Weather Inspections

Refer to Chapter 7 - Hot Weather Inspections for instructions.

Inspectors must place temporary speed restrictions, if required, to protect areas of tight rail. If necessary, track must be removed from service until rail is adjusted.

When documenting heat inspections, the inspector must write heat inspection in the comments of the inspection report.

8.9.14 Special Inspections - Cold Weather Inspections

Refer to Chapter 7 - Cold Weather Inspections for instructions.

On main tracks, cold weather inspections must be performed as directed by the Director Track Maintenance.

Inspect for:

- Broken rails
- Pull-aparts
- Curve movement
- Wide gap between rail-ends
- Bent bolts
- Cracked or broken joint bars
- Canted rail

When documenting cold weather inspections, the inspector must write cold inspection in the comments of the inspection report.

8.10 FRA Inspection Guidelines

Track and Signal FRA Inspectors can make unannounced or unaccompanied track inspections. Union Pacific will cooperate with reasonable requests to accompany inspection officials during these visits. Managers are to make every attempt to accompany FRA inspectors.

To minimize conflicts with previously scheduled railroad functions:

- Request that, except in emergencies, the FRA or State Inspector provide at least 1 week advance notice for inspections.

If a FRA or State Inspector arrives unannounced and request that railroad personnel accompany him or her, the railroad manager will:

- Cooperate as long as scheduled commitments are not compromised. An unannounced FRA or State inspector's visit does not automatically take priority over all other employees' duties.
- Reschedule the inspection if the manager cannot accompany the inspector because of prior commitments.
- If the manager cannot arrange some form of company representation, inform the inspector to proceed alone if the inspection cannot be rescheduled.

8.10.1 Identifying Exceptions - Defects

A defect is a condition that does not comply with FRA minimum track/signal safety standards. The FRA Inspector will indicate a defect when there are no checks marked in the violations recommended section on the FRA Inspection Report. If the FRA Inspector indicates a defect, the company representative must prescribe appropriate remedial action immediately.

8.10.2 Identifying Exceptions - Violations

A violation is an FRA enforcement activity that results in civil penalties. Violations generally are recommended when track/signal defects are noted that present a safety hazard to trains and/or the public, or a pattern of repeated or willful non-compliance exists. The FRA Inspector will indicate a violation when "yes" is checked in the violations recommended section on the FRA Inspection Report. If the FRA Inspector indicates a violation, the company representative will prescribe appropriate remedial action immediately.

8.10.3 Violation Penalties

All track/signal violations are referred back to the FRA, which will assess fines of up to $25,000 per violation per day against the railroad. Penalties may be assessed against individuals for willful violations, and, in the case of gross negligence or repeated violations causing imminent hazard, or has caused death or injury, penalties may be up to $105,000. Railroad companies are subject to a $25,000 maximum fine per occurrence if they require or permit an employee who is installing, repairing, or maintaining a signal system to go on duty or remain on duty in violation of the Hours of Service Act.

All employees are subject to federal penalties if they willfully falsify track/signal inspection or hours of service records.

8.10.4 FRA Reports

Whenever an FRA Inspector completes an inspection, an FRA report will be provided to the company representative. All defects recorded by the FRA Inspector must be remediated immediately, if needed, and corrected as soon as possible. Reports will be entered into the Track/Signal Maintenance Planner as soon as possible by the designated employee via e-email address frasnelling@yahoo.com or by fax number 402-271-4081.

8.10.5 FRA Report- Railroad Follow-Up Instructions

After reviewing the FRA Inspection Report, the Manager Track/Signal Maintenance will complete the follow-up to the FRA Report as follows:

1. Enter the type of remedial action taken, using the remedial action codes for each item number.
2. Enter the completion date for each item number.
3. Sign and date the form.
4. Send copy of completed form to the Director of Track/Signal Maintenance.
5. **All completed FRA reports are required to be returned to the FRA.** Mail to the address listed on the reverse side of the form.

8.10.6 FRA Report - Violations

Union Pacific has implemented a web based FRA violation management system. All corrective actions and supporting documents are to be entered in the FRA Violation Management System. Go to the Track Maintenance Planner (TMP)> FRA Reports> FRA Inspection Search> FRA Inspection.

When a violation is issued, Manager Track/Signal Maintenance will:

1. Enter the type of remedial action taken on the hard copy of the FRA Inspection Report, using the remedial action codes for each item number.
2. Enter the completion date for each item number.

3. After all remedial action codes and completion dates have been entered; send the original form to the Director of Track/Signal Maintenance.
4. Record the corrective action and supporting documents in the FRA Inspection Database. TMP > FRA Reports Tab> FRA Inspection Search .

Director Track/Signal Maintenance will:
1. Review, sign and date the FRA Inspection Report.
2. Forward the copy of the FRA Inspection Report where violations are noted to the Chief Engineer upon receipt.
3. Return the FRA Inspection Report where violations are noted to the FRA within 30 days after the end of the month the violation was written.

8.10.7 FRA Violation Investigation Procedures

If the FRA Inspector indicates a violation, the Manager Track/Signal Maintenance will:
1. Investigate every violation.
2. Take photographs of exception. Pictures should include:
   - General area of alleged violation.
   - Actual measurements or conditions (level board, tape measure, etc.).
3. When taking pictures of cross tie violations use the following procedure:
   - 0109B4-Number crossties in sequence for a 39 foot segment (pictures should be taken of no more than 4 ties in a row).
   - 0109B1, 0109B2– Number the sequence of the tie cluster, including geometry measurements and overall track surface and tie conditions (pictures should be taken of no more than 4 ties in a row).
   - 0109B3– Distance measurement to nearest effective tie and overall tie conditions at the joint.
4. In addition to the FRA report, prepare a detailed written report explaining the circumstances regarding the violation, including:
   - Time and date of the FRA inspection.
   - Photographs, sketches, or measurements.
   - Names of all Track Inspectors/Signal Maintainers over defined section of track during the previous 3 months.
   - General track/signal conditions.
   - History of prior defects in vicinity of the location.
   - Proposed corrective/disciplinary action, if necessary.
5. Upload the report and attachments into the FRA Inspection Database and forward a copy of the report and attachments to the Chief Engineer, Director Track/Signal Maintenance and the Track Inspection/Signal FRA Compliance team in Omaha within 15 days of the date of the violation.

8.10.8 FRA Requests for Information

All FRA requests for information must be submitted in writing to the AVP Engineering Maintenance with the exception of the following:
1. Track
   a. Timetables/Slow Orders/General Orders (when performing inspections).
   b. Lists of 213.7 designated employees.
   c. FRA Track Inspection Records (1 Year from date of review).
   d. Rail Inspection Records (2 years from date of review).
   e. Cut in/Cut out reports (1 Year from date of review).
   f. Joint bar inspection frequency reports. (1 Year from date of review)
2. Signal
   a. Timetables/Slow Orders/General Orders (when performing inspections).
   b. Signal Inspection records (2 Years from date of review).

If there are any questions regarding requests for information or location of official reports contact Track/Signal Inspection Compliance Team.

8.10.9 FRA Electronic Inspection Record Review Guidelines

FRA Inspectors are to review inspection reports at Service Unit headquarters. When FRA inspectors request electronic viewing of the records, a railroad representative will provide access to the Union Pacific Operating FRA Access link. Prior to the arrival of the FRA the railroad representative will need to send an email to dsaadm@up.com and Rita A. Pfingsten/UPC@up.com (requests will be answered between the hours of 6:00am to 5:30pm CST Monday through Friday).

1. Requesting a FRA User ID and Password:
   a. The Subject line should read Engineering FRA ID.
   b. The body of the email should read: Please assign an Engineering XFRA ID and Password for an FRA Inspector that will be on Site.

c. The Start Date that the FRA Inspector will be on UP property: ***#Date.***

d. The Inspector will be on UP property for ***#number of Days.***

2. Logging in Using the FRA User ID and Password:
   a. Shut down all open applications. This will include all open web pages.
   b. Completely logoff your computer.
   c. Login using the (FRA) USER ID and Password you were given.
   d. Open a new company web page. Select Department and on the right hand side select FRA Access.
   e. Enter the XFRA user ID and Password you have been given by the dsaadm department.

Records are to be viewed from the terminal and can only be printed in cases where non-compliance needs to be documented. If paper reports were used to document inspections, they must be maintained at the Service Unit headquarters, and provided to the FRA to supplement electronic records.

8.10.10 Signal Inspection Intervals and Record Keeping

For signal and train control system inspection intervals and record keeping instructions, refer to Union Pacific Railroad Signal Inspection and Maintenance Instructions and to the Standard Signal Drawings.

8.11 Required Field Documentation – FRA Compliance

Employees must be able to produce the following items for the FRA, if duties require.

1. Rule Books – Must have copy of GCOR/MW Rule Book, CE Bulletins, Timetable, Special Instructions, General Orders, Written CWR Procedures, FRA 213 Track Safety Standards and Signal Maintenance Instructions/Standard Drawings.
2. On-Track Safety Qualification Card.
3. FRA 213.7 (and for Class 6 track 213.305) Qualification Card – to be carried by employees who either inspect track or perform repairs that require placing or removing slow orders.
4. Statement of On Track Safety (If using individual Train Detection).
5. Machine operators' inspection log book – Updated and kept in machine.
6. Operators Manual (Equipment) – Safe operation instructions.
7. Hy-rail Inspection Logbook – Required to be kept in the vehicle and completed on a daily basis.
8. Working radio – Must have access when using On-Track Safety.

8.12 Derailment Investigation

Refer to Union Pacific's Derailment Cause-Finding and Prevention, (PB-21818). Form can also be found at MyUP > Reference > Derailment Investigation System > Post Derailment Track Geometry Measurement Sheet.

8.13 Track Maintenance Planner – Engineering Defect Management Guidelines

The Track Maintenance Planner (TMP) is the official tool at the UPRR for managing overall Track Maintenance Activities. It also includes the legally required FRA record keeping for all track maintenance activities. It is the accountability of all track maintenance personnel that manage track maintenance, perform inspections or complete repairs to provide timely and accurate reporting in the TMP.

Defect and Exception Overview:

The TMP has the ability to manage multiple defects or exception types. These include:

1. FRA Defects – Support 213 Criteria
   - Found by Track Inspector or Other MOW Personnel
   - Found by Rail Test Operations
   - Found by FRA Inspectors
2. Critical Defects
   - Found by the EC Car in accordance with FRA and UPRR regulations
3. Urgent Exceptions
   - Found by the EC Car and should be repaired
4. TMP Items
   - Exceptions or conditions found that require corrections to ensure they do not become FRA or Critical Defects
5. Informational Items
   - Items populated by various sources that provide the MTM with information that may help identify conditions or prioritize work

Defect Management Guidelines:

1. FRA and Critical Defects require specific remediation reporting and closure
   - Remediation of all FRA defects should be documented in the TMP within 5 business days of the defect report

- Remediation of all Critical geometry exceptions should be completed in the TMP within 5 business days of the defect report
- Defects should be "Closed" by the gang or work group that completes the field repair as part of daily production reporting
- Track Inspectors should only close defects they find and repair
- MTM's can close exceptions in the TMP but will be required to provide a specific closure code and field validation code
- DTM's should review with MTMs at least every 30 days to ensure proper management of exceptions
- 213.9b and Scheduled for Repair Remedial Defects – must be repaired or the track removed from service within 30 days

2. Urgent Exceptions – May not require remedial action (slow orders)
    - Urgent geometry exceptions should be closed by the gang that completes the field repairs
    - MTM can close exceptions but a specific closure code and validation are required
3. TMP Items – Require no remedial action and are scheduled and managed by the MTM
    - Should be closed by the gang that completes the field repairs
    - MTM can close items that are no longer valid – closure comment required
4. The TMP has automated closure capabilities and will close targeted FRA Defects (properly remediated), and Critical defects (properly remediated) that are within the limits of program maintenance work or by the most recent Geometry Car run
5. The Automated Closure process will not close any CWR Adjust events. These events will need to be closed by the MTM. The MTM is required to provide a specific closure code and comments.

Defect and Exception Closure:
Beginning February 1, 2015 all FRA, Critical, Urgent and TMP items in the Track Maintenance Planner will require a specific Closure Code in order to complete the closure of the item.
All items repaired or field verified by Service Unit or section gangs should be closed by the gang that completes the repair/verification in Production Reporting. The closure codes in Production Reporting include:

- Repair Completed
- Field Verified – Defect/Exception Not Found
- Track Removed from Service/Retired
- Field Verified – Repair Completed by Other Gang
- Duplicate Defect or Exception

Defects or Exceptions Closed in the TMP by the MTM or Track Inspector will require the following:

1. Closure Code Selection
    a. Repair Complete*
    b. Repaired by Program Work*
    c. Field Verified – Defect\Exception Not Found *
    d. Track Removed from Service/Retired *
    e. TMP Item – No Longer Valid
    f. Urgent Defect – Scheduled for Program Maintenance
    g. TMP Item – Scheduled for Program Maintenance
    h. Duplicate Defect or Exception
2. Closure codes above with an asterisk (*) will require an additional details including:
    - Gang that Completed Repair (Item a, b)
    - Who Field Verified (Item a, b, c)
    - Who removed from service (Item d)

GLOSSARY

This section includes definitions of terms relating to track work, switches, frogs, guard rails, crossings, and turnouts.

Abutment

A substructure composed of stone, concrete, brick, or timber supporting the end of a span.

Adjustable Separator

A metal block or two or more parts acting as a filler between the running rail and the guard rail and designed to provide varying widths of flangeway.

Alignment

The horizontal location of a railroad as described by curves and tangents.

Alloy Steel

Steel to which has been added silicon, manganese, nickel, or other elements to give greater strength, or impart other desirable properties for a particular use.

Angle Bar

One of two bars used to join two rail ends together to form continuous track.

Auxiliary Track

Any track not otherwise specified that directly connects to any main track, siding or industrial lead where cars or locomotives are left standing.

Ballast

Material selected for placement on the roadbed for the purpose of holding the track in line and at surface.

Ballast Section

A vertical cross section of the track from the subballast up, including ballast.

Bolted Rail Crossing

A crossing in which all the running surfaces are of rolled rail, the parts being held together with bolts.

Bolted Rigid Frog

A frog built essentially of rolled rails, with fillers between the rails, and held together with bolts.

Branch Line

The secondary line or lines of a railway.

Buckled Track

A major irregularity in track alignment caused by excessive compression in the rails. See also Thermal Misalignment.

Cant

The tilt or inclination on a surface.

Center Frogs

The two frogs at the opposite ends of the short diagonal of a crossing.

Classification Track

One of the tracks in a classification yard, or a track used for classification purposes.

Classification Yard

A rail yard consisting of a number of usually parallel tracks, used for making up trains.

Clearance Point

The location behind a turnout where track centers reach 13 foot. Exception: Yard tracks that have designed track centers of 12 foot 6 inches.

Closure Rails

The rails located between the parts of any special trackwork layout, as the rails between the switch and the frog in a turnout (sometimes called the lead rails or connecting rails); also the rails connecting the frogs of a crossing or adjacent crossings.

Company Material

Material transported by a particular railroad such as rail, cross ties, ballast, fuel oil, etc., used in connection with its operations.

Compound Curve

A continuous curve composed of two or more different curves put together with no tangent in between them, curving in the same direction.

Compromise Joint (Trackwork)

A rail joint between rails of different height and section, or rails of the same section but of different joint drillings.

Compromise Rail

A relatively short section of rail where one end is forged to a different section of rail.

Conformal Frog

A frog with a 1:20 sloped running surface designed to better fit the profile of wheels.

Connecting Rod

The rod that connects the switch stand and switch rod.

Connecting Track

A track defined as such in EFMS and the Track Inspection System, usually a track or a wye that connects two subdivisions or railroads.

Continuous Welded Rail (CWR)

Rail length that is 400 feet or longer.

Controlled Siding

A siding within CTC or Interlocking limits where a signal indication authorizes the siding's use.

Creosote

A tar distillate produced by high-temperature carbonization of bituminous coal and used in wood treatment.

Crib

The lateral space between two railroad ties.

Cross Level

The distance one rail is above or below another. This should not be confused with superelevation on curves.

Cross Tie

The transverse member of the track structure to which the rails are spiked or otherwise fastened to provide proper gage and to cushion, distribute, and transmit the stresses of traffic through the ballast to the roadbed.

Crossing (Rail)

A structure, used where one track crosses another at grade, consisting of four connected frogs.

Crossing Plates

Plates interposed between a crossing and the ties or other timber to protect the ties and to better support the crossing by distributing the loads over larger areas.

Crossover

A combination of two switches that connect two adjacent tracks.

Crossover, Double

Two crossovers that intersect between the connected tracks.

Crossover, Universal

Two crossovers in opposite directions.

Curve, Compound

A continuous change in direction of alignment by means of two or more contiguous simple curves of different degrees having a common tangent at their junction points.

Curve, Degree of

The angle subtended at the center of a simple curve by 100 ft. chord.

Curve, Reverse

Two contiguous simple curves in opposite directions, with a common tangent at their junction point.

Curve, Simple

A continuous change in direction of alignment by means of an arc of a single radius.

Curve, Vertical

A transition in the track to connect two intersecting grade lines.

Curved Closure Rail

The rail between the switch point and frog on the diverging side of a turnout.

Curved Lead

The distance between the actual point of the switch and the half-inch point of the frog, measured on the outside gage line of the turnout.

Departure Track

One of the tracks in a departure yard on which outgoing cars are placed.

Departure Yard

A rail yard where trains are assembled and made ready for departure.

Derail

A safety device, attached to one rail of a siding or storage track that will cause a car to be derailed in the event it rolls free towards a main track where it could cause a major accident.

Derailment

Anytime the wheels of a car or engine come off the head of the rail.

Drift Pin

A special railroad tool of round steel tapered for insertion to align holes by striking the large end.

Drill Track

A track connecting with the ladder track, over which locomotives and cars move back and forth in switching.

Dutchman

Short piece of rail that can be used to reduce the gap between rails ends. Used to make emergency or temporary movement of trains over a wide joint gap. Must be used within the limits of joint bars.

Easer Rail (or Easer)

A rail placed with its head along the outside and close up to the head of the running rail and sloped at the ends to provide a bearing for the overhanging portion of hollowed-out treads of worn wheels.

Elevation (of Curves) Superelevation

The vertical distance that the outer rail is above the inner rail.

End Frogs

The two frogs at the opposite ends of the long diagonal of a crossing.

Expansion Shim

Spacer inserted between ends of abutting rails while track is being laid to provide allowance for expansion of steel when temperature changes.

Facing Point Switch

A track switch, the points of which face traffic approaching in the direction for which the track is signaled.

Fastenings

Joint bars, bolts, clips, lag screws and spikes.

Fastenings, Auxiliary

Locknuts, spring washers, tie plates, rail braces, cotter pins and anti-creeping devices.

Federal Railroad Administration (FRA)

An agency of the U.S. Department of Transportation with jurisdiction over matters of railroad safety.

Fiber Optics

Light transmission through very fine flexible glass rods.

Field Side

The side of a rail opposite the gage side.

Field Weld

A weld joining two rails together after rails are installed in track.

Filler Block (Trackwork)

A steel block molded and designed to keep uniform the angle spread between lead and turnout rails and frogs, etc.

Flange Lubricator

A device by which either grease or oil can be applied to the flanges of a locomotive driving wheel for the purpose of preventing flange wear and cutting. Rail lubricators, mounted along the rail in high curvature territory are also used to apply lubricant to passing flanges to reduce both wheel and rail wear.

Flangeway

The open way through a track structure that provides a passageway for wheel flanges.

Flangeway Depth

The depth of the wheel flange passageway.

Flangeway Width

The distance between the gage line and the guard line of a track structure, which provides a passageway for wheel flanges.

Flare

A tapered widening of the flangeway at the end of the guard line of a track structure, as at the end of a guard rail or at the end of a frog or a crossing wing rail.

Flare Opening

The distance between the gage line and the guard line of a track structure at the wider end of the flare.

Flat Yard

A yard where car switching is dependent on locomotive power with little assistance from gravity.

GLOSSARY

Foot Guard

A filler for the space between converging rails to prevent human feet from becoming accidentally wedged between the rails.

Fouling Point

The location behind turnouts that measures 50 feet beyond the clearance point.

Frog

A track structure used at the intersection of two running rails to provide support for wheels and passageways for their flanges, thus permitting wheels on either rail to cross the other.

Frog Angle

The angle formed by the intersecting gage lines of a frog.

Frog Heel

The end of a frog furthest from the switch, or opposite the point end.

Frog Number

The ratio of the spread to the length of the frog.

Frog Plates

Any specially designed plate used between the toe and heel of a frog.

Frog Point

The part of a frog lying between the gage lines extending from their intersection toward the heel end.

(a) Theoretical Point

The point of intersection of the gage lines of a frog.

(b) Half-Inch Point

A point located at a distance from the theoretical point towards the heel equal in inches to one-half the frog number, and at which the spread between the gage lines is one-half inch. It is the origin from which measurements are made.

(c) Actual Point

The physical location of the point of frog. This is called the 5/8” point.

Frog, Throat

The point at which the converging wings of a frog are closest together.

Frog, Toe

The end of a frog nearest the switch.

Fusee

A warning device consisting of a cardboard tube filled with a combustible mixture of chemicals that burns brightly when ignited and remains burning for varying lengths of time. Fusees are ignited and dropped on the right-of-way to indicate to a following train the presence of stopped or slow-moving equipment ahead.

Gage (Track)

See Standard Gage.

Gage Line

A line 5/8 in. below the top of the center line of head of running rail along the side nearer the center of the track.

Gage Plate

A metal plate, extending from rail to rail, used to maintain gage of track.

Gage Rod

A device for holding track to correct gage, generally consisting of 1-1/4-in. rod with a forged jaw on one end and a malleable jaw on the other end, adjustable through a lock nut.

Gauntlet Track

A section of railroad track (as over a bridge or in a narrow pass) where two lines of track overlap so that one rail of each track is within the rails of the other. In such cases no switch is needed. The crossing of the two inner rails is made by ordinary frogs.

Geotextile

A material designed to permit the passage of water through it, but not particles of soil or dirt carried by the water. Used under ballast to function as a subballast. Also used to wrap corrugated or loose jointed pipe and to line drainage trenches or French drains. Also called “filter fabric” or “engineering fabric.”

Grade (Degree Of)

As used in connection with railway line, the rise or fall in a track expressed as a ratio to 100 feet of horizontal track.

Grade Crossing

An intersection of a highway with a railroad at the same level.

Guard Check Gauge

The distance between guard line and gage line, measured across the track at right angles to the gage lines.

Guard Face Gauge

The distance between guard lines, measured across the track at right angles to the gage lines.

Guard Line

A line along the side of the flangeway that is nearer the center of the track and at the same elevation as the gage line.

Guard Rail

A rail or other structure laid parallel with the running rails of a track to prevent wheels from being derailed; or to hold wheels in correct alignment to prevent their flanges from striking the points of turnout or crossing frogs or the points of switches. A rail or other structure laid parallel with the running rails of a track to keep derailed wheels adjacent to running rails.

Guard Rail (Frog)

A rail or other device to guide the wheel flange so that it is kept clear of the point of the frog.

Guard Rail (Switch)

A rail or other track structure laid parallel with the running rail ahead of a split switch and forming a flangeway with the running rail, to hold the wheels of rolling stock in correct alignment when approaching the switch.

Guard Rail Brace

A metal shape designed to fit the contour of the side of the guard rail and extend over the tie, with provision for fastening thereto, to restrain the moving or tilting of the guard rail away from the running rail.

Guard Rail Brace, Adjustable

A guard rail brace, which may be adjustable laterally with respect to the rail, to vary the distance between the guard rail and the running rail.

Guard Rail Clamp

A device consisting of a yoke and fastenings designed to engage the running rail and the guard rail and hold them in correct relation to each other.

Guard Rail, One-Piece

A guard rail consisting of a single complete unit, either fabricated or cast, designed so that no auxiliary parts or fastenings other than spikes are required for its installation.

Head Rod

A rod connecting the points of a switch or movable point frog, by means of which the relative location of the points is maintained and to which the operating rod is attached.

Head Separation

The point on a switch rail where the head of the rail attains its full width.

Head Block Ties

The ties to which a switch stand is attached.

Heel (of Frog)

The end of the frog farthest from the switch.

Heel Block

A steel block, through which bolt holes are drilled, that is placed between the heel of a switch point and its stock rail.

Heel Length

The distance between the heel end and the half-inch point of a frog, measured along the gage line.

Heel Spread

The distance, at the heel, between the gage line of a switch rail and the gage line of its stock rail. (This has been standardized at 6-1/4 in. for AREMA style switches.)

House Track

A track diverging from the main track or siding used to set out cars or store equipment.

Hump

The hill over which cars are pushed for classification in a hump yard.

Industrial Track

A switching track serving industries, such as mines, mills, smelters, and factories.

Insulated Rail Joint

A joint in which electrical insulation is provided between adjoining rails.

Insulated Switch

A switch in which the fixtures, principally the gage plates and the switch rods, connecting or reaching from one rail to the opposite rail, are provided with insulation so that the electric track circuit will not be shunted.

Insulation

A device or material that prevents the flow of electric current in a track circuit from passing from one rail to the other or through switches and other track structures.

Joint Bar

A steel bar commonly used in pairs for joining rail ends in railroad track.

Joint Gap

The distance between the ends of rails joined by joint bars.

Joint Rail Drilling

The spacing of holes in the ends of rails or other track structures to receive the bolts for fastening joint bars.

Joint, Permanent

A rail joint that will remain in track.

Joint, Rail

The area of fastenings and rail where rail ends meet.

Joint, Supported

A rail joint that sits directly on top of a tie.

Joint, Suspended

A rail joint that sits between two consecutive ties.

Knuckle Rail

A bent rail, or equivalent structure, forming the obtuse point against which the movable center points, of a movable point crossing or slip switch, rest when set for traffic.

Lead (Actual)

The length between the actual point of the switch and the half-inch point of the frog measured on the line of the main track.

Lead (Theoretical)

The distance from the theoretical point of switch to the theoretical point of the frog, measured on the line of the main track.

Lead Track

An extended track connecting to a series of yard tracks.

Line

The condition of the track with regard to uniformity in direction over short distances on tangents, or uniformity of curvature over short distances on curves.

Lock Nut

A special type of nut with a feature that prevents the nut from turning off the bolt once it is secured. Lock nuts are not reusable since removing them generally destroys the locking feature.

Lock Rod

A rod, attached to the front rod or lug of a switch, movable point frog, or derail, through which a locking plunger may extend when the switch points or derail are in the normal or reverse position.

Lock Washer

A washer designed to prevent undesired loosening of a nut after it has been tightened.

Main Track (Line)

A track extending through yards and between stations that must not be occupied without authority or protection. (General Code)

Manganese Steel

Steel containing a high percent of manganese; an alloy of steel to increase hardness and wear resistance.

Manganese Steel Insert Crossing

A crossing in which a manganese steel casting is inserted at each of the four intersections, being fitted into rolled rails and forming the points and wings of the crossing frogs.

Manganese Tipped Switch

A split switch in which the head of one or both of the switch rails is cut away in the point portion and manganese steel insert is fastened to the rail to form the point.

Monday Maul

Sledge hammer.

Movable Center Point

One of the movable tapered rails of a movable point crossing or slip switch.

Movable Point Frog

A frog equipped with points that are movable in the same manner as the points on a switch.

Movable Point Crossing

A crossing of small angle in which each of the two center frogs consists essentially of a knuckle rail and two opposed movable center points with the necessary fixtures.

Passing Track

A track to the main track for meeting or passing trains. Today this is called a siding.

Planing, Bottom

The cut planed at an angle on the bottom of the base of the switch rail from the point and towards the heel to allow the switch rail to rest on the top of the base of the stock rail when the switch rail is closed.

Planing, Chamfer Cut

The vertical beveling of the gage side of the switch point to produce a sharp edge that prevents wheel flanges from striking the point.

Planing, Side

The cuts made on the sides of the head of the switch rail to form the taper.

Planing, Top

The cut made on the top of the head of the switch rail from the point and to approximately the head separation.

Point of Switch (Actual)

The end of the switch rail farther from the frog; the point where the spread between the gage lines of the stock rail and the switch rail is sufficient for a switch point.

Point of Switch (Theoretical) of Vertex

The point where the gage line of the switch rail, if extended, would intersect the gage line of the stock rail.

Point Rail, Switch Rail, or Switch Point

The tapered rail of a split switch.

Pull-Apart

A condition that exists at a rail joint when all the bolts in one rail end are missing and the two rail ends have gapped.

Rail

In track, a rolled steel shape, commonly a T-section, designed to be laid end to end in two parallel lines on cross ties or other suitable supports to form a track for railway rolling stock.

Rail Anchor

A device attached to the base of a rail bearing against a cross tie to prevent the rail from moving longitudinally under traffic.

Rail Bond

A short metal cable attached to adjacent rails at the joints to ensure proper electrical continuity across the joint.

Rail Brace

A bracing device used at switches, movable point frogs, etc., in combination with switch, tie, or gage plates for holding the rail from lateral roll.

Rail Brace (Switch)

A metal shape designed to fit the contour of the side of the stock rail and extend over the switch plate, with provision for fastening through the plate to the tie, to restrain the lateral roll of the stock rail.

Rail Brace, Adjustable (Switch)

A rail brace that may be adjusted laterally with respect to the stock rail, to compensate for variations in the dimensions of the rail and to permit adjusting for wear.

Rail Creep

Longitudinal sliding of rails in track under traffic or because of temperature changes.

Rail Joint

A fastening designed to unite the abutting ends of contiguous rails.

Rail Lubricator (Flange)

A device designed to apply grease to the gage side of the rail head at the beginning of a curve, to minimize wear of the rail and wheel flange or to eliminate noise.

Rail Lubricator (Top of Rail)

A device designed to apply lubrication to the top of the rail head to minimize wear of the rail and reduce lateral forces, or to eliminate noise.

Railbound Manganese Steel Frog

A frog consisting essentially of a manganese steel body casting fitted into and between rolled rails and held together with bolts.

Reinforcing Rail

A bent rail placed with its head along the outside or close up to the head of a knuckle rail to strengthen it and to act as an easer rail; or a piece of rail similarly applied to a movable center point.

Relay Rails

Rails taken up from tracks where formerly used, suitable for relaying in other tracks.

Retarder

A braking device, usually power operated, built into a railway track to reduce the speed of cars by means of brake-shoes which, when set in braking position, press against the sides of the lower portions of the wheels.

Reverse Elevation

In curved track, when the outer rail is lower than the inner rail.

Right of Way

The strip of land on which a railroad track is built.

Rip Track

A car repair facility with one or more tracks.

Roadbed

The foundation upon which the ballast, ties and rails of a railroad are laid.

Running Rail

a.) The rail or surface on which the tread of the wheel bears.

b.) Longitudinal movement of rail caused by an insufficient fastening system.

Running Track

A track reserved for movement through a yard.

Scale Track

A track leading to and from, and passing over a track scale.

Screw Spike

A cylindrical threaded spike, designed to be turned with a special wrench into holes bored in ties, to secure rails or to act as a tie plate holder.

Section Limits

A division of railroad into specific territories for maintenance purposes. Sections are usually inspected and maintained by an assigned group of men.

Self-Guarded Frog (Flange Frog)

A frog provided with guides or flanges, above its running surface, which contact the tread rims of wheels for the purpose of safely guiding their flanges through the frog.

Side Track

An auxiliary track to the main track.

Siding

A track connected to the main track and used for meeting or passing trains. Locations of sidings are shown in the timetable. (General Code)

Slide Fence

A fence interconnected to the signal system placed at the bottom of a cut to warn trains of rock slides by the use of signal indication.

Slip Switch, Double

A combination of a rail crossing and two turnouts interconnected into one assembly.

Slip Switch, Single

A combination of a rail crossing and one turnout interconnected into one assembly.

Snow Fence

A barrier placed along the right of way to prevent blowing snow from drifting onto the track.

Solid Manganese Steel Frog

A frog consisting entirely of a single manganese steel casting.

Special Trackwork

Any trackwork consisting of more than two rails and ties. Examples are turnouts, switches and crossing frogs.

Specification

A set of instructions that provide the requirements of a material to be manufactured or constructed.

Spike

A long steel square nail with a cutting edge used to fasten track components in place.

Spiked Switch

A switch whose points are held in fixed position by a spike to prevent the switch from being thrown or to prevent trains from using track that has been taken out of service.

Spiral

The gradual and uniform increase and decrease of curvature between the tangent and the full curve.

Split Switch

A track structure consisting of two movable point rails and necessary fixtures used to divert rolling stock from one track to another.

Split Switch with Graduated Risers

A split switch in which the switch points are gradually elevated by means of graduated riser plates until they reach the required height above the stock rail.

Split Switch with Uniform Risers

A split switch in which the switch points have a uniform elevation on riser plates for the entire length of the switch, the point rail rise being run off back of the switch points in the closure rails.

Spring Rail Frog

A frog with a movable wing rail that is held against the point rail by springs, thus making an unbroken running surface for wheels using one track, whereas the flanges of wheels on the other track force the movable wing rail away from the point rail to provide a passageway.

Spring Rail Frog, Right-Hand and Left-Hand

Standing at the toe end of a spring rail frog and looking toward its point, a right-hand frog has the movable wing rail located on the right-hand side, and a left-hand frog has the movable wing rail located on the left-hand side.

Spring Switch

A switch with a spring mechanism that returns the switch points to the original position after they are trailed through.

Spring Washer

A component designed to apply compressive force to prevent reverse movement of a nut.

Spur

A single-ended track diverging from a main or other track.

Standard Gage

The standard distance between rails of North American railroads: 4 ft. 8-1/2 in. measured between the inside faces of the rail heads 5/8 in. below the top of the rail.

Stock Rail

The rail against which the point of a switch or derail fits.

Stock Rail Bend

The bend placed in the stock rail at or near the switch point to match the switch rail angle.

Storage Track

A track on which cars are placed when awaiting disposition or when not in service.

Straight Closure Rail

The rail between the switch point and frog on the straight side of a turnout.

String Lining

a.) A method to determine the alignment of a curve by measuring offset from a string line to the gage side of the high rail.

b.) When a train pulls it's consist off the low side of a curve.

Stripped Joint

See Pull-Apart.

Subballast

Any material spread on the finished subgrade of the roadbed below the ballast to provide better drainage, prevent upheaval by frost, and better distribute the load over the roadbed.

Subgrade

The finished surface of the roadbed below the ballast and track.

Sun Kink

See *Thermal Misalignment*.

Switch

A track structure with movable rails to divert rolling stock from one track to another.

Switch Angle

The angle included between the gage lines of the switch rail at its point and the stock rail.

Switch Circuit Controller

A device connected at the point to switch, derail, or moveable point frog which will electrically indicate an open switch condition when the switch point is open 1/4" or more.

Switch Heater

A device that will heat the area around a switch to melt snow and ice.

Switch Heel

The designated location on the switch point where the heel block is located.

Switch Machine

A machine used to throw track switches. Switch machines can be powered operated or used manually.

Switch Plate

Any specially designed tie plate for use in the switch area of a turnout.

Switch Point

A machined rail with a sharp end mated against a stock rail used to divert rolling stock from one track to another.

Switch Point Derail

A device consisting of at least one switch point for the intended purpose of derailing rolling stock.

Switch Point Protector

A device that diverts a rolling wheel away from the switch point.

Switch Rail Brace

A brace placed against a running rail to dissipate lateral force thus preventing rail turnover.

Switch Rod

A rod connecting the two points of a switch which maintains the proper distance between the points.

Switch Stand

A device for the manual operation of a switch.

Switch Tie

Ties made of various lengths used in a switch, turnout or special trackwork.

Tangent

A section of track that connects two curves.

Thermal Misalignment

An irregularity in track alignment caused by excessive compressive forces in the rail.

Thermite Weld

A weld, made by pouring molten materials into the gap between rail ends, that fuses the rail ends together.

Throat of Frog

The location ahead of the point at which the wing rails of a frog are closest together.

Throw of Switch

The distance between the back of the open switch point and gage line of the stock rail measured along the center line of the No. 1 switch rod. (This distance is standardized at 4-3/4 in.)

Tie Pad

A dampening device located between the rail and the tie.

Tie Plate

A steel plate between a rail and a tie.

Tie Plug

A wood or composite material used to fill holes in ties from which spikes have been removed.

Toe (of Frog)

End of a frog nearest the switch.

Toe Length

The distance between the toe end of the frog and the half-inch point of the frog, measured along the gage line.

Track

An assembly of rails, ties, ballast and fastenings over which cars, locomotives, and trains are moved.

Track Bolt

A bolt with a button head and oval, or elliptical neck, and a threaded nut designed to fasten rails and joint bars.

Track Crossing (slang; Diamond)

A track component consisting of four connected frogs that permits one track to cross another at grade.

Track Shims

Flat wood boards of length and width similar to tie plates. They are placed between the ties and the tie plates when the ballast is frozen to correct surface irregularities.

Transition Rail (Trackwork)

A manufactured rail using the same rail section that is machined to compensate for various amounts of rail head loss.

Tread

a.) The top surface of the rail that contacts the wheel.

b.) The portion of the wheel that contacts the top of the rail.

Turnback Curve

The curve(s) directly behind the diverging side of a turnout.

Turnout

A section of trackwork that allows rolling stock to be diverted from one track to another.

Turnout, Panel

A pre-assembled turnout complete or in sections.

Turnout Plates

Any specially designed tie plate used between the heel of the switch point and toe of the frog.

Turnout Number (Size)

The number corresponding to the size of the frog used in the turnout.

Washout

An erosion of the permanent roadbed by storm or flood.

Wheel Flange

The portion of the wheel that protrudes down from the wheel tread to guide rolling stock along the track.

Wide Gage

Any gage wider than standard gage caused by track deterioration or improper installation.

Wye

A track arrangement shaped like the letter Y but with a connecting segment between the two upper legs to enable the turning of equipment.

Yard

A system of tracks, other than main tracks and sidings, used for making up trains, storing cars, and other purposes.

NOTES

APPENDIX

APPENDIX

A.1 Typical Construction Costs

INSTALL TRACK			**COST/TF**	**COST/MILE**
SH CWR		20 ties/39' (Laid in panels and relaid)	$129.06	$681,437
New CWR		24 ties/39' (Laid in panels and relaid)	$217.65	$1,149,192
New CWR HH		2640 Concrete Ties/mile	$185.25	$978,120
INSTALL 136/141# PREPLATED TURNOUTS				
(Includes labor & materials for turnout and ballast.)				**COST/**
(Does not include any money for removal or signal costs)				**TURNOUT**
	No, 7	PPTO Yard Standard - RBM Frog		$83,964
	No. 9	PPTO Yard Standard - RBM Frog		$99,379
	No. 11	PPTO Yard Standard - SMSG Frog		$112,985
	No. 11	PPTO Wood - XLRBM Frog		$123,407
	No. 11	PPTO Conc. ML Standard - XLSR Frog		$138,454
	No. 15	PPTO Wood Tie-XLSR		$153,493
	No. 15	PPTO Wood Tie - XLRBM Frog		$138,352
	No. 15	PPTO Conc. ML Standard - XLSR Frog		$165,735
	No. 20	PPTO Wood - XLRBM Frog		$243,430
	No. 20	PPTO Wood XLSR Frog		$271,232
	No. 20	PPTO Conc. MPF		$258,613
	No. 24	PPTO Concrete MPF		$431,424
	No. 30	PPTO Conc. Premium MPF		$509,880
UNLOAD AND PLACE ONE CAR OF BALLAST (YARD TRACK)				**COST/**
				CAR
(Includes unload, place, surface and line, WTS)				$2,130
UNLOAD AND PLACE BALLAST FOR ONE TURNOUT				
				COST/
(Includes labor & material)				**TURNOUT**
	No, 7	(1 car)		$4,950
	No. 9	(1.33 cars)		$5,125
	No. 11	(2 cars)		$5,325
	No. 15	(3 cars)		$8,427
	No. 20	(4 cars)		$9,827
	No 24	(5 cars)		$11,227
	No. 30	(6 cars)		$17,053
Source: Misc. Notes - Engr. Project Management (MAS) 01/01/2012				

A.2 Typical Labor Rates of Pay

FOREMAN	Straight Time	Over Time
B & B	$23.96	$35.94
System Steel Gang	$27.56	$41.34
Tie, Curve, or Surfacing Gangs	$26.39	$39.59
Steel Erection	$25.53	$38.30
Water Service	$26.07	$39.11
Section Foremen (Main Line)	$24.09	$36.14

OPERATORS	Straight Time	Over Time
REO (Class 1)	$25.20	$37.80
TMO	$23.48	$35.22
SPTMO	$23.85	$35.78
RPTMO	$23.20	$34.80
RPTO	$23.09	$34.64

TRUCK DRIVERS	Straight Time	Over Time
Semitrailer	$24.89	$37.34
2 Ton or More	$23.86	$35.79
Sectionman Truck Operator	$23.36	$35.04

LABORERS	Straight Time	Over Time
B & B	$21.18	$31.77
Track Extra Gang	$21.03	$31.55
Sectionman	$21.32	$31.98

SIGNAL	Straight Time	Over Time
Signal Maintenance Foreman **	$29.36	$44.04
Signal Maintainer	$26.88	$40.32
Signalman	$25.45	$38.20
Asst. Signalmen	$23.13	$34.70

NOTE : ** Monthly Salary

Source: GMS 390 ROSTERS 09/01/11

A.3 Derailment Estimating Costs

	DESCRIPTION	UNIT	LABOR*	MATERIAL	TOTAL
	Track Panels	Each	$2,000	$3,500	$5,500
	#11 Turnout including switch ties	Each	$46,000	$92,000	$138,000
	#15 Turnout including switch ties	Each	$50,000	$109,000	$159,000
	#20 Turnout including switch ties	Each	$96,000	$126,000	$222,000
	Switch Machine	Each	$19,250	$22,458	$41,708
	Ties - 8 ft.	Each	$124	$43	$167
	Ties - 9 ft.	Each	$124	$43	$167
	Ballast (Car) including WTS	Each	$1,400	$700	$2,100
	CWR - 1440 ft. strings	Each	$14,000	$40,000	$54,000
	Crossing Protection (2 Gates)	Each	$53,400	$91,043	$144,443
	Crossing Protection (2 Flashers)	Each	$37,050	$57,859	$94,909
	Electric Lock	Each	$43,055	$38,887	$81,942
	Intermediate Signal (B/B) Single Trk.	Each	$33,051	$41,920	$74,971
	Intermediate Signal (B/B) Double Trk.	Each	$57,350	$68,737	$126,087

NOTE: These unit costs should not be used for any purpose other than for derailment/accident cost estimating as they were prepared by reviewing typical derailment costs and factors such as use of non-production gangs, substantial overtime, etc. are included.

* Direct labor only (no additives applied)
Source: Engr. Proj. Management 01/01/2012 (ECB)

A.4 Track Material Weights and Measures

Rail	Size	Wt. Per 39ft (lbs.)	Tons/Mile
All types	141	1829	123.8
	136	1768	119.68
	133	1729	117.04
	115	1495	101.20
Ties	**Size**	**Weight (lbs.)**	**No./Track Mile**
Softwood cross tie	7"x 9"x 9'	190	3249
Hardwood cross tie	7"x 9"x 9'	285	3249
Softwood switch tie	7"x 9"	21 lbs/ft	
Hardwood switch tie	7"x 9"	32 lbs/ft	
Concrete cross tie	9" x 11" x 8'6"	700	2640
Concrete switch tie	9 1/2" x 11 1/4"	106 lbs/ft	
Steel cross tie 8'6"	10 mm	180	
Steel cross tie 8'6"	12 mm	211	2640
Steel switch tie	12 mm	23.5 lbs/ft	
OTM	**Size**	**Weight (lbs)**	**Packaging**
Tie Plate	7 3/4" x 16"	27.6	6000/carload
	8" x 16" cast	23.8	7000/carload
	8" x 14"	22.3	7500/carload
	7 1/2" x 13"	19.6	8500/carload
Track Spike	6" x 5/8"	0.83	220/keg
Track Bolt w/ nut and washer	1 1/8" x 6 1/2"	3.13	50/keg
	1 1/16" x 6"	2.4	50/keg
	1" x 6"	2.38	50/keg
	7/8" x 5"	1.48	50/keg
Joint Bar			
Std. Steel	136/141 lb rail	59	Pair
	133 lb rail	58.5	Pair
	115 lb rail	53.5	Pair
Insulated poly	133 lb rail	54.5	Pair
	115 lb rail	50.1	Pair
Rail anchor			
Bar Stock (Unit)	6" base	2.094	50/bag
Bar Stock (Unit)	5 1/2" base	1.96	50/bag
Safelok 1 Spring Clip		1.6	50/bag
Safelok 1, 3 Part Ass'y	6" base	1.1	40/box
Safelok Std. Insulator		0.1	200/bag
Safelok HD Insulator		0.5	50/bag
Safelok III Spring Clip		1.75	50/bag
Safelok III , 3 Part Ass'y		1.05	40/box
Frogs	**Size**	**Weight (lbs)**	**Packaging**
#9 SGSM	133#	1810	ea.
#10 RBM	115#	3575	ea.
#10 RBM	133#	4800	ea.
#10 Plate Pkg.	133#	889	ea.
#10 Spring	133#	6200	ea.
#11 RBM	136#	5823	ea.
#11 Spring	141#	6800	ea.
#14 RBM	133#	4900	ea.
#14 Spring w/plates	133#	8220	ea.
#15 RBM	136#	6317	ea.
#15 Spring	141#	6680	ea.
#16 RBM	115#	6720	ea.
#20 RBM	133#	12700	ea.
#20 MPF	133#	13000	ea.
#24 MPF	!41#	14000	ea.
#30 MPF w/ base plate	133#	15000	ea.

Track Material Weights and Measures, continued

Switch Points	**Size**	**Weight (lbs)**	**Packaging**
16'6" extended	133#	2050	ea.
16' 6" extended	136#	2070	ea.
19' 6" extended	141#	2200	ea.
24' extended	133#	2100	ea.
26" extended	141#	2200	ea.
39' extended	133#	2400	ea.
39' extended	141#	2482	ea.
Adj. Guard Rail Ass'y	**Size**	**Weight (lbs)**	**Packaging**
13'	113/141#	1011	ea.
19' 6"	133/141#	1632	ea.
26'	133/141#	2450	ea.
Transition Rails	**Size**	**Weight (lbs)**	**Packaging**
141 to 133 Comp/Transition	141# to 133#	1775	ea.
141 to 132 Transition	141# to 132#	1792	ea.
136 to 115 Comp/Transition	136# to 115#	1000	ea.
Ballast	**Size**	**Weight (lbs)**	**Packaging**
Class 1	2 1/4- 3/4	2450 lbs/yd^3	72 yd^3/carload
Class 2	1 3/8 - 3/8	2450 lbs/yd^3	72 yd^3/carload
Class 3	3/4 minus	2550 lbs/yd^3	72 yd^3/carload
Rip Rap	**Size**	**Weight (lbs)**	**Packaging**
Class 1	Less than 200 lbs	2450 lbs/yd^3	54 yd^3/air dump
Class 2	200 To 1000 lbs.	2450 lbs/yd^3	54 yd^3/air dump
Class 3	1000 to 4000 lbs.	2450 lbs/yd^3	54 yd^3/air dump
Class 4	Over 4000 lbs.	2450 lbs/yd^3	$54d^3$/air dump

A.5 Conversion Chart for Changing Decimal Miles into Linear Feet

DECIMALS OF A MILE IN FEET							
Decimal Miles	Feet	Decimal Miles	Feet	Decimal Miles	Feet	Decimal Miles	Feet
0.01	53	0.26	1373	0.51	2693	0.76	4013
0.02	106	0.27	1426	0.52	2746	0.77	4066
0.03	158	0.28	1478	0.53	2798	0.78	4118
0.04	211	0.29	1531	0.54	2851	0.79	4171
0.05	264	0.30	1584	0.55	2904	0.80	4224
0.06	317	0.31	1637	0.56	2957	0.81	4277
0.07	370	0.32	1690	0.57	3010	0.82	4330
0.08	422	0.33	1742	0.58	3062	0.83	4382
0.09	475	0.34	1795	0.59	3115	0.84	4435
0.10	528	0.35	1848	0.60	3168	0.85	4488
0.11	581	0.36	1901	0.61	3221	0.86	4541
0.12	634	0.37	1954	0.62	3274	0.87	4594
0.13	686	0.38	2006	0.63	3326	0.88	4646
0.14	739	0.39	2059	0.64	3379	0.89	4699
0.15	792	0.40	2112	0.65	3432	0.90	4752
0.16	845	0.41	2165	0.66	3485	0.91	4805
0.17	898	0.42	2218	0.67	3538	0.92	4858
0.18	950	0.43	2270	0.68	3590	0.93	4910
0.19	1003	0.44	2323	0.69	3643	0.94	4963
0.20	1056	0.45	2376	0.70	3696	0.95	5016
0.21	1109	0.46	2429	0.71	3749	0.96	5069
0.22	1162	0.47	2482	0.72	3802	0.97	5122
0.23	1214	0.48	2534	0.73	3854	0.98	5174
0.24	1267	0.49	2587	0.74	3907	0.99	5227
0.25	1320	0.50	2640	0.75	3960	1.00	5280

A.6 Conversion Table for Equivalent Measurements of Fractions/Decimals/Millimeters

FRACTIONS-DECIMALS-MILLIMETERS					
FRACTION	DECIMAL	MM	FRACTION	DECIMAL	MM
1/64	0.01563	0.396	33/64	0.51563	13.096
1/32	0.03120	0.793	17/32	0.53125	13.493
3/64	0.04680	1.190	35/64	0.54688	13.890
1/16	0.06250	1.587	9/16	0.56250	14.287
5/64	0.07810	1.984	37/64	0.57813	14.684
3/32	0.09370	2.381	19/32	0.59375	15.081
7/64	0.10938	2.778	39/64	0.60938	15.478
1/8	0.12500	3.175	5/8	0.62500	15.875
9/64	0.14063	3.571	41/64	0.64063	16.271
5/32	0.15625	3.968	21/32	0.65625	16.668
11/64	0.17188	4.365	43/64	0.67188	17.065
3/16	0.18750	4.762	11/16	0.68750	17.462
13/64	0.20313	5.159	45/64	0.70313	17.859
7/32	0.21875	5.556	23/32	0.71875	18.256
15/64	0.23438	5.953	47/64	0.73438	18.653
1/4	0.25000	6.350	3/4	0.75000	19.050
17/64	0.26563	6.746	49/64	0.76563	19.446
9/32	0.28125	7.143	25/32	0.78125	19.843
19/64	0.29688	7.540	51/64	0.79688	20.240
5/16	0.31250	7.937	13/16	0.81250	20.637
21/64	0.32813	8.334	53/64	0.82813	21.034
11/32	0.34375	8.731	27/32	0.84375	21.431
23/64	0.35938	9.128	55/64	0.85938	21.828
3/8	0.37500	9.525	7/8	0.87500	22.225
25/64	0.39063	9.921	57/64	0.89063	22.621
13/32	0.40625	10.318	29/32	0.90625	23.018
27/64	0.42188	10.715	59/64	0.92188	23.415
7/16	0.43750	11.112	15/16	0.93750	23.812
29/64	0.45313	11.509	61/64	0.95313	24.209
15/32	0.46875	11.906	31/32	0.96875	24.606
31/64	0.48438	12.303	63/64	0.98438	25.003
1/2	0.50000	12.700	1	1.00000	25.400

A.7 Conversion Table for FRA Defect Codes

New FRA Code		Previous Code	
213.4	**Excepted Track**	**213.4**	**Excepted track**
0004A	Excepted track segment not identified in appropriate record.	4.01	Excepted track segment not identified in appropriate record.
0004B	Excepted track segment located within 30 feet of an adjacent track subject to simultaneous operation at speeds in excess of 10 mph.	4.02	Excepted track segment located within 30 feet of an adjacent track subject to simultaneous operation at speeds in excess of 10 mph.
0004C	Excepted track not inspected in accordance with § 213.233(c) and 213.235 as specified for Class 1 track.	4.03	Excepted track not inspected in accordance with §213.233(c) and 213.235 as specified for Class I track.
0004D	Train speed exceeds 10 mph on excepted track.	4.04	Train speed exceeds 10 mph on excepted track.
0004E1	Occupied passenger train operated on excepted track.	4.05	Occupied passenger train operated on excepted track.
0004E2	Freight train operated on excepted track with more than five cars required to be placarded in accordance with 49 CFR Part 172.	4.06	Freight train operated on excepted track with more than five cars required to be placarded in accordance with 49 CFR Part 172.
0004E3	Train with a car required to be placarded by 49 CFR Part 172 operated over excepted track within 100 feet of a bridge or in a public street or highway.	4.07	Train with a car required to be placarded by 49 CFR ·-·· Part 172 operated over excepted track within 100 feet of a bridge or in a public street or highway.
0004F	Failure to notify FRA of removal of trackage from excepted status.	4.08	Failure to notify FRA of removal of trackage from excepted status.
213.5	**Responsibility for Compliance**		N/A
0005A	Failure of owner to either bring track into compliance, halt operations, or operate subject to the conditions of this Part.		N/A
213.7	**Designation of qualified persons to super-vise certain renewals and inspect track**	**213.7**	**Designation of qualified persons to super-vise certain renewals and inspect track**
		7.01	**Reserved**
0007A2	Failure of track owner to have persons demonstrate required knowledge, ability to detect deviations and prescribe remedial action, inspection.		N/A
0007A3	Failure of person to have written authorization for restoration and renewal.	7.02	Failure of track owner to designate qualified persons to supervise restorations & renewals
0007B	Failure of track owner to use qualified persons to inspect track.	7.06	Failure of track owner to designate qualified persons to inspect track for defects.
0007B2	Failure of track owner to have persons demonstrate required knowledge, ability to detect deviations and prescribe remedial action, restoration and renewal.		N/A
0007B3	Failure of person to have written authorization for inspection.		N/A
0007C	Failure of track owner to use qualified persons to inspect, restore or renew CWR.		N/A
0007C2	Failure to complete comprehensive CWR training course.		N/A
0007C3	Failure of track owner to have persons demonstrate required knowledge, ability to detect deviations, CWR.	7.03	Failure to use qualified person to pass trains over broken rails or pull aparts.
0007C4	Failure of person to have written authorization to inspect, restore or renew CWR.		N/A

New FRA Code		Previous Code	
0007D	Failure of track owner to use not fully qualified persons to pass trains over broken rails or pull aparts.		N/A
0007D2	Train speed exceeds 10 mph over broken rails or pull aparts.	7.04	Train speed exceeds 10 m.p.h. over broken rails or pull aparts.
0007D3	Person not watching or prepared to stop train movements over broken rails or pull aparts.		N/A
0007D4	Failure to promptly notify and dispatch person(s) fully qualified under § 213.7 to the location of the broken rail or pull apart.	7.05	Failure to promptly notify and dispatch person fully qualified under §213.7 to the location of the broken rail or pull apart.
0007E	Failure of track owner to properly maintain written records of designation and basis for each designation.	7.07	Failure of track owner to properly maintain written records of designation.
213.9	**Classes of track; operating speed limits**	**213.9**	**Classes of track; operating speed limits**
0009B1	Failure to restore other than excepted track to compliance with Class 1 standards within 30 days after a person designated under § 213.7(a) has determined that operations may safely continue over defect(s) not meeting Class 1 or excepted track standards.	9.01	Failure to restore other than excepted track to compliance with Class I stds. within 30 days after a per-son designated under §213.7(a) has determined that operations may safely continue over defect(s) not meeting Class l or excepted track stds.
0009B2	Failure of track owner to enforce, over Class 1 defects, the limiting conditions imposed by person designated under § 213.7(a).	9.02	Failure of track owner to enforce, over Class I defects, the limiting conditions imposed by person designated under §213.7(a).
		9.03	Reserved
213.11	**Restoration or renewal of track under traffic conditions**	**213.11**	**Restoration or renewal of track under traffic conditions**
0011	Proper qualified supervision not provided at work site during work hours when track is being restored or renewed under traffic conditions.	11.01	Proper qualified supervision not provided at work site during work hours when track is being restored . or renewed under traffic conditions.
213.13	**Measuring track not under load**	**213.13**	**Measuring track not under load**
0013	Failure to add dynamic movement to static measurement	13.01	Failure to add dynamic movement to static measurement
213.33	**Drainage**	**213.33**	**Drainage**
0033A1	Drainage or water-carrying facility not maintained.	33.01	Drainage or water-carrying facility not maintained.
0033A2	Drainage or water-carrying facility obstructed by debris.	33.02	Drainage or water-carrying facility obstructed by debris.
0033A3	Drainage or water-carrying facility collapsed.	33.03	Drainage or water-carrying facility collapsed.
0033A4	Drainage or water-carrying facility obstructed by vegetation.	33.04	Drainage or water-carrying facility obstructed by vegetation.
0033A5	Drainage or water-carrying facility obstructed by silting.	33.05	Drainage or water-carrying facility obstructed by silting
0033A6	Drainage or water-carrying facility deteriorated to allow subgrade saturation.	33.06	Drainage or water-carrying facility deteriorated to allow subgrade saturation.
0033A7	Uncontrolled water undercutting track structure or embankment.	33.07	Uncontrolled water undercutting track structure or embankment.
213.37	**Vegetation**	**213.37**	**Vegetation**
0037A	Combustible vegetation around track-carrying structures.	37.01	Combustible vegetation around track-carrying structures.
0037B1	Vegetation obstructs visibility of railroad signs and fixed signals.	37.02	Vegetation obstructs visibility of railroad signs and fixed signals.
0037B2	Vegetation obstructs visibility of grade crossing warning signs and signals by the traveling public.	37.10	Vegetation obstructs visibility of grade crossing warning signs and signals by the traveling public.

New FRA Code		Previous Code	
0037C1	Vegetation interferes with railroad employees performing normal trackside duties.	37.04	Vegetation interferes with railroad employees per-forming normal trackside duties.
0037C2	Vegetation obstructs passing of day and night signals by railroad employees.	37.03	Vegetation obstructs passing of day and night signals by railroad employees.
0037C3	Excessive vegetation in toepaths and around switches that interferes with employees performing normal trackside duties.	37.08	Excessive vegetation in toepaths and around switch-es that interferes with employees performing normal trackside duties.
0037D	Vegetation prevents proper functioning of signal and/or communication lines.	37.05	Vegetation prevents proper functioning of signal and/or communication lines.
0037E1	Excessive vegetation at train order office, depot, interlocking plant, a carman's building, etc., prevents employees on duty from visually inspecting moving equipment when their duties so require.	37.06	Excessive vegetation at train order office, depot, interlocking plant, a carman's building, etc., prevents employees on duty from visually inspecting moving equipment when their duties so require.
0037E2	Excessive vegetation at train meeting points prevents proper inspection by railroad employees of moving equipment.	37.07	Excessive vegetation at train meeting points prevents proper inspection of moving equipment by railroad employees.
0037E3	Vegetation brushing sides of rolling stock that prevents employees from visually inspecting moving equipment from their normal duty stations.	37.09	Vegetation brushing sides of rolling stock that pre-vents employees from visually inspecting moving equipment from their normal duty stations
213.53	**Gage**	**213.53**	**Gage**
0053A	Gage measurement improper		N/A
0053B1	Gage dimension on tangent track exceeds allowable.	53.01	Gage dimension exceeds allowable on tangent track.
0053B2	Gage dimension on tangent track is less than allowable	53.02	Gage dimension is less than allowable on tangent track.
0053B3	Gage dimension on curved track exceeds allowable	53.03	Gage dimension exceeds allowable on curved track.
0053B4	Gage dimension on curved track is less than allowable	53.04	Gage dimension is less than allowable on curved track.
0053B5	Gage dimension for excepted track exceeds allowable	53.05	Gage dimension exceeds allowable for excepted track.
213.55	**Alinement**	**213.55**	**Alinement**
0055A1	Alinement deviation of tangent track for a 62-foot chord exceeds allowable	55.01	Alinement deviation of tangent track exceeds allowable.
0055A2	Alinement deviation of curved track for a 62-foot chord exceeds allowable.	55.02	Alinement deviation of curved track exceeds allowable for a 62-foot chord.
0055A3	Alinement deviation of curved in Class 3-5 track for a 31-foot chord exceeds allowable.	55.03	Alinement deviation of curved track exceeds allowable for a 31-foot chord.
213.57	**Curves; elevation and speed limitations**	**213.57**	**Curves; elevation and speed limitations**
		57.01	**Reserved**
0057A1	Maximum crosslevel on a curve in Class 1 and 2 track exceeds allowable.	57.06	Maximum crosslevel on curve exceeds allowable.
0057A2	Maximum crosslevel on curve in Class 3-5 track exceeds allowable.		N/A
0057B1	Operating speed exceeds allowable for 3-inches of unbalance, based on curvature and elevation.	57.02	Operating speed exceeds allowable for 3-inches of unbalance, based on curvature and elevation.
0057C1	Operating speed exceeds allowable for 4-inches of unbalance, based on curvature and elevation.	57.03	Operating speed exceeds allowable for 4-inches of unbalance, based on curvature and elevation.

New FRA Code		Previous Code	
0057D	Operating speed exceeds allowable for a FRA approved unbalance based on curvature and elevation for contiguous high speed track exceeds allowable.	57.04	Operating speed exceeds allowable for a FRA approved unbalance based on curvature and elevation approved for track contiguous to high speed track.
		57.05	**Reserved**
213.57	**Elevation of curved track; runoff**		N/A
0059A	Where fixed physical conditions are not considered, operating speed based on curvature and actual minimum elevation in a curve exceeds allowable		N/A
0059B	Improper elevation runoff in a spiral exceeds allowable		N/A
213.63	**Track surface**	**213.63**	**Track surface**
0063A1	Runoff in any 31-feet of rail at end of raise exceeds allowable.	63.01	Runoff in any 31-feet of rail at end of raise exceeds allowable.
0063A10	Crosslevel differences in all of six or more consecutive pairs of staggered joints in Class 2-5 track exceeds allowable.	63.13	Crosslevel differences for six or more consecutive pairs of staggered joints exceeds allowable.
0063A2	Deviation from uniform profile on either rail exceeds allowable.	63.02	Deviation from uniform profile on either rail exceeds allowable.
0063A3	Deviation from zero crosslevel at any point on tangent track exceeds allowable	63.05	Deviation from zero crosslevel at any point on tangent exceeds allowable.
0063A4	Reverse crosslevel on curve track exceeds allowable	63.10	Reverse elevation on curve exceeds allowable.
0063A5	Difference in crosslevel (warp) between any two points less than 62-feet apart on tangent track exceeds allowable.	63.07	Difference in crosslevel between any two points less than 62-fect apart on tangents exceeds allowable.
0063A6	Difference in crosslevel (warp) between any two points less than 62-feet apart on curve track between spirals exceeds allowable.	63.08	Difference in crosslevel between any two points less than 62-fect apart on curves between spirals exceeds allmvable.
0063A7	Difference in crosslevel (warp) between any two points less than 62-feet apart on spiral track exceeds allowable.	63.09	Difference in cross level between any two points less than 62-fect apart on spirals exceeds allowable.
0063A8	Variation in crosslevel per 31-feet on a physically restricted length spiral exceeds allowable.	63.11	Deviation in crosslevel per 31-fcet exceeds allowable on restricted length spiral.
0063A9	Where elevation at any point in curve track equals or exceeds six inches, the difference in crosslevel within 62-feet between that point and a point with greater elevation exceeds allowable	63.12	Difference in crosslevel within 62-fect between a point on a curve that equals or exceeds 6-inches and a point with greater elevation exceed allowable.
		63.03	**Reserved**
		63.04	**Reserved**
		63.06	**Reserved**
213.103	**Ballast; general**	**213.103**	**Ballast; general**
0103A	Fouled or insufficient ballast failing to transmit and distribute loading	103.01	Insufficient Ballast
0103B	Fouled or insufficient ballast failing to restrain the track laterally, longitudinally or vertically.	103.02	Fouled Ballast
0103C	Fouled ballast failing to provide adequate drainage for the track.		N/A
0103D	Fouled or insufficient ballast failing to maintain proper geometry.		N/A
213.109	**Crossties**	**213.109**	**Crossties**
0109A	Crossties made of unsound material		N/A

New FRA Code		Previous Code	
0109B1i	39-foot segment of track does not have sufficient number of crossties to provide effective support to hold gage within limits prescribed in § 213.53(b).		N/A
0109B1ii	39-foot segment of track does not have sufficient number of crossties to provide effective support that will maintain surface within the limits prescribed by § 213.63.		N/A
0109B1iii	39-foot segment of track does not have sufficient number of crossties to provide effective support that will maintain alinement within the limits prescribed by § 213.55.		N/A
0109B2	Crossties not effectively distributed to support a 39-foot segment of track.	109.03	Crossties not effectively distributed to support a 39-foot segment of track.
0109B3	No effective support ties within the prescribed distance from a joint.	109.02	No effective support ties within the prescribed distance from a joint.
0109B4	Failure to maintain the minimum number of crossties per FRA track class for each 39-foot segment of track as indicated in table in this section.	109.05	Fewer than minimum allowable number of non-defective ties per 39 feet for turnouts and curved track over 2 degrees.
		109.04	Fewer than minimum allowable number of non-defective ties per 39 feet for tangent and curved track less than 2 degrees.
0109C1	Crossties, other than concrete, that meet the minimum requirements of § 213.109(b)(4), are broken through.		N/A
0109C2	Crossties, other than concrete, that meet the minimum requirements of § 213.109(b)(4), are split or otherwise impaired to the extent the crosstie will allow the ballast to work through, or it will not hold spikes or rail fasteners.		N/A
0109C3	Crossties, other than concrete, that meet the minimum requirements of § 213.109(b)(4), are so deteriorated that the crosstie plate or base of the rail can move laterally 1/2-inch relative to the crosstie.		N/A
0109C4	Crossties, other than concrete, that meet the minimum requirements of § 213.109(b)(4), are cut by the crosstie plate through more than 40 percent of a crosstie's thickness.		N/A
0109D1	Concrete crosstie broken through or deteriorated to the extent that prestressing material is visible		N/A
0109D2	Concrete crosstie deteriorated or broken off in vicinity of shoulder or insert so fastener assembly can pull or move laterally more than 3/8-inch relative to crosstie		N/A
0109D3	Concrete crosstie deteriorated such that base of either rail can move laterally more than 3/8-inch relative to crosstie on curves of 2 degrees greater; or can move laterally more than 1/2-inch relative to crosstie on tangent track or curves of less than 2 degrees		N/A

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0109D4	Concrete crosstie deteriorated or abraded at any point under the rail seat up to a depth of 1/2-inch or more		N/A
0109D5	Concrete crosstie deteriorated such that the crosstie's fastening or anchoring system, including rail anchors, is unable to maintain longitudinal rail restraint, or maintain rail hold down, or maintain gage due to insufficient fastener toehold		N/A
0109D6	Concrete crosstie configured with less than two fasteners on the same rail except as provided in § 213.127(c)		N/A
0109G	Track constructed without crossties does not effectively support track structure.	109.05	Track constructed without crossties does not effectively support track structure.
		109.01	**Operating speed exceeds allowable for a FRA approved unbalance based on curvature and elevation approved for track contiguous to high speed track.**
213.110	**Gage restraint measurements systems**	**213.110**	**Gage restraint measurements systems**
0110A	Failure to maintain and operate GRMS within minimum design requirements over designated GRMS line segments	110.05	Failure to maintain and operate GRMS within mini-mum design requirements over designated GRMS line segments.
0110A1	Failure to notify FRA at least 30 days prior to the designation of a GRMS line segment	110.01	Failure to notify FRA at least 30 days prior to the designation of a GRMS line segment.
0110A2	Failure to notify FRA at least 10 days prior to the removal of a line segment from GRMS designation	110.02	Failure to notify FRA at least 10 days prior to the removal of a line segment from GRMS designation.
0110B1	Failure to provide required information identifying a GRMS line segment	110.03	Failure to provide required information identifying a GRMS line segment.
0110C	Failure to provide sufficient technical data to establish compliance with minimum GRMS design requirements	110.04	Failure to provide sufficient technical data to establish compliance with minimum GRMS design requirements.
0110G	Failure of GRMS to provide analog trace of specified parameters	110.06	Failure of GRMS to provide analog trace of specified parameters
0110H	Failure of GRMS to provide exception report listing of specified parameters	110.07	Failure of GRMS to provide exception report listing of specified parameters.
0110I	Failure to provide exception report listing to Part 213.7 individual prior to next inspection required under § 213.333	110.08	Failure to provide exception report listing to § 213.7 individual prior to next inspection required under§ 213.233.
0110J1i	Failure to maintain and make available documented calibration procedures on GRMS vehicle	110.09	Failure to maintain and make available documented calibration procedures on GRMS vehicle.
0110J1ii	Failure to initiate a daily instrument verification procedure	110.10	Failure to initiate a daily instrument verification procedure.
0110J2	Failure to maintain PTLF accuracy within five-percent of 4,000 reading	110.11	Failure to maintain PTLF accuracy within five-per-cent of 4,000-pound reading.
0110K	Failure to meet training requirements.	110.13	Failure of GRMS training program to meet minimum requirements.
0110L	Failure to initiate required remedial action for exceptions listed on GRMS record of lateral restraint	110.15	Failure to initiate required remedial action for exceptions listed on GRMS record of lateral restraint.
0110M1i	Gage widening exceeds allowable measured with PTLF	110.16	Gage widening exceeds allowable measured with PTLF.
0110M5	Failure to provide functional PTLF to § 213.7 individual whose territory is subject to requirements of § 213.110	110.17	Failure to provide functional PTLF to § 213.7 individual whose territory is subject to requirements of§ 213.110.

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0110M6	Failure to restore contact between rail and lateral rail restraint components	110.18	Failure to restore contact between rail and lateral rail restraint components
0110N	Failure to keep GRMS records as required	110.19	Failure to keep GRMS records as required.
0110O	Failure to conduct GRMS inspections at required frequency	110.20	Failure to conduct GRMS inspections at required frequency.
		110.12	**Failure to make available GRMS training program.**
		110.14	**Failure to provide GRMS training to§ 213.7 individual whose territory is subject to requirements of § 213.110.**
213.113	**Defective Rails**	**213.113**	**Defective rails**
0113A	Operation continued over defective rail without required remedial action.		N/A
0113B	Rail defect originating from bond wire attachment [where a defect results from a bond wire attachment, FRA inspectors must cite this defect code and also include a description of the applicable rail defect as described in §213.113]	113.16	Rail defect originating from bond wire attachment [Where a defect results from a bond wire attachment, FRA inspectors must cite this defect code and also include a description of the applicable rail defect as described in *213.113l
0113B1	Transverse fissure	113.01	Transverse Fissure
0113B10	Ordinary break	113.12	Ordinary Break
0113B11	Damaged rail	113.14	Damaged Rail
0113B12	Flattened rail	113.15	Flattened Rail
0113B13	Bolt-hole crack	113.07	Bolt-Hole Crack
0113B14	Broken or defective weld	113.13	Broken or Defective Weld
0113B15	Head web separation	113.08	Head Web Separation
0113B2	Compound fissure	113.02	Compound Fissure
0113B3	Horizontal split head	113.03	Horizontal Split Head
0113B4	Vertical split head	113.04	Vertical Split Head
0113B5	Split web	113.05	Split Web
0113B6	Piped rail	113.06	Piped Rail
0113B7	Broken base	113.09	Broken Base
0113B8	Detail fracture	113.1	Detail Fracture
0113B9	Engine burn fracture	113.11	Engine Burn Fracture
213.115	**Rail end Mismatch**	**213.115**	**Rail end mismatch**
0115A1	Rail-end mismatch on tread of rail exceeds allowable.	115.01	Rail-end mismatch on tread of rail exceeds allowable.
0115A2	Rail-end mismatch on tread of rail exceeds allowable (CWR).	115.03	Rail-end mismatch on tread of rail exceeds allowable (CWR)
0115A3	Rail-end mismatch on gage side of rail exceeds allowable.	115.02	Rail-end mismatch on gage side of rail exceeds allowable.
0115A4	Rail-end mismatch on gage side of rail exceeds allowable (CWR).	115.04	Rail-end mismatch on gage side of rail exceeds allowable (CWR)
213.118	**Continuous welded rail (CWR); Plan approval and review**		
0118A1	Failure of track owner to develop and implement written CWR procedures.		N/A
0118A2	Failure to comply with written CWR procedures.		N/A
0118A3	Failure of track owner to develop a training program for the implementation of their written CWR procedures.		N/A
0118C	Failure of track owner to comply with existing CWR plan.		N/A
0118E1	Failure of track owner to file a revised CWR plan with associate administrator of safety/chief operating officer within 30 days of revision.		N/A

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0118E2	Failure of track owner to re-submit a conforming plan within 30 days of receipt of final submission decision.		N/A
213.119	**Continuous welded rail (CWR); general**	**213.119**	**Continuous welded rail (CWR); general**
0119A	Failure to comply with written CWR procedures - installation and adjustment	119.02	Failure to comply with written CWR procedures.
0119B	Failure to comply with written CWR procedures - anchoring or fastening requirements	119.10	Failure to comply with written CWR procedures anchoring requirements
0119C	Failure to comply with written CWR procedures - joint installation and maintenance procedures	119.06	Failure to record the location of, conditions of, and remedial action for joints in CWR, as required.
0119D	Failure to comply with written CWR procedures - maintaining desired rail installation temperature range	119.11	Failure to comply with written CWR procedures rail neutral temperature
0119E	Failure to comply with written CWR procedures - curved track	119.12	Failure to comply with written CWR procedures monitoring procedures
0119F	Failure to comply with written CWR procedures - train speed	119.13	Failure to comply with written CWR procedures train speed
0119G	Failure to comply with written CWR procedures - physical track inspections	119.14	Failure to comply with written CWR procedures inspection procedures
0119H	Failure to comply with written CWR procedures - CWR joint inspection	119.07	Failure to inspect joints in CWR at required frequency.
0119I	Failure to comply with written CWR procedures - training	119.03	Failure of track owner to develop a training program for the implementation of their written CWR procedures.
0119J	Failure to comply with written CWR procedures - recordkeeping	119.04	Failure to keep CWR records as required.
0119K	CWR procedures and revisions not available at job site or maintained in one manual		N/A
		119.01	**Failure of track owner to develop and implement written CWR procedures.**
		119.05	**Failure of track owner to institute required provisions for inspecting joints in CWR.**
		119.08	**Railroad using alternate methods to inspect joints in CWR without seeking approval from FRA.**
		119.09	**Railroad using alternate methods to inspect joints in CWR before approval has been granted**
213.121	**Rail joints**	**213.121**	**Rail joints**
0121A1	Rail joint not of structurally sound design and dimension (jointed track)	121.01	Rail joint not of structurally sound design and dimension (Jointed rail)
0121A2	Rail joint not of structurally sound design and dimension (CWR).	121.11	Rail joint not of structurally sound design and dimension (CWR).
0121B1	Cracked or broken joint bar in Classes 3 through 5 track (other than center-break) (jointed track)	121.02	Cracked or broken joint bar in Classes 3 through 5 track (other than center-break) (Jointed rail)
0121B2	Cracked or broken joint bar in Classes 3 through 5 track (other than centerbreak) (CWR)	121.12	Cracked or broken joint bar in Classes 3 through 5 track (other than centerbreak) (CWR).
0121B3	Cracked or broken insulated joint bar in Classes 3 through 5 track (other than centerbreak) (CWR).	121.17	Cracked or broken insulated joint bar in Classes 3 through 5 track (other than centerbreak) (CWR)
0121B4	Worn joint bar allows excessive vertical movement of rail in joint in Classes 3 through 5 track (jointed track)	121.04	Worn joint bar allows excessive vertical movement of rail in joint in Classes 3 through 5 track (jointed rail)
0121B5	Worn joint bar allows excessive vertical movement of rail in joint in Classes 3 through 5 track (CWR).	121.14	Worn joint bar allows excessive vertical movement of rail in joint in Classes 3 through 5 track (CWR)

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0121C1	Center cracked or broken joint bar (jointed track)	121.03	Center cracked or broken joint bar (Jointed rail)
0121C2	Center cracked or broken joint bar (CWR).	121.13	Center cracked or broken joint bar (CWR).
0121C3	Center cracked or broken insulated joint bar (CWR)	121.15	Center cracked or broken insulated joint bar (CWR)
0121D1	Less than 2 bolts per rail at each joint for conventional jointed rail in Classes 2 through 5 track.	121.05	Less than 2 bolts per rail at each joint for conventional jointed rail in Classes 2 through 5 track.
0121D2	Less than 1 bolt per rail at each joint for conventional jointed rail in Class 1 track.	121.06	Less than I bolt per rail at each joint for convention-al jointed rail in Class 1 track.
0121E	Less than 2 bolts per rail at any joint in continuous welded rail.	121.07	Less than two bolts per rail at any joint in continuous welded rail.
0121F1	Loose joint bars (jointed track)	121.08	Loose joint bars (jointed rail)
0121F2	Loose joint bars (CWR).	121.18	Loose joint bars (CWR).
0121G1	Torch-cut or burned-bolt hole in rail in Classes 2 through 5 track (jointed track)	121.09	Torch-cut or burned-bolt hole in rail in Classes 2 through 5 track (jointed rail)
0121G2	Torch-cut or burned-bolt hole in rail in Classes 2 through 5 track (CWR).	121.19	Torch-cut or burned-bolt hole in rail in Classes 2 through 5 track (CWR).
0121H1	Joint bar reconfigured by torch cutting in Classes 3 through 5 track (jointed track)	121.10	Joint bar reconfigured by torch cutting in Classes 3 through 5 track (jointed rail)
0121H2	Joint bar reconfigured by torch cutting in Classes 3 through 5 track (CWR).	121.20	Joint bar reconfigured by torch cutting in Classes 3 through 5 track (CWR).
		121.16	**Reserved**
213.122	**Torch Cut Rail**	**213.122**	**Torch cut rail**
0122Ai	Torch cut rail applied in Class 3 through 5 track for other than emergency.	122.01	Torch cut rail applied in Class 3 through 5 track for other than emergency.
0122Aii	Failure to remove torch cut rails within specified time frame.	122.02	Failure to remove torch cut rails within specified time frame.
0122B1	Failure to remove non-inventoried torch cut rail within 30 days of discovery.	122.03	Failure to remove non-inventoried torch cut rail with-in 30 days of discovery.
0122B2	Train speed exceeds allowable over non-inventoried torch cut rail.	122.04	Train speed exceeds allowable over non-inventoried torch cut rail.
213.123	**Tie Plates**	**213.123**	**Tie Plates**
0123A	Insufficient tie plates in Class 3 through 5 track.	123.01	Insufficient tie plates in Class 3 through 5 track.
0123B	Object between base of rail and the bearing surface of the tie plate causing concentrated load.	123.02	Object between base of rail and the bearing surface of the tie plate causing concentrated load.
213.127	**Rail Fastenings**	**213.127**	**Rail Fastenings**
0127A	Failure of fastening components to effectively maintain gage within the limits described in § 213.53(b)	127.02	Fasteners in a 39-foot track segment not effectively maintaining gage
0127A2	Insufficient fasteners in a track segment.	127.01	Insufficient fasteners in a 39-foot track segment.
0127A3	Insufficient fasteners at rail joint.		N/A
0127B	Failure of applied rail anchors to provide effective longitudinal restraint		N/A
0127C	Failure of fastener placement at insulated joints from performing as intended, or the crosstie does not effectively support the rail		N/A
213.133	**Turnouts and Track Crossing Generally**	**213.133**	**Turnouts and Track Crossing Generally**
0133A1	Loose, worn, or missing switch clips.	133.01	Loose, worn, or missing switch clips.
0133A10	Missing switch, frog, or guard rail plates.	133.10	Missing switch, frog, or guard rail plates.
0133A11	Loose or missing switch point stops.	133.11	Loose or missing switch point stops.
0133A12	Loose, worn, or missing frog bolts.	133.12	Loose, worn, or missing frog bolts.

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0133A13	Loose, worn, or missing guard rail bolts.	133.13	Loose, worn, or missing guard rail bolts.
0133A14	Loose, worn or missing guard rail clamps, wedge, separator block, end block, or other components.	133.14	Loose, worn or missing guard rail clamps, wedge, separator block, end block, or other components.
0133A15	Turnout or track crossing fastenings not intact or maintained.	133.20	Turnout or track crossing fastenings not intact or maintained.
0133A16	Obstruction between switch point and stock rail.	133.15	Obstruction between switch point and stock rail.
0133A17	Obstruction in flangeway of frog.	133.16	Obstruction in flangeway of frog.
0133A18	Obstruction in flangeway of guard rail.	133.17	Obstruction in flangeway of guard rail.
0133A2	Loose, worn, or missing clip bolts (transit, side jaw, eccentric, vertical).	133.02	Loose, worn, or missing clip bolts (transit, side jaw, eccentric, vertical).
0133A3	Loose, worn, or defective connecting rod.	133.03	Loose, worn, or defective connecting rod.
0133A4	Loose, worn, or defective connecting rod fastening.	133.04	Loose, worn, or defective connecting rod fastening.
0133A5	Loose, worn, or defective switch rod.	133.05	Loose, worn, or defective switch rod.
0133A6	Loose, worn, or missing switch rod bolts.	133.06	Loose, worn, or missing switch rod bolts.
0133A7	Worn or missing cotter pins.	133.07	Worn or missing cotter pins.
0133A8	Loose or missing rigid rail braces.	133.08	Loose or missing rigid rail braces.
0133A9	Loose or missing adjustable rail braces.	133.09	Loose or missing adjustable rail braces.
0133B	Insufficient anchorage to restrain rail movement.	133.18	Insufficient anchorage to restrain rail movement.
0133C	Flangeway less than 1 1/2 inches wide.	133.19	Flangeway less than 1" inches wide.
213.135	**Switches**	**213.135**	**Switches**
0135A1	Stock rail not securely seated in switch plates.	135.01	Stock rail not securely seated in switch plates.
0135A2	Stock rail canted by overtightening rail braces.	135.02	Stock rail canted by overtightening rail braces.
0135B1	Improper fit between switch point and stock rail.	135.03	Improper fit between switch point and stock rail.
0135B2	Excessive lateral or vertical movement of switch point.	135.05	Excessive lateral or vertical movement of switch point.
0135B3	Lateral or vertical movement of a stock rail adversely affecting the fit of the switch point to the stock rail.		N/A
0135C	Outer edge of wheel contacting gage side of stock rail.	135.04	Outer edge of wheel contacting gage side of stockrail.
0135D	Heel of switch insecure.	135.06	Heel of switch insecure.
0135E1	Switch stand or switch machine insecure or operable with excessive lost motion.	135.07	Insecure switch stand or switch machine.
0135E2	Connecting rod insecure or operable with excessive lost motion.	135.08	Insecure connecting rod.
0135F	Throw lever operable with switch lock or keeper in place.	135.09	Throw lever operable with switch lock or keeper in place.
0135G	Switch position indicator not clearly visible.	135.10	Switch position indicator not clearly visible.
0135H1	Unusually chipped or worn switch point.	135.11	Unusually chipped or worn switch point.
0135H2	Improper switch closure due to metal flow.	135.12	Improper switch closure due to metal flow.
0135I	Use of tongue and plain mate where speeds exceed Class one.	135.13	Use of tongue and plane mate where speeds exceed class one
213.137	**Frogs**	**213.137**	**Frogs**
0137A	Insufficient flangeway depth.	137.01	Insufficient flangeway depth.
0137B	Frog point chipped, broken, or worn in excess of allowable.	137.02	Frog point chipped, broken, or worn in excess of allowable.
0137C	Tread portion of frog worn in excess of allowable.	137.03	Tread portion of frog worn in excess of allowable.

New FRA Code		Previous Code	
0137D	Use of flange bearing frog where speed exceeds that permitted by Class 1.	137.04	Use of flange bearing frog where speed exceeds that permitted by Class 1.
0137E	Severe frog condition not otherwise provided. (advisory only cannot be used solely to recommend violation)	137.99	Severe frog condition not otherwise provided.]Advisory only cannot be used solely to recommend violation]
213.139	**Spring Rail Frogs**	**213.139**	**Spring Rail Frogs**
0139A	Outer edge of wheel contacting side of spring wing rail.	139.01	Outer edge of wheel contacting side of spring wing rail.
0139B	Toe of wing rail not fully bolted and tight.	139.02	Toe of wing rail not fully bolted and tight.
0139B1	Ties under or wing rail not solidly tamped.	139.03	Ties under or wing rail not solidly tamped.
0139C1	Bolt-hole defect in spring frog.	139.04	Bolt-hole defect in frog.
0139C2	Head and web separation in spring frog.	139.05	Head and web separation in frog.
0139D	Insufficient **compression** in spring to hold wing rail against point rail.	139.06	Insufficient **tension** in spring to hold wing rail against point rail
0139E	Excessive clearance between hold-down housing and horn.	139.07	Excessive clearance between hold-down housing and horn
213.141	**Self-Guarded Frogs**	**213.141**	**Self-Guarded Frogs**
0141A	Raised guard worn excessively.	141.01	Raised guard worn excessively.
0141B	Frog point rebuilt before restoring guarding face.	141.02	Frog point rebuilt before restoring guarding face.
213.143	**Frog Guard Rails and Guard Faces; Gage**	**213.143**	**Frog Guard Rails and Guard Faces; Gage**
0143A1	Guard check gage less than allowable.	143.01	Guard check gage Jess than allowable.
0143A2	Guard face gage exceeds allowable.	143.02	Guard face gage exceeds allowable.
0143A3	Cracked or broken guard rail.	143.03	Cracked or broken guard rail.
213.205	**Derails**	**213.205**	**Derails**
0205A	Derail not clearly visible.	205.01	Derail not clearly visible.
0205B	Derail operable when locked.	205.02	Derail operable when locked.
0205C1	Loose, worn, or defective parts of derail.	205.03	Reserved
0205C2	Insecure derail or stand	205.04	Improper size derail.
0205D1	Improper size derail.	205.05	Improperly installed derail.
0205D2	Improperly installed derail.	205.06	Loose, worn, or defective parts of derail.
213.233	**Track inspections**	**213.233**	**Track inspections**
0233A	Track inspected by other than qualified designated individual.	233.01	Track inspected by other than qualified designated individual
0233B	Track being inspected at excessive speed.	233.02	Track being inspected at excessive speed.
0233B1	One inspector inspecting more than two tracks or inspecting tracks with centers greater than allowable.	233.05	One Inspector inspecting more than two tracks.
0233B2	Two inspectors inspecting more than four tracks or inspecting tracks with centers greater than allowable.	233.06	Two Inspectors inspecting more than four tracks.
0233B3i	Main track not traversed within the required frequency.	233.08	Main track not traversed within the required frequency.
0233B3ii	Siding track not traversed within the required frequency.	233.09	Siding track not traversed within the required frequency.
0233C	Failure to inspect at required frequency.	233.03	Failure to inspect at required frequency.
0233D	Failure to initiate remedial action for deviations found.	233.04	Failure to initiate remedial action for deviations found.
		233.07	**Inspection performed on track outside of maximum allowable track center distances.**
213.234	**Automated inspection of track constructed with concretwe ties**		**N/A**

New FRA Code		Previous Code	
0234B1	Failure to inspect at required frequency on Class 4 and 5 main track and Class 3 main track with regularly scheduled passenger service, exceeding 40 million gross tons annually, at least twice each calendar year, with no less than 160 days between inspections		N/A
0234B2	Failure to inspect at required frequency on Class 4 and 5 main track and Class 3 main track with regularly scheduled passenger service equal to or less than 40 million gross tons annually, at least once per calendar year.		N/A
0234B3	Failure to inspect at required frequency on Class 3, 4, and 5 main track with exclusively passenger service, either an automated inspection or walking inspection once per calendar year.		N/A
0234B4	Failure to inspect at required frequency in accordance with paragraph (b)(1) or (b)(2) of this section because of train operation interruption.		N/A
0234C	Sections of tangent track greater than 600 feet constructed of concrete crossties, not inspected		N/A
0234D1	Automated inspection measurement system incapable of measuring and processing rail seat deterioration.		N/A
0234E	Failure of automated inspection measurement system to produce an exception report.		N/A
0234F	Failure to maintain and make available to FRA a record of the inspection data and exception record for the track inspected.		N/A
0234G	Failure to maintain proper procedures for data integrity.		N/A
0234H	Failure to provide annual rail seat deterioration training.		N/A
213.235	**Inspection of switches, track crossings, and lift rail assemblies or other transition devices on moveable bridges**	**213.235**	**Inspection of switches, track crossings, and lift rail assemblies or other transition devices on moveable bridges**
0235A1	Failure to inspect turnouts at required frequency.	235.01	Failure to inspect turnouts at required frequency.
0235A2	Failure to inspect track crossings at required frequency.	235.02	Failure to inspect track crossings at required frequency.
0235A3	Failure to inspect lift rail assemblies or other transition devices on moveable bridges at required frequency.	235.03	Failure to inspect lift rail assemblies or other transition devices on moveable bridges at required frequency
0235B	Failure to operate specified switches in Classes 3 through 5.	235.04	Failure to operate specified switches in Classes 3 through 5.
0235C	Switch, turnout, track crossing or transition device used less than once a month and not inspected on foot before use		N/A
0235C1	Track used less than once a month not inspected on foot before use		N/A
213.237	**Inspection of Rail**	**213.237**	**Inspection of Rail**
0237A	Failure to inspect rail for internal defects at required frequency.	237.01	Failure to inspect rail for internal defects at required frequency.

New FRA Code		Previous Code	
0237B	Failure of equipment to inspect rail at joints.	237.02	Failure of equipment to inspect rail at joints.
0237C	Defective rail not marked properly.	237.03	Defective rail not marked properly.
0237E	Improper action taken after expiration limits of previous internal rail defect search.	237.04	Failure to reduce operating speed until valid rail inspection is performed.
213.239	**Special Inspections**	**213.239**	**Special Inspections**
0239A	Failure to conduct special inspections when required.	239.01	Failure to conduct special inspections when required.
213.241	**Inspection Recoeds**	**213.241**	**Inspection records**
0241A	Failure to keep records as required.	241.01	Failure to keep records as required.
0241B1	Failure of inspector to complete report the day of the inspection.	241.02	Failure of Inspector to complete report at time of inspection.
0241B2	Failure of inspector to sign report.	241.03	Failure of inspector to sign report.
0241B3	Failure to indicate the nature of deviation.		N/A
0241B4	Failure of inspector to provide required information.	241.04	Failure of Inspector to provide required information.
0241B5	Failure to record required periodic or follow-up CWR joint inspection	241.15	Failure to record required CWR joint inspection
0241C	Failure of rail inspection record to provide required information.	241.05	Failure of rail inspection record to provide required information.
0241D	Failure to make records available for copying and inspection.	241.06	Failure to make records available for copying and inspection.
0241E1	Electronic system does not maintain the integrity of each record.	241.07	Electronic system does not maintain the integrity of each record.
0241E2	Electronic storage not initiated within 24 hours.	241.14	Electronic storage not initiated within 24 hours.
0241E3	Electronic system allows record or amendments to be modified.	241.08	Electronic system allows record or amendments to be modified.
0241E4	Electronic amendments not stored separately from record.	241.09	Electronic amendments not stored separately from record.
0241E4i	Person making electronic amendment not identified.	241.10	Person making electronic amendment not identified.
0241E5	Electronic system corrupts or losses data.	241.11	Electronic system corrupts or losses data.
0241E6	Paper copies of records not made available for inspection and copying.	241.12	Paper copies of records not made available for inspection and copying.
0241E7	Inspection reports not available to inspector or subsequent inspectors	241.13	Inspection reports not available to Inspector or sub-sequent Inspectors.

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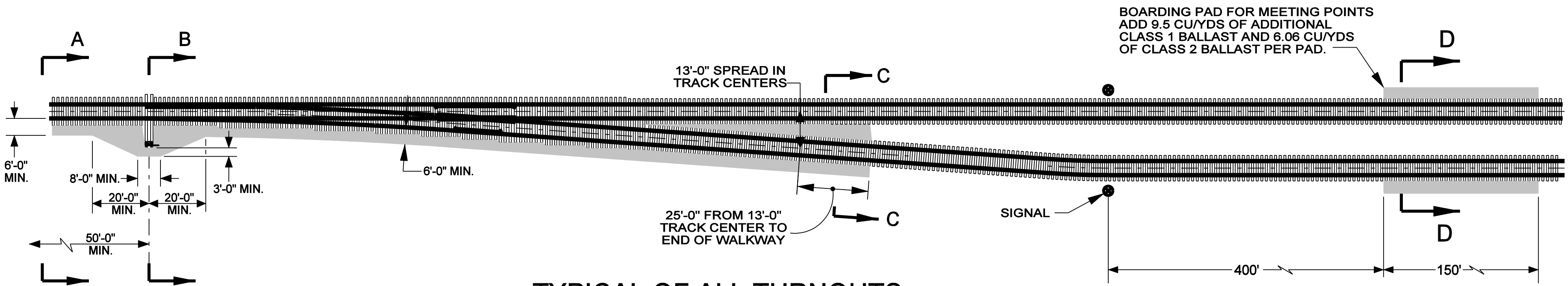

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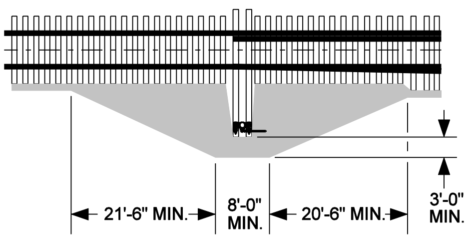
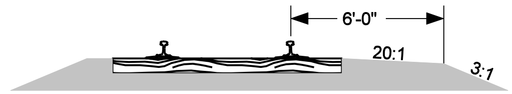
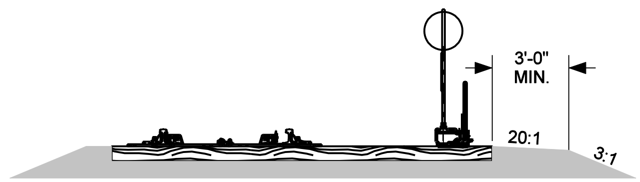


DERAIL DETAIL

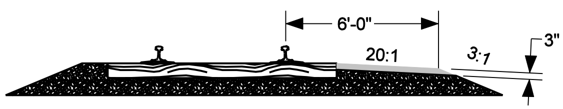
REQUIRES 8 CU/YDS OF ADDITIONAL BALLAST



VIEW A-A

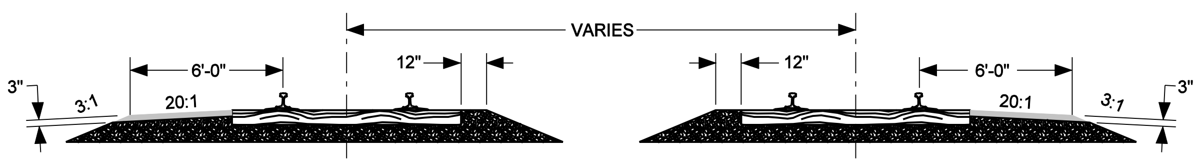


SECTION B-B



ALTERNATE SECTION FOR FREQUENTLY USED MAINLINE TURNOUTS

SECTION C-C



SECTION D-D

ADDITIONAL BALLAST REQUIRED FOR WALKWAY CONSTRUCTION

BALLAST TYPE	NORMAL APPLICATION	FREQUENTLY USED	MAINLINE HAND THROW
TURNOUT NO.	CLASS 1 OR 2	CLASS 1	CLASS 2
9	27.2 CU/YDS	16.9 CU/YDS	10.3 CU/YDS
10	28.5 CU/YDS	17.7 CU/YDS	10.8 CU/YDS
14	36.1 CU/YDS	22.4 CU/YDS	13.7 CU/YDS
*20	45.9 CU/YDS	28.5 CU/YDS	17.4 CU/YDS
*30	65.7 CU/YDS	40.8 CU/YDS	24.9 CU/YDS

*DOES NOT INCLUDE WALKWAY FOR MOVEABLE POINT FROG SWITCH MACHINE

LEGEND:

CLASS 2 BALLAST

CLASS 1 BALLAST

NOTES:

WALKWAYS SHALL BE CONSTRUCTED WITH THE SAME TYPE OF BALLAST USED IN THE TURNOUT EXCEPT THAT FREQUENTLY USED HAND THROW MAINLINE TURNOUTS SHALL BE CONSTRUCTED WITH CLASS 2 BALLAST.

RENEWED TURNOUTS ARE THOSE WHICH ARE NEWLY INSTALLED, REPLACED. UNDERCUT. OR HAVE 50% OF THE TURNOUT TIES REPLACED.

BOARDING PADS FOR MEETING POINTS SHALL BE CONSTRUCTED WITH CLASS 2 BALLAST.

VARIOUS STATE WALKWAY REGULATIONS WILL SUPERCEDE THIS DRAWING AND MUST BE COMPLIED WITH.

UNION PACIFIC RAILROAD RECOMMENDED PRACTICES

BALLAST SECTION FOR RENEWED TURNOUTS AND DERAILS

DATE: MAY 17, 2000
FILE NO.: TOBALLAST.DGN

UNION PACIFIC RAILROAD

Signal Maintenance, Inspection, Test and Standard Instructions

Yellow Book

Rev. 11/05/15

The safety and reliability of our signal system demands proper maintenance and thorough testing. It is vital that these systems be installed, maintained, inspected, and tested in accordance with the Signal Maintenance, Inspection, Test and Standard Instructions and Standard Drawings. The purpose of these instructions is to verify the proper operation of our signal system. It is absolutely crucial that all problems be located and corrected before the system is placed in service. In addition, thorough testing is vital when a system is disarranged or modified, and at the specified time intervals to ensure these systems and equipment continue to operate as designed. There is absolutely no substitute for thorough installation, testing, inspection, and maintenance of signal apparatus.

Union Pacific Signal Tests and Standards

Signal Maintenance, Inspection, Test and Standard Instructions

Union Pacific Signal Tests and Standards

Union Pacific Signal Tests and Standards

Union Pacific Signal Tests and Standards

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Union Pacific Signal Tests and Standards

Chapter 1 General Instructions

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1.1 General Instructions

1.1.1 General Instructions Rev. 09/06

A. **Books to Have On Hand.** Rev. 05/15

Employees engaged in the construction, maintenance and/or testing of signal and interlocking apparatus must have in their possession a current, and updated electronic or printed copy of the following:

- UP Rules Book,
- Current Timetable
- Chief Engineer Instructions Bulletins
- Safety Data Sheets (SDS)
- Electrical Safety Rules
- Engineering Track Maintenance Field Handbook
- Signal Maintenance, Inspection, Test and Standard Instructions

Employees will be examined on these rules and instructions.

B. **Familiarization With Rules.** Rev. 08/96

Employees must familiarize themselves with these rules and instructions and make certain that they are clearly understood. This requirement also applies to special instructions that may be issued from time to time covering the inspection and testing of signal apparatus. If any rules and instructions are not clearly understood, it is the employee's responsibility to so inform their supervisor, who will interpret the rules or instructions in question.

C. **No Changes Made Without Approval.** Rev. 01/14

Changes in these rules, instructions or supplements will not be made without the approval from the AVP of Engineering - Signals.

D. **Signal Maintenance Planner.** Rev. 01/09

The U.P.R.R. FSM (SMP) Signal Maintenance Planner will be used to plan and record signal tests and maintenance.

E. **Government Regulations.** Rev. 12/97

Employees must comply with government regulations applying to signal and interlocking systems. In the event of a conflict between the government regulations and instructions contained herein, the most stringent regulation, rule or instruction will take precedence.

F. **Testing.** Rev. 09/06

All signal apparatus that affects train operation or public safety must be tested when installed, modified, or disarranged and at least once every designated time frame thereafter.

G. **Compromising Public or Train Safety.** Rev. 02/01

Signal employees must not perform any work that may compromise the integrity of the signal system permitting unsafe public or train movements. This includes, but is not limited to causing: improper proceed signals, activation failures of crossing warning devices, and defeating signal locking circuits.

H. **Record Keeping.** Rev. 12/97

No test is complete until the appropriate forms have been properly filled out representing the actual tests performed. Retention and distribution of the original and copies will be in compliance outlined in these instructions.

1.1.2 Territories Rev. 09/06

A. **Familiarization With Territory.** Rev. 10/14

An employee, on being assigned to a new territory or duties, must promptly familiarize themselves with the territory and the operation of the apparatus assigned to their care.

B. **Responsibility for Inspection.** Rev. 10/14

Each employee is responsible for the inspection, testing, adjustment, and proper maintenance of all signals, interlocking apparatus, and other apparatus assigned to their care. Each employee must promptly report to the supervisor any condition requiring the supervisor’s attention.

C. **Inspections Made Within Time Limit.** Rev. 02/01

Tests and inspections of facilities shall be made within the specified time limit and as outlined in the Signal Test and Maintenance Instructions. Any unexplainable fault detected in connection with testing must be promptly reported to the Manager of Signal Maintenance. All signal apparatus must be checked as often as necessary to ensure safe and efficient operation.

D. **Alterations Must Not Be Made Without Approval.** Rev. 08/96

Alterations must not be made to any apparatus unless authorized by the Director of Signal Maintenance. Revised plans must be procured from Manager of Signal Maintenance.

E. **Installation of Experimental Devices.** Rev. 01/14

Installation of experimental or unapproved devices must not be made unless specifically authorized by the AVP of Engineering - Signals.

F. **Removal of Essential Apparatus.** Rev. 08/96

When it is necessary to remove or disconnect any essential apparatus for replacement, repairs, testing, inspection, or cleaning, train or engine movement over the route must not be permitted unless; a) levers and operating units affected are properly secured, or b) the apparatus is restored and the devices are known to be in proper working order.

G. **Temporary Telephones.** Rev. 08/96

When the conductors of switch, signal, or other circuits are considered for use as temporary carriers of telephone circuits, it must be determined that such use will not adversely affect the safety of the signal system.

H. **In Case of Failure.** Rev. 08/96

In the event of failure of or damage to a signal or interlocking apparatus, or highway crossing apparatus, the employee in charge must immediately notify the Control Operator or Dispatcher concerning the apparatus affected. Additionally, the employee must make arrangements for the safe movement of railroad and highway traffic until the repairs are completed. The employee in charge will thoroughly investigate the failure, eliminate all possible causes and promptly make a complete report to the Manager of Signal Maintenance.

I. **Standard Time.** Rev. 03/11

Solid state devices or recording devices with date timestamp clocks will be set to standard time.

- **Date time stamp devices which allow the automatic switching to daylight savings time feature to be enabled or disabled, must have the feature disabled and the time set to standard time.**
- **Devices designed to automatically switch to daylight savings time will be allowed if the feature cannot be disabled. These devices must be entered into SATS.**

1.1.3 Protection and Authority Rev. 08/96

A. **Protection for Movements of Trains.** Rev. 08/96

Maintenance changes or tests, which may interfere with safe operation of trains or other rail movements, must not be started until such movements have been fully protected. Temporary adjustments, when required, must be made in such manner that the safety of trains or other operations will not be impaired. When adjustment, change or replacement is made, tests must be performed **immediately** to determine that the apparatus functions as intended. When making tests of the apparatus, the proper instruments must be used and it must be known that no unsafe conditions are set up by the application of testing equipment.

B. **Removal from Service.** Rev. 08/96

The removal from service of any signal facility or circuits pertaining to signals is prohibited without proper authority.

C. **Maintenance of Apparatus.** Rev. 08/96

The maintenance of an apparatus not specifically covered in these instructions shall be performed in accordance with the manufacturer's instructions.

1.1.4 If Track is Found Unsafe

Rev. 08/96

If the track is found to be unsafe due to broken rail, wide gauge, obstruction or other unsafe conditions, the signals governing movement over that section of track must be secured to display their most restrictive indication. Additionally, immediate action must be taken to protect train movements in accordance with flagging rules and the proper authorities must be notified.

1.1.5 Proper Grounding

Rev. 08/96

A. **Circuits Kept Ground Free.** Rev. 08/96

All circuits, the functioning of which affect public and train safety must be kept free of grounds as indicated in the test procedure (Rule 234.249 - Ground Test, or Rule 236.2 and 107 – Quarterly Ground Test) contained in these instructions.

B. **Grounding & Lightning Arrestors.** Rev. 08/12

High voltage transformers, static wires, air gap switches, signal masts, instrument cases, control machines, etc., as well as all lightning arrestors shall be properly connected to ground and maintained with a resistance to ground of preferably less than five (5) ohms when dry. Additional ground rods or ground enhancement materials shall be applied as necessary to obtain a five (5) ohms resistance to ground, but in no case more than fifteen (15) ohms. Resistance will be measured utilizing an approved ground test meter.

C. **Electrical Storms.** Rev. 08/96

Whenever electrical storms occur, the Signal Maintainer must, if on duty or as soon as possible after returning to duty, check circuits for grounds and contact the Dispatcher or Operator to determine the general condition of interlocking and/or signal systems on their territory. The Signal Maintainer or other employee under the direction of the Manager of Signal Maintenance must promptly make an inspection of highway crossing signals and check to ensure that all apparatus and power supplies are functioning as intended. Corrective action must be taken immediately.

D. **Test to Ensure Circuits are Ground Free.** Rev. 08/96

Due to the hazard of electrical shock, employees must test to ensure that circuits are free of grounds before coming in contact with low voltage terminals or wires when changing signal apparatus.

1.1.6 Binding Posts and Conduits Rev. 08/96

A. **Binding Posts.** Rev. 08/96

All binding posts must have their full complement of nuts and washers. All terminal connections must be kept tight. When tightening nuts, care must be used to avoid undue strain or damage to threads on binding posts, small machine screws, and bolts.

B. **Wire Conduits.** Rev. 08/96

Wire conduits must be installed and maintained to prevent mechanical injury to wires and cables and must exclude entry and habitation by rodents and insects. Outside conduits must be watertight. Wire openings of instrument cases must be packed tightly with approved sealing material. Wire and cable openings, and other wire-ways which may act as a flue in the event of a fire, must be sealed with approved material.

C. **Placing Objects Near Apparatus.** Rev. 05/15

Do not place any object which might interfere with the proper functioning of any signal apparatus in a battery or terminal case, instrument enclosure, control machine, or any other compartment which may interfere with the signal apparatus.

D. **Using Care When Drilling.** Rev. 08/96

Extreme care must be used when drilling, filing, or chipping metal parts in an area near relays, terminal boards, or other exposed electrical connections. Suitable safeguards must be provided to prevent metal particles from producing unsafe conditions. Care must also be used to prevent tools, keys or other metal articles from bridging adjacent electrical connections.

1.1.7 Layouts and Wires Rev. 01/14

A. **Layout and Circuit Plans.** Rev. 01/14

Plans must be legible and correct and shall be maintained in good condition. Plans that are torn, faded, or have experienced more than one change marked in colored pencil are not considered to be legible and correct. Plans shall be kept at each interlocking, automatic signal, controlled point, highway grade crossing and at other locations where they are required. Locations shall have only one set of plans. The required plans include track layout plans and circuit plans. At locations where mechanical locking is in service, locking sheets and dog charts must also be properly maintained.

B. **Wires Properly Identified.** Rev. 08/96

All wires must be tagged so that they can be identified at each terminal. The circuit nomenclature on the tags must correspond with the circuit plans. The tags shall be made of insulating material, placed where they will not interfere with any moving parts of apparatus, and legible.

1.1.8 Locking and Location of Apparatus Rev. 04/14

A. **Locking of Apparatus.** Rev. 04/14

All signal heads, junction boxes, cases, enclosures, switch machines, circuit controllers, battery boxes, power meter, etc. must be kept locked. (Wrench or nut locking is acceptable when a nut bell is provided.)

B. **Location of Apparatus.** Rev. 08/96

All signal apparatus shall be located and maintained so that it will not constitute a source of danger to trainmen or others and shall meet standard clearance requirements.

1.1.9 Equipment Kept in Good Condition Rev. 04/14

A. **Signal Apparatus.** Rev. 04/14

All signal apparatus shall be kept in good condition, free from excessive lost motion, rust, grease, and dirt. Connections shall be kept tight and cotter keys properly installed. Electrical contacts shall be kept clean and properly adjusted. Apparatus will be properly lubricated according to specifications. All field equipment that is to be painted must be maintained with a proper coat of paint that meets Union Pacific specifications.

B. **Signal Enclosures.** Rev. 04/14

All signal enclosures will be kept clean and provide protection from weather and dirt. Doors will operate freely and gaskets will be in good condition. Weeds and brush will be cleared away from enclosure. Enclosure must be kept water tight and rodent free. All locations will be maintained free of trash or debris that may interfere with the proper operation of equipment or create a fire hazard. All enclosures are to be painted and must be maintained with a proper coat of paint that meets Union Pacific specifications.

C. **Test Equipment** Rev. 05/15

Test equipment, including shunt cords, will be maintained according to manufacturer’s instructions. Shunt cords must be verified to be within manufacturer’s tolerance prior to its use for setting or testing signal equipment. Test equipment will be calibrated annually by an outside entity, unless otherwise not required by the manufacturer’s instructions.

1.1.10 Pole Line Inspection

Rev. 08/96

Pole line and associated equipment shall be inspected frequently and maintained in good condition; all line wires must be appropriately tied to insulators. Aerial cable is required to be supported by messenger wire.

1.1.11 Cable Locators

Rev. 02/00

Before using a cable locator on any "in service" cable, the employee(s) making the test must take action to ensure that the application of the cable locator will not compromise public and train safety. This action would include, but is not limited to: having information relative to train movements to ensure that no trains will be endangered or delayed while test is being made; and providing the appropriate warning time to the public of an approaching train. In all cases, cable locators will not be hooked-up to working conductors within a cable until arrangements have been made to protect train movements, provide safe operation for the motoring public, and ensure no damage will be made to signal equipment.

1.1.12 Trenching, Digging or Boring

Rev. 05/15

When work being performed requires trenching, digging or boring at crossings or within the approaches to crossings, near signals, interconnects, switches, enclosures, cases, or locations where insulated wires, cables, and the integrity of signal or crossing circuitry may be compromised, the following must be performed:

A. **Before Trenching, Digging or Boring.**

Rev. 05/15

Before trenching, digging or boring operations begin, it is the responsibility of the designated employee in charge to:

1. At least 48 hours before performing work, contact the UPRR Call Before You Dig hotline to determine if there are any fiber optic cables or other utilities in the work area.
2. At least 48 hours before performing work, contact the state one-call hotline, who will notify all utility owners within the work area. Call the North American One Call Referral System to obtain the appropriate state one-call number.

   Note: Do not begin work until all utilities in the work area have been located and marked by their owners.
3. Be familiar with the location of all signal and crossing equipment in the affected area.
4. Ensure system is clear of grounds by performing a ground test at each affected location as outlined in (Rule 234.249 - Ground Test, or Rule 236.2 and 107 – Quarterly Ground Test)

5. Verify and record levels on crossing(s), remote starts, or wayside equipment where applicable.
6. Contact SOC (Signal Operations Center) to create an informational ticket, if work involves boring.
7. Use a cable locator as outlined in 1.1.11 Cable Locators on page 1-7 to properly locate all cables at location. Mark all cables with industrial grade paint and/or flags a minimum of every 6-8 feet for entire length of cable. If any cable cannot be located, there must be potholes dug to locate.

   Note: When working around switch machines, signals and enclosures, if the exact location of existing cables is in doubt, use hand tools to complete work.

B. **After Trenching, Digging or Boring.** Rev. 05/15

After trenching, digging, or boring activity is completed, or at the end of each work day, the designated employee in charge must:

1. Ensure a ground test is performed at each affected location as outlined in (Rule 234.249 - Ground Test, or Rule 236.2 and 107 – Quarterly Ground Test).
2. Verify levels recorded for crossing(s), remote starts, and wayside equipment has not changed.
3. Activate the crossing(s) and ensure all gates, lights, and interconnects are functioning properly.
4. Perform an operational test of affected wayside signal location(s) by lighting lights, verifying that tracks and switches are indicating properly.
5. Verify with Dispatcher, or SOC (SOC must be contacted if boring was completed to close ticket) that the signal system has not been compromised prior to leaving the work location.
6. Complete applicable form(s), and as soon as practicable, forward the original(s), to the Manager of Signal Maintenance.

1.1.13 Derail Protection of Cars in Storage Rev. 10/11

Cars in storage for more than 10 days will be protected with derail(s). Placement of these derail(s) will require all switches leading to the track to be spiked or clamped and tagged to remove them from service. Additionally, derails must be placed to prevent cars from rolling out of storage track. The train dispatcher will issue a Form C track bulletin to remove the track from service; track bulletins in effect for more than 72 hours will be moved to Superintendent Bulletin or Subdivision General Order.

A. **Placement of Derail(s) on Controlled Sidings.** Rev. 10/14

The following instructions will be followed for the placement of derails when cars are placed in storage on controlled sidings:

1. Prior to installing derail(s), Manager Signal Maintenance (MSM) will contact the Manager Signal Design to determine proper method of disabling signals governing movement through the siding. Manager Signal Design will then confirm the disabling procedure in a lotus note to both the MSM and the Sr. Manager Signal Operations.
2. When contacted by MSM, SOC will contact the dispatch center to arrange for the issuance of a Form C track bulletin removing the siding from service. The train dispatcher will then place switch blocks on all dual-control siding switches.
3. The MSM will request SOC to open a ticket that will remain in hold status until the signals are tested and returned to service.
4. After the disabling procedures and issuance of a Form C track bulletin have been confirmed, signal personnel will disable the signals.
5. Engineering personnel will spike or clamp and tag (out-of-service) all switches leading to or on the controlled siding.
6. Engineering personnel will place derail(s) 25 feet from the first and last car in the siding, in accordance with the instructions in the Engineering Track Maintenance Field Handbook.

B. **Removal of Derail(s) on Controlled Sidings.** Rev. 10/11

The following instructions will be followed before cars that have been placed in storage on a controlled siding can be pulled from the siding:

1. Engineering personnel will remove the derail(s) if all cars are to be pulled from the siding. If cars will be returned or added to the track for storage, hinged or sliding derail(s) may be left fastened to the ties, in the open position, while the switching move is made. When cars left in the track or additional cars are added, the provisions of 1.1.13B. step 3 of this instruction does not apply.
2. Engineering personnel will pull spikes or remove point clamps and remove out-of-service tags on all switches.
3. Signal personnel will enable and test signals. Then return track to service through Signal Operations Center (SOC). SOC will then contact the dispatcher to return track to service.

1.2 Circuit Wiring and Testing

1.2.1 Circuit Wiring

Rev. 01/14

A. **No Circuit Modification.** Rev. 01/14

No circuit modifications may be made without authorization from a Director of Signal Maintenance, or Director of Signal Construction, and approval from Director, Manager or Sr. Circuit Designer of Signal Design.

B. **Familiarize With Signal Circuits.** Rev. 08/96

All personnel shall be fully familiar with the signal circuits they are wiring and the wiring standards that apply. If uncertain of the wiring standards, the foreman, supervisor, Manager of Signal Maintenance, or Manager of Signal Construction should be consulted.

C. **Before Wiring or Rewiring.** Rev. 01/09

Before any wiring or rewiring is started, signal employees shall study the circuit plans of the work and thoroughly familiarize themselves with the circuit principles involved. The employee in charge, Manager of Signal Maintenance, or Manager of Signal Construction must be notified of any errors detected. Signal employee in charge must perform a ground test (Rule 234.249 - Ground Test, or Rule 236.2 and 107 – Quarterly Ground Test) and clear grounds before wiring or rewiring is started.

D. **After Wiring or Rewiring.** Rev. 02/01

When any wiring or rewiring is completed, the employee in charge must perform a ground test (Rule 234.249 - Ground Test, or Rule 236.2 and 107 – Quarterly Ground Test) and ensure that the proper operating tests are performed to determine that the system is functioning properly before returning the system to service. Proper form(s) must be completed for the applicable tests on a daily basis.

E. **Revised Plan(s).** Rev. 08/96

Upon completing the wiring or rewiring at a signal location, the signal employee in charge will send a revised plan to the Manager of Signal Maintenance. Include with the revised plan: the location, project number and a brief description of the work performed; in addition, the employee in charge will include his name, title, and the date the work was completed.

1.2.2 Adjust, Repair, Replace or Disarrange

Rev. 12/97

A. **Adjustment, Repair or Replacement.** Rev. 12/97

When any essential component of a system or interlocking apparatus fails to perform its intended signaling function, it shall be adjusted, repaired or replaced without undue delay. When a component is changed out, the replacement will be an exact or equivalent replacement part. After replacement is made, an operating test shall be made to determine that all affected circuits that were disarranged are functioning properly. Tests must be performed as outlined in instruction 1.2.3 on page 1-12.

B. **Disarrangement.** Rev. 09/06

A disarrangement has occurred when: a relay is replaced with another; a cable having two or more conductors is severed or replaced; more than one wire is removed from a terminal at a time; or any component is adjusted, repaired or replaced that may affect the safety of the public or train operation.

Examples of Disarrangement

- **Changing Out a Relay.**

  Person changing out a relay will determine that the proper relay is used according to the print. The Signal Inspector, Maintenance Foreman or Signal Technician must be notified immediately and the Manager of Signal Maintenance informed. Test of circuits affected must be made in accordance with test instructions before returning the system to service, and the proper form(s) must be completed for the applicable tests. The Signal Inspector or Maintenance Foreman will make a calibration test of the relay within 30 days. Maintainers' spare relays will be tested so they will be current with relays in service.

- **Changing Out a Power Operated Switch Machine.**

  The designated signal employee in charge must perform Rule 236.327 and 382 - Switch Obstruction, Rule 236.103 and 334 - Point Detector, Rule 236.307 and 236.380 - Indication Locking, Switch Locking (see Rule 236.379 - Route Locking) and Rule 236.2 and 107 – Quarterly Ground Test in accordance with test instructions before returning the system to service. Visually ensure that governing signal(s) display proper aspect corresponding to the position of the switch. Verify with the Dispatcher or Control Operator that switch indications and route correspond with field apparatus. Complete the proper forms for the applicable tests.

- **Changing Out a Cable.**

  The designated signal employee in charge will perform tests of the circuits affected by the change, and megger the new cable before returning the system to service. Proper form(s) must be completed for applicable tests.

- **Circuits Disarranged For Any Reason.**

  The designated signal employee in charge will test the circuits or components disarranged in accordance with test instructions before returning the system to service, and complete the proper form(s) for applicable tests.

1.2.3 Testing

Rev. 12/97

A. **Testing.** Rev. 12/97

Testing of all signal circuits and apparatus that affect public or train safety will be performed, as outlined in these instructions, before being placed in service, when modified or disarranged, and at least once every required time frame thereafter. Proper form(s) must be completed for applicable tests on a daily basis.

B. **Employee in Charge.** Rev. 12/97

When testing becomes necessary, it is the responsibility of the designated employee in charge to perform the appropriate tests unless the person(s) listed on the periodic test instructions are present.

C. **Precaution.** Rev. 12/97

The employee(s) making tests must have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

D. **Proceed Signal Not Mistakenly Displayed.** Rev. 12/97

Before testing, proper steps must be taken to ensure that a proceed signal is not mistakenly displayed to any train or engine. This would include any upgrade to approach signals.

E. **Operational Tests.** Rev. 12/97

Operational tests of a signal system must be performed by making visual observations of all signals involved to verify that the proper aspects are displayed. The use of meters to determine that line circuits or relays have the proper polarity or energy applied is not an acceptable alternative for the visual observation of signal aspects.

F. **Approved Jumpers** Rev. 05/15

Note: Additional instructions apply to approved jumpers when used to disable Crossing Warning devices. (8.1.15F. on page 8-40)

Only approved jumpers may be used when testing or disabling signal circuits. These jumpers must be red, fluorescent yellow or fluorescent orange and at least five feet in length. No exceptions will be allowed. Jumper color must sharply contrast the color of the enclosure’s wiring.

Each jumper will indicate an identifying number and owner identification. When jumpers are associated with a signal construction gang, the owner identification may be the gang number in lieu of an individual’s initials. In this case, the gang foreman or specified man in charge will be responsible for all jumpers assigned to that work group. In all cases, each jumper will include a jumper number in addition to the owner’s identification.

Each individual agreement signal employee will be limited to six jumpers in his/her immediate possession. Each signal gang will be limited to thirty jumpers that indicate the gang number.

When special conditions merit an increase in the number of jumpers an employee or gang requires to perform their normal duties, permission to carry additional jumpers must be obtained from a non-agreement (manager, director, etc.) signal employee. The approving non-agreement signal employee will document the jumper quantity exception, including the employee’s name and/or gang number and the number of jumpers approved for possession.

Note: Additional instructions apply to approved jumpers when used to disable Crossing Warning devices. (8.1.15F. on page 8-40)

G. **Confirm That Required Tests Are Complete.** Rev. 12/97

Checks must be made to confirm that each required test has been completed. Verify that any connections that were opened to perform testing are securely re-closed. Every jumper utilized during testing must be removed and accounted for.

H. **Notify Dispatcher or Operator.** Rev. 12/97

Before testing, notify the Dispatcher or Operator of the specific area and signal apparatus that the proposed testing will affect. When tests are completed, verify that the Dispatcher or Operator has control of the location under test and indications correspond with field apparatus.

I. **Tests Recorded.** Rev. 04/14

Once tests are complete, the employee responsible for performing the tests must ensure tests are properly entered into the Signal Maintenance Planner (SMP) or Field Signal Maintenance **(**FSM) as soon as practicable.

J. **Proper Forms.** Rev. 12/97

Once tests are complete, the employee responsible for performing the tests must complete the applicable form(s) as soon as practicable, forwarding the original(s) to the Manager of Signal Maintenance.

1.2.4 Solid State Interlocking

Rev. 11/98

A. **Definition of Terms** Rev. 01/09

Electro Static Discharge (ESD) – The discharge of a static voltage stored by a person. Walking over a vinyl floor may generate a static voltage of 250 to 12,000 volts depending upon relative humidity. Lower humidity permits a higher static voltage. An ESD voltage of 30 volts may damage electronic components.

Chips – A common term used to describe an integrated circuit or microprocessor.

Module – Card containing components and printed circuit wiring that may be removed from a box or chassis. Modules may be plug or cable connected and is typically keyed to facilitate correct installation.

EPROM – Erasable Programmable Read Only Memory

EEPROM – Electrically Erasable Programmable Read Only Memory (Flash ROM)

Checksum – The sum of a group of data items, used for verification of the E-prom contents.

CRC – Cyclic Redundancy Check is a check performed on data to verify the integrity of the data on the chip.

CDROM – Compact Disk Read Only Memory

Software – The detailed instructions to operate a computer. The term was created to differentiate instructions (program) from hardware.

Application Software – List of instructions (program) designed and created by Signal Design for a specific location. This program identifies code rates, cab outputs, type of signal heads, etc. and the same program may be used at various locations.

Executive Software – List of instructions (program) designed and created by the Vendor. This program defines the basic operation of the hardware (card check, CPU check, I/O integrity checks) and performs all safety checks on the hardware.

Equation – Computer logic that performs the same decision function(s) that relay logic circuits perform.

Hardware – Actual physical computing machinery, as opposed to software which is the list of instructions (program) to operate hardware.

In-Service Breakdown Tests – A comprehensive test of every function of a signal system. Including, but not limited to: signals, power operated devices, cab outputs, input/output functions, etc.

Full-System Locking Tests – Performance of all applicable locking tests as required by the FRA and described in the Signal Maintenance, Inspection, Test and Standard Instructions.

Operational Tests – Verification that equipment or apparatus is operating as designed. In addition to the check for basic operation, test to ensure proper control and indication of the equipment or apparatus.

Reduced-Test Validation - Verification of changes made to site specific application software utilizing a vendor's validation software.

B. **Proper Installation, Storage, Handling and Care of Cards and Chips**

Rev. 09/06

- Package and store in static shielding bags, conductive component containers, conductive shipping tubes or conductive leaded foam.
- Store site specific chips at the designed location.
- Do not store in vehicles or in direct sunlight.
- Take all precautions to eliminate or reduce the effects of ESD by handling without touching discrete components and pins.
- EPROMS removed due to version upgrade, must be packaged properly and returned to the Manager of Signal Design.
- Ensure proper placement and orientation. Verify identical replacement before installation. Before installing chips, verify checksum and CRC utilizing an EPROM Tester. **Never install a chip based solely on its label identification.** Properly seat chip in the appropriate socket and verify EPROM pins are not bent underneath the chip.
- When determined to be bad order, ship component in the proper packaging with the following information enclosed: site location, specific problem that lead to replacement, employee name, title and phone number. Remove and retain EPROMS from bad order components. EPROMS that have been determined "Bad Order" must be marked "VOID" and discarded immediately. Order replacement EPROMS from the appropriate source. Retain all application EPROMS, as repair facilities will not return non-vendor software.
- Ensure replacement module and the module to be replaced, are properly inventoried and updated in SATS.

C. **Proper Installation, Storage, Handling and Care of Cards with Permanently Installed EEPROM** Rev. 01/09

- Package and store in static shielding bags, conductive component containers, or in a spare chassis.
- Store site specific programmed cards at the designed location.
- Take all precautions to eliminate or reduce the effects of ESD by handling without touching discrete components and pins.
- Verify that CDROM with site specific software and executives is at the location.
- Never store CDROM in direct sunlight or on heat generating surfaces.
- Verify identical replacement before installation. Before placing card in service, ensure all jumpers and software are identical. **Verify software on card by using vendor recommended methods.**
- When determined to be bad order, ship component in the proper packaging with the following information enclosed: site location, specific problem that lead to replacement, employee name, title and phone number.
- Ensure replacement module and the module to be replaced, are properly inventoried and updated in SATS.

D. **In Service Breakdown Tests** Rev. 01/09

1. Verify all software version, checksum and CRC match the specific information on the location's print or documentation. Additionally, verify chassis ID is correct.
2. Perform a complete breakdown test of every individual input and output. Signal aspect verification must be performed through visual inspection of each signal head. Verify:
    - Proper operation of all signals, including approach signals, for every possible route
    - Appropriate cab rates where applicable
    - Proper switch operation
    - All proper track codes
    - Perform all FRA required locking tests, including opposing signals at the adjacent control points.
3. Document all required test results on the appropriate form and send information to the Manager of Signal Maintenance that is responsible for the location under test.

Note: It is essential that correct and comprehensive testing be performed when “in service breakdown tests” are performed. In some cases, this will be the only time the integrity of certain signal functions will be tested.

E. **Software Information** Rev. 01/09

Logic software can be separated into two basic categories: executive and application.

1. **Executive Software** Executive software is programmed and furnished by the Electronic Controller’s respective vendor. The executive software performs the following functions:
    - Safety, communications, input/output functions.
    - Passes information to and from the application software.
    - Performs redundant microprocessor checks.
    - Periodically performs checks to detect failure of various modules.
    - Monitors the integrity of external I/O connections attached to the solid state controller.
2. **Application Software** Application software is programmed and furnished by Union Pacific’s Signal Design. The application software performs the following functions:
    - Vital locking checks that were previously made through relay logic.
    - Determines code rates, cab outputs, and cab rates.
    - Determines color light or searchlight signal aspects.
    - Defines any vital or non-vital outputs to conventional relay circuits.
    - Defines any vital or non-vital inputs from conventional relay circuits.

F. **Software Replacement** Rev. 01/09

The following information, regarding software replacement, applies to an in service location that was functioning properly and had a comprehensive “in service breakdown test” performed. Verification of a chip’s version, checksum and CRC must be performed utilizing an appropriate test device (e.g. EPROM Tester). **Never use a replacement EPROM based solely on its label identification.**

1. Executive Software Replacement
    - Determine that each replacement chip’s version, checksum and CRC are the same as the in service chips.
    - Following the manufacturer’s procedure, replace all executive chips as a set.

- If the replacement chips are of the same version, performance of “Full System Locking Tests” is not required. However, operational tests of signals, switches, inputs/outputs, cab rates and time delays must be verified. Additionally, verify that the same values are indicated in SATS.
- If the replacement chips are of a higher version, contact Signal Design to ensure compatibility with application software. Full “System Locking Tests” may be required by the Vendor (consult appropriate vendor manual), or Signal Design. Additionally, verify that the higher version values are indicated in SATS.
- Never replace an Executive chip set with a lower (earlier) revision Executive chip set without receiving authorization from Signal Design.

2. Application Software Replacement

- Determine that each replacement chip’s version, checksum and CRC are the same as the in service chips. Additionally, verify that the same values are indicated in SATS and on the prints or documents at the location.
- If the replacement chips are verified to be identical, no additional tests are required.
- In cases where application software has been authorized by signal design to be upgraded and replacement EPROMS contain new or modified equations (different checksum and CRC values), all application chips must be replaced as a set and “Full System Locking Tests” must be performed before placing the location back in service**.** Additionally, ensure that the upgraded values are indicated in SATS and on the prints or documents at the location.

Exception: If the changes or upgrades have been documented by the Design Office and the upgraded program has “Reduced Test Validation” documentation; testing may be limited to the changed equation(s) and the circuitry that is affected by the change.

G. Software Replacement for Cards with Permanently Installed EEPROM

Rev. 01/09

The following information, regarding software replacement, applies to an in service location that was functioning properly and had a comprehensive “in service breakdown test” performed. Verification of a CPU card’s version, checksum and CRC must be performed utilizing an appropriate test device (e.g. Laptop). **Always verify the software on the CPU is the same as the software on the CDROM.**

1. Executive Software Replacement
    - Determine that each replacement CPU executive version, checksum and CRC is the same as the in service CPUs.
    - If the replacement CPU Executive is of the same version, performance of “Full System Locking Tests” is not required. However, operational tests of signals, switches, inputs/outputs, cab rates and time delays must be verified. Additionally, verify that the same values are indicated in SATS.
    - If the replacement CPU Executive is of a higher version, contact Signal Design in Omaha to ensure compatibility with application software. Full “System Locking Tests” may be required by the Vendor (consult appropriate vendor manual), or Signal Design. Additionally, verify that the higher version values are indicated in SATS.
    - Never replace a CPU Executive with a lower (earlier) revision CPU Executive without receiving authorization from Signal Design.
    - Never replace a CPU Executive with a higher (later) revision CPU Executive without verifying with Signal Design.
2. Application Software Replacement
    - Determine that each replacement CPU Application version, checksum and CRC is the same as the in service CPU. Additionally, verify that the same values are indicated in SATS and on the prints or documents at the location.
    - If the replacement application software is verified to be identical, no additional tests are required.
    - In cases where application software has been authorized by signal design to be upgraded, and replacement CDROMS containing new or modified equations (different checksum and CRC values) “Full System Locking Tests” must be performed before placing the location back in service**.** Additionally, ensure that the upgraded values are indicated in SATS and on the prints or documents at the location.

Exception: If the changes or upgrades have been documented by the Signal Design Office and the upgraded program has “Reduced Test Validation” documentation; testing may be limited to the changed equation(s) and the circuitry that is affected by the change.

H. **Hardware Information**

Rev. 01/09

The same wiring disarrangement rules and instructions that apply to relay logic signal systems apply to all Electronic Controlling Devices. All circuits must be tested that are affected by the disarrangement.

1. Modules or Cards

Modules or cards will be considered the same as a conventional keyed plug-in relay. If the module or card is removed and the same module is reinstalled, no additional tests are required. However, if a card or module is removed and a new identical card is installed, the appropriate operational and/or locking tests must be performed for the functions related to the card or module replacement.

2. Replacing Modules That Do Not Contain Executive or Application Software

   - Verify the replacement module is identical and carries the same or greater revision level.
   - If applicable, set all jumpers and dip switches in the same position as the module to be replaced.
   - Install replacement module following the manufacturer's recommended procedure.
   - Perform operational tests of all effected signal apparatus or functions related to the replaced module (per appropriate vendors manuals and the Signal Maintenance, Inspection, Test and Standard Instructions).
   - Ensure replacement module and the module to be replaced are properly inventoried and updated in SATS.

3. Replacing Modules That Contain Executive or Application Software

   - Verify the replacement module is identical and carries the same or greater revision level.
   - If applicable, set all jumpers and dip switches in the same position as the module to be replaced.
   - If applicable, remove the software chips located on the module to be replaced and properly install them as a set onto the replacement module following the manufacturers' recommended procedure.
   - Perform the required tests as outlined in the appropriate vendor's manual for the card being replaced. Not all card replacements will require a "Full System Locking Test".
   - Ensure replacement module and the module to be replaced, are properly inventoried and updated in SATS.

Note: Some cards contain setup information specific to the location; this setup information must be verified and set to the original settings of the location. If application software has been changed, follow the appropriate procedures outlined in the application software replacement section of the Signal Maintenance, Inspection, Test and Standard Instructions.

1.2.5 Portable Electronic Equipment

Rev. 05/15

A. **Hand Held and Laptop Computers** Rev. 01/09

It is each employee's responsibility to see that the Hand Held unit or Laptop computer is kept properly charged. All hand held and laptop computers must be uploaded periodically to ensure that the latest software programs are loaded. Technical problems encountered with the upload or download process should be resolved through the local SMP trainer. Contact the Engineering Help desk if further assistance is necessary.

B. **Attaching Communication Device to Vital Network.** Rev. 01/14

No device may be attached to a vital communications network, communications port carrying vital signal data, communications port carrying local control panel data, or diagnostic port of any microprocessor controlled vital signal controller without authority of the Director of Signal Design. Exception; laptop computers directly connected via serial or Ethernet cable may be temporarily used for diagnostics.

C. **Compliance with RIM policy** Rev. 05/15

Employee will comply with the Records & Information Management (RIM) Policy for any **Record**. A **Record** is information, regardless of medium or format, that has business value to the Company. Records are maintained on a variety of media including, but not limited to: various forms of electronic storage, computer disks or tapes, optical media, microfilm, microfiche, photographs, and video.

1.3 Filling Out Forms

1.3.1 Instructions for Filling Out Form 24094 or FSM by Column

Rev. 07/14

All applicable tests must be made to affected circuits and/or equipment when being placed in service, modified or disarranged (see 1.2.2 on page 1-11), and at least once every designated time frame thereafter.

All records of tests must include the location, date of test, equipment tested, results of test, and the condition in which the equipment is left. Documentation of the employee performing the test must be recorded.

When any adjustment, repair or replacement is made, such action must be recorded by utilizing the appropriate recording mark, including comments of action performed.

Note: The FRA Rule(s) listed next to each test is for reference only and may not be the only rule(s) that apply to the device.

Switch Obstruction (FRA Rules 236.327 and 382) - Each switch, movable point frog or derail will be listed separately as designated on the print, including the type of switch. Switch must not be locked normal or reverse when the points are prevented from closing to within 3/8 inch. (Does not apply to hand-operated switches without switch and lock movements.)

Inductor Gauging (FRA Rules 236.526, 529, 531 and 576) - List each device tested. Roadway element must be gauged for proper height and alignment. (Applies to Automatic Train Stop (ATS) systems.)

Valve Locks (FRA Rule 236.383) - Valve lock function must be tested and determined effective. (Applies to electropneumatic switches only.)

Switch Circuit Controller (FRA Rules 236.6, 103, 205, 303 and 342) - Each switch will be listed separately as designated on the print; if not designated on the print, use the milepost or station name - include the type of switch. (Does not apply to power-operated switches without external switch circuit controller.)

Point Detector (FRA Rules 236.103, 205, 303 and 334) - Each switch will be listed separately as designated on the print - including the type of switch. (Applies to power-operated switches only.)

Shunt Fouling (FRA Rules 236.51, 56, 57, 58 and 104) - Each switch will be listed separately as designated on the print; if not designated on the print, use the milepost or station name. (Applies to all shunt fouling circuits in all systems.)

Ground (FRA Rules 236.2 and 107) - List each energy buss at the location. (Not required on track circuit wires or AC distribution circuits grounded in the interest of safety.)

Overload - Each switch will be listed separately as designated on the print - including the type of switch. (Applies to power-operated switches only; refer to 2.2.1D. Clutch Adjustment on page 2-5 for the test.)

TAWS - Ensure that lights are visible and horns are audible quarterly. (Applies to all certified TAWS locations.)

Restoring Feature (FRA Rule 236.386) - Each switch will be listed separately as designated on the print - including the type of switch. (Applies to electropneumatic switches.)

Impedance and Insulation Resistance (FRA Rules 236.527 and 576) - List each device tested. The resistance between ground and an inert inductor coil must be 10,000 ohms or more. Trip arm valves and return springs must function as intended. (Applies to Automatic Train Stop (ATS) systems.)

Signal Mechanism (FRA Rule 236.102 - 6 Month Inspection) - List each signal separately as designated on the print. Observe mechanism while it is operated to all positions. (Applies to all semaphore and searchlight type signal mechanisms.)

Note: Two year test recorded on Form 24096 on page 1-45.

Cross Protection (FRA Rule 236.384) - List each switch or device separately as designated on the print - including the type of switch. (Applies only to interlockings provided with cross protection devices.)

Time Releases (FRA Rule 236.109) - List each time element’s nomenclature and the required predetermined time interval. Record the actual time and the applicable “Recording Mark” indicating the results of the test. (Applies to all systems.)

Valves and Valve Magnets (FRA Rule 236.383) - List each switch, derail or movable-point frog separately as designated on the print. Record the pick-up and release values of the valve magnet using the appropriate line on the back of the form. (Applies only to electropneumatic switches.)

Movable Bridge (FRA Rules 236.312 and 387) - List each bridge locking circuit, including each circuit controller or device that functions as such. (Applies to movable bridge interlockings.)

ACS, ATS and ATC Cut in Circuit (FRA Rule 236.577) - Each test loop will be listed by milepost or as designated on the print. (Applies to Automatic Cab Signal, Automatic Train Stop and Automatic Train Control.)

Mechanical Locking (FRA Rules 236.304, 326, 335, 336, 337, 338, 339, 340, 341 and 376) - List each interlocking machine - including the type. (Applies to mechanical and electromechanical interlockings.)

Approach Locking (FRA Rules 236.305, 314, 377, 407, 410) - List each approach circuit, signal or switch. Perform the time release test (FRA Rule 236.109) for each device's effective time element and record in the appropriate column. (Applies to all signal systems where approach locking is used.)

Time Locking (FRA Rules 236.305, 314, 378, 407 and 410) - List each time locking circuit or route. Perform the time release test (FRA Rule 236.109) for each route's effective time element device and record in the appropriate column. (Applies to all signal systems where time locking is used.)

Route Locking (FRA Rules 236.302, 309, 379 and 408) - List each circuit or signal and route. For ease of recording multiple switch routes, list the entering signal and then the opposing signal or exiting track for each route in the "Signal Number" column. Additionally, to further identify each route, it may be necessary to record switch position in the "Switch Number" column. (Applies to all signal systems where route locking is used.)

Indication Locking (FRA Rules 236.307 and 380) - Applies to interlocking and traffic control systems.

Switch Indication - List each switch or lever as designated on the print.

Signal Indication - List each signal or lever as designated on the print.

Traffic Locking (FRA Rules 236.381 and 405) - List each locking circuit and direction. (Applies to manual interlocking as designated in the timetable; test not required in CTC territory.)

TAWS - Perform the TAWS test for each route and record in the appropriate column. (Applies to all certified TAWS locations.)

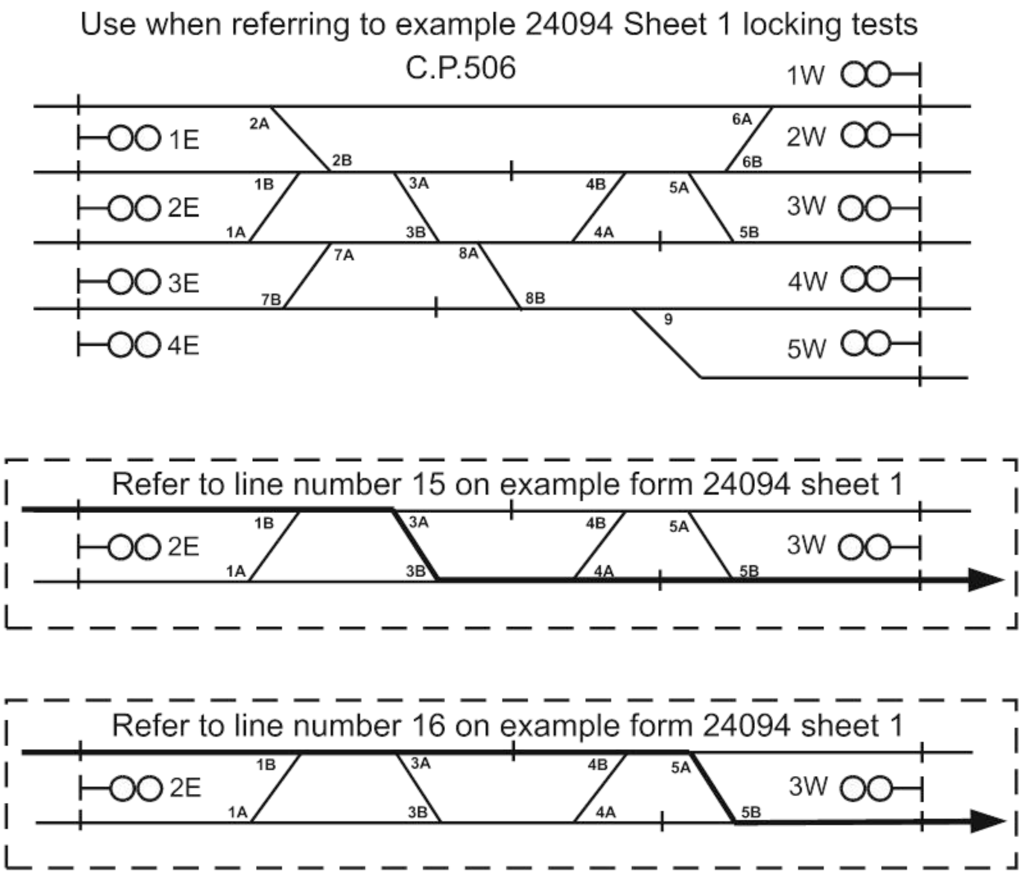

Figure 1-1 Locking Example

1.3.2 Instructions for Filling Out Form 24239 or FSM by Column

Rev. 07/14

All applicable tests must be made to affected circuits and/or equipment when being placed in service, modified or disarranged (see 1.2.2 on page 1-11), and at least once every designated time frame thereafter.

All records of tests must include the D.O.T. Number, location (city/county, state, street/road name, date of test (month/day/year), equipment tested, results of test and the condition in which the equipment is left. Documentation of the employee performing the test must be recorded.

When any adjustment, repair or replacement is made, such action must be recorded by utilizing the appropriate recording mark, including comments of action performed.

When performing the FRA required periodic inspections and tests, every effort should be made to inspect and test all of the grade crossing's apparatus for the particular periodic timeframe. Whenever a partial inspection or test is performed, each individual piece of equipment inspected or tested must be listed on the form.

Note: The FRA Rule(s) listed next to each test is for reference only and may not be the only rule(s) that apply to the device.

A. **Monthly Inspections and Tests** Rev. 07/14

Ground (234.249) - List each energy source tested (i.e., B10, B12, B16, XB12, EB12, etc.) in the "Equipment Tested or Inspected" column. If a measurable ground is detected, record the value and comments of corrective action taken. Test is performed to ensure that circuits are free of any ground or combination of grounds that will permit a current flow of 75 percent, or more, of the release value of any relay or electromagnetic device in the circuit. Wayside and crossing solid state equipment will be cleared of any leakage current to ground.

Standby Power (234.251) - List each standby power source tested (i.e. B10, B12, B16, XB12, EB12, etc.) in the "Equipment Tested or Inspected" column. If action is required because power source is found to be inadequate, make record of the measured voltage and comments of corrective action taken.

Visibility and Damage (234.253c) - Enter "All" in the "Equipment Tested or Inspected" column when all flashing light units at the location are inspected for proper visibility, dirt and damage. If a partial inspection is performed, each light unit inspected must be listed individually (i.e. Flasher A, Unit 2B, etc.)

Gate and Mechanism Condition (234.255a) - Enter "All" in the "Equipment Tested or Inspected" column when all gate mechanisms and gate arms at the location are inspected. If a partial inspection is performed, each gate mechanism and gate arm must be listed individually. Inspection is performed to ensure that gate arm length equals the length indicated on the circuit plans, or in the absence of a measurement on the circuit plans, the gate arm extends across at least 90% of each lane of approaching traffic; and that lights and light wires are secured to the gate arm.

Gate Operation (234.255b) - Enter "All" in the "Equipment Tested or Inspected" column when all gate arms at the location have been observed for proper operation. If a partial observation is performed, each gate arm observed must be listed individually. Inspection is performed to ensure that each gate arm starts its downward motion not less than 3 seconds after flashing lights begin to operate.

Warning System Operation (234.257a & b) - Enter "All" in the "Equipment Tested or Inspected" column when the crossing warning system, including audible warning devices, are tested and verified to be operating as intended. If a partial test is performed, list apparatus tested individually.

Traffic Signal Pre-empt (234.261) - List each interconnection according to nomenclature or other positive identification in the "Equipment Tested or Inspected" column.

B. **Three Month Inspections and Tests** Rev. 04/14

Cutout Circuit (234.269) - List each cutout circuit according to nomenclature or other positive identification in the "Equipment Tested or Inspected" column.

Track Connections (234.271) - Enter "All" in the "Equipment Tested or Inspected" column when all insulated joints, bond wires, and track connections within the limits of the train detection circuitry have been inspected. If a partial inspection is performed, make record of the location of the apparatus inspected.

C. **Annual Inspections and Tests** Rev. 07/14

Light Unit Alignment (234.253a) - Enter "All" in the "Equipment Tested or Inspected" column when all flashing light units have been inspected for proper alignment and visibility. If a partial inspection is performed, each light unit inspected must be listed individually (i.e. Flasher A, Unit 2B, etc.)

Flash Rate (234.253a) - If only one flasher relay or device is utilized at the location, enter "All" in the "Equipment Tested or Inspected" column. If more than one flasher relay or device is located at the location, enter the nomenclature of each flasher relay or device in the "Equipment Tested or Inspected" column. A flash rate number entered in this column indicating a minimum of 35 and a maximum of 65 will be considered a recording mark of "C". If adjustment, repair or replacement is made, the appropriate recording mark (A, R, or S) will be entered in this column with the actual flash rate and comments of action taken.

Lamp Voltage (234.253b) - Enter "All" in the "Equipment Tested or Inspected" column when all light unit lamp voltages have been tested for proper voltage. If adjustment, repair or replacement is made, the actual measured lamp voltage and action taken must be recorded on the back of the form. If a partial test is performed, each light unit tested must be listed individually (i.e. Flasher A, Unit 2B, etc.) Test is performed to ensure that each lamp's voltage is not less than 85 percent of the prescribed lamp rating.

Hold Clear Device (234.255c) - Enter "All" in the "Equipment Tested or Inspected" column when all hold clear devices at the location have been tested for proper operation. If a partial observation is performed, each gate arm associated with the hold clear device tested must be listed individually.

Warning Time (234.259) - Identify the type of train detection equipment (i.e. DC Track Circuit, AC Track Circuit, Motion Sensor Model, Constant Warning Model, GCP3000, HXP3, etc.) in the "Train Detection Device" column. Indicate the track and route/direction tested in the "Equipment Tested or Inspected" column. Indicate the method of testing (i.e. observation, calculated, or recorded) in the "Method Used" column. Record the Warning Time as follows:

- **Observation - Record the designed warning time as Expected Results and the observed time as Actual Results**
- **Calculated – Record the designed warning time as Expected Results and completed test as Actual Results.**
- **Recorded – Record the designed warning time as Expected Results and shortest warning time provided as the Actual Results**
- Show the results of test in the "Test Results" Column.
- **Time Release / Time Relays (234.265) - List each time relay or time release nomenclature in the "Equipment Tested or Inspected" column. Enter the predetermined required time in the "Required Predetermined Time" column and enter the actual time in the "Actual Time" column, place the appropriate recording mark indicating the results of the test in the "Test Results" column.**

Note: Timing devices which perform internal functions associated with motion detectors, motion sensors, and grade crossing predictors are not subject to the requirements of this rule.

1.3.3 Instructions for completing Baseline Capture Form for Vital Application Software and Vital Configuration

Rev. 07/14

The various platform specific forms are:

- Electrologic (BCFE)
- Microlok (BCFM)
- VHLC (BCFV)

Note: At locations having additional chassis in remote enclosures, and/or multiple chassis in the same enclosures, a form is required for each chassis at the location.

1. Record the cabin tag#, program name(s) and version(s).
2. Record the CRC(s) and associated prom number(s) as needed for the chassis that use EPROM(s) to store the application software. Electrologic locations that have a four chip application will need the MAP file information for both programs captured.
3. For Electrologic and VHLC, record the chassis ID settings.

4. For Microlok, record the name of each of the software selectable straps. Record if the strap is set true (T) or false (F) in the user variables. Different locations have site specific settings from the same base application that must be verified from the chassis specifically, and not from the circuit plans for the location.

5. For all chassis, record the slot number and module type for all various input module(s) installed. Modules providing inputs for the chassis may be as an input only, an input/output, or a lamp drive module type. For Microlok, include the cable address for each module.

Example: Microlok uses two types of input modules the In8Out8 and/or the In16. For IN8Out8 modules, record only the inputs in fields 1-8 and for IN16 modules, record all inputs in fields 1-16.

6. For all chassis, record the nomenclature for each vital input on the input module(s). If the input is used as a configuration strap, indicate if it is energized (H) or de-energized (L). Do not record any non-vital inputs, unless used as a configuration strap.

1.4 Forms

The remainder of this page is intentionally blank to maintain correct printing format

Form 24094 Revised 01/03

UNION PACIFIC RAILROAD
SIGNAL DEPT. DOT-RS&I TEST

Recording Mark
C - Test complete. Equipment in satisfactory condition.
*A - Adjustment made & test complete. Equipment in satisfactory condition.
*R - Repairs or replacement needed.
*S - Repairs or replacement made. Equipment in satisfactory condition.
* - Explain on back of form

Type of Switch
EL - Electrically locked hand throw
HX - Hand-throw crossover
PX - Power operated crossover
P - Power operated
H - Hand-throw
S - Spring

Signature ____________

Headquarters ____________

M.P. to M.P. ____________

Sheet ____ of ____ Sheets

Test must be made when placed in service, modified or disarranged, and at least once every designated time frame thereafter.

		Equipment Identification				Monthly		3 Months								6 Months			1 Year						2 YEAR							
																			Time Release/Relay 236.109													
Location	Date	Battery Bus 236.107	Signal Number, Route or Timing Device	Switch Number	Type of Switch	Switch Obstruction 236.382	Inductor Gauging 236.576	Valve Locks 236.383	Switch Circuit Controller 236.103	Point Detector 236.103	Shunt Fouling 236.104	Grounds 236.107	Restoring Feature 236.386	Overload	TAWS - Lights and Horns	Impedance & Insulation Resistance 236.576	Signal Mechanism 236.102	Cross Protection 236.384	Required Predetermined Time	Actual Time	Test Results	Valves & Valve Magnets 236.383	Movable Bridge 236.387	ACS Cut-in Circuits 236.577	Indication Locking 236.380	Time Locking 236.378	Approach Locking 236.377	Route Locking 236.379	Mechanical Locking 236.376	Traffic Locking 236.381	TAWS Test	NO.
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Chapter 1 Top

Line	Remarks
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Form 24094 Revised 01/03

Recording Mark
C - Test complete. Equipment in satisfactory condition.
*A - Adjustment made & test complete. Equipment in satisfactory condition.
*R - Repairs or replacement needed.
*S - Repairs or replacement made. Equipment in satisfactory condition.
* - Explain on back of form

Type of Switch
EL - Electrically locked hand throw
HX - Hand-throw crossover
PX - Power operated crossover
P - Power operated
H - Hand-throw
S - Spring

UNION PACIFIC RAILROAD
SIGNAL DEPT. DOT-RS&I TEST

Test must be made when placed in service, modified or disarranged, and at least once every designated time frame thereafter.

Signature J.S. Doe
Headquarters Cheyenne
M.P. to M.P. 506.4 to 520.4
Sheet 1 2

		Equipment Identification				Monthly		3 Months								6 Months			1 Year (Time Release/Relay 236.109)						2 YEAR							
Location	Date	Battery Bus 236.107	Signal Number, Route or Timing Device	Switch Number	Type of Switch	Switch Obstruction 236.382	Inductor Gauging 236.576	Valve Locks 236.383	Switch Circuit Controller 236.103	Point Detector 236.103	Shunt Fouling 236.104	Grounds 236.107	Restoring Feature 236.386	Overload	TAWS - Lights and Horns	Impedance & Insulation Resistance 236.576	Signal Mechanism 236.102	Cross Protection 236.384	Required Predetermined Time	Actual Time	Test Results	Valves & Valve Magnets 236.383	Movable Bridge 236.387	ACS Cut-in Circuits 236.577	Indication Locking 236.380	Time Locking 236.378	Approach Locking 236.377	Route Locking 236.379	Mechanical Locking 236.376	Traffic Locking 236.381	TAWS Test	NO.
C.P. 506.4	01/02/2006			1A	PX	C				C	C			C																		1
C.P. 506.4	01/02/2006			1B	PX	C				C	C			C																		2
C.P. 506.4	01/02/2006			9	P	A				C	S			C																		3*
C.P. 506.4	01/02/2006	B10										S																				4*
		B10E										C																				5
		B10W										C																				6
		B16										C																				7
C.P. 506.4	01/03/2006		1AE														C															8
C.P. 506.4	01/03/2006		2AW														S								C							9*
C.P. 506.4	01/04/2006		1TER																5'20"	5'15"	C											10
C.P. 506.4	01/04/2006		1COTER																3'40"	3'25"	C											11
C.P. 506.4	01/04/2006		1TTER																10"	10"	C											12
																																13
C.P. 506.4	01/04/2006		2AE/2AW																						C	C		C				14
C.P. 506.4	01/04/2006		2BE/1BW	3REV																					C	C		C				15
C.P. 506.4	01/04/2006		2BE/3ET	5REV																					C	C		C				16
C.P. 506.4	01/04/2006			1A	PX																				C							17
C.P. 506.4	01/04/2006			1B	PX																				C							18
C.P. 506.4	01/05/2006		1ET																					C								19
																																20
M.P. 507	01/05/2006			1	H				A		S																					21*
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Form 24094 Revised 01/03

Recording Mark
C - Test complete. Equipment in satisfactory condition.
*A - Adjustment made & test complete. Equipment in satisfactory condition.
*R - Repairs or replacement needed.
*S - Repairs or replacement made. Equipment in satisfactory condition.
* - Explain on back of form

UNION PACIFIC RAILROAD
SIGNAL DEPT. DOT-RS&I TEST

Signature J.S. Doe
Headquarters Cheyenne
M.P. to M.P. 506.4 to 520.4
Sheet 2 2

Type of Switch
EL - Electrically locked hand throw
HX - Hand-throw crossover
PX - Power operated crossover
P - Power operated
H - Hand-throw
S - Spring

Test must be made when placed in service, modified or disarranged, and at least once every designated time frame thereafter.

		Equipment Identification				Monthly		3 Months								6 Months			1 Year						2 YEAR							
																			Time Release/Relay 236.109													
Location	Date	Battery Bus 236.107	Signal Number, Route or Timing Device	Switch Number	Type of Switch	Switch Obstruction 236.382	Inductor Gauging 236.576	Valve Locks 236.383	Switch Circuit Controller 236.103	Point Detector 236.103	Shunt Fouling 236.104	Grounds 236.107	Restoring Feature 236.386	Overload	TAWS - Lights and Horns	Impedance & Insulation Resistance 236.576	Signal Mechanism 236.102	Cross Protection 236.384	Required Predetermined Time	Actual Time	Test Results	Valves & Valve Magnets 236.383	Movable Bridge 236.387	ACS Cut-in Circuits 236.577	Indication Locking 236.380	Time Locking 236.378	Approach Locking 236.377	Route Locking 236.379	Mechanical Locking 236.376	Traffic Locking 236.381	TAWS Test	NO.
Interlocker MP509	01/06/2006			1	P													C														1
	01/06/2006		1TER																5'	5'10"	C											2
	01/06/2006		1AE/1W		P																				C		C	C	C			3
	01/06/2006		1BE/2W		P																				C		C	C	C			4
																																5
Workman Bridge	01/09/2006		WENRL																				C									6
	01/09/2006		WESRL																				C									7
	01/09/2006		WEBL																				C									8
	01/09/2006		EENRL																				C									9
	01/09/2006		EESRL																				A									10*
	01/09/2006		EEBL																				C									11
	01/09/2006		WENRS																				C									12
	01/09/2006		WESRS																				A									13*
																																14
Electropneumatic MP 515	01/09/2006			7				C					C									C										15
																																16
ATS Inductor MP520	01/09/2006						C									C																17
																																18
C.P. 506.4	01/10/2006		1AE/1W												C																C	19
	01/10/2006		1BE/2W												C																C	20
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Form 24239 Rev 10/24/2013

RECORDING MARK

C - Test complete. Equipment in satisfactory condition.
*A - Adjustment made & test complete. Equipment in satisfactory condition.
*R - Repairs or replacement needed.
*S - Repairs or replacement made. Equipment in satisfactory condition.
* - Explain on back of form.

Union Pacific Railroad

Signal Department D.O.T - RS & I Test

Test must be made when placed in service, modified or disarranged, and at least once every designated time frame thereafter.

Signature ____________________

Headquarters ____________________

MP. to M.P. ____________________

Sheet ___ **of** ___ **Sheets**

								Monthly							3 Months		1 Year											
																					Warning Time 234.259				Time Release / Time			
M.P.	Street/Road	City/County	State	Train Detection Device (GCP3000, HXP3, DC, AFO, AC, etc.)	D.O.T Number	Equipment Tested or Inspected (Batt, Timer, Flasher, Gate, Track, etc.)	Date of Test	Ground 234.249	Standby Power 234.251	Visibility & Damage 234.253 (c)	Gate & Mech Condition 234.255 (a)	Gate Operation 234.255 (b)	Warning Sys. Operation 234.257 (a & b)	Traffic Signal Pre-empt 234.261	Cutout Circuit 234.269	Track Connections 234.271	Light Unit Alignment 234.253 (a)	Flashrate 234.253 (a)	Lamp Voltage 234.253 (b)	Hold Clear 234.255 (c)	Expected Results	Method Used: O, C, R	Actual Results	Test Results	Required Predetermined Time	Actual Time	Test Results	Line No.
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Chapter 1 Top

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Form 24239 Rev 01/14/2014

RECORDING MARK

C - Test complete. Equipment in satisfactory condition.
*A - Adjustment made & test complete. Equipment in satisfactory condition.
*R - Repairs or replacement needed.
*S - Repairs or replacement made. Equipment in satisfactory condition.
* - Explain on back of form.

Union Pacific Railroad

Signal Department D.O.T - RS & I Test

Test must be made when placed in service, modified or disarranged, and at least once every designated time frame thereafter.

Signature J.S. Doe
Headquarters Overland Ut.
MP. to M.P. 810.2 to 813.00
Sheet 1 of 1 Sheets

Example

M.P.	Street/Road	City/County	State	Train Detection Device (GCP3000, HXP3, DC, AFO, AC, etc.)	D.O.T Number	Equipment Tested or Inspected (Batt, Timer, Flasher, Gate, Track, etc.)	Date of Test	Monthly: Ground 234.249	Monthly: Standby Power 234.251	Monthly: Visibility & Damage 234.253 (c)	Monthly: Gate & Mech Condition 234.255 (a)	Monthly: Gate Operation 234.255 (b)	Monthly: Warning Sys. Operation 234.257 (a & b)	Monthly: Traffic Signal Pre-empt 234.261	3 Months: Cutout Circuit 234.269	3 Months: Track Connections 234.271	1 Year: Light Unit Alignment 234.253 (a)	1 Year: Flashrate 234.253 (a)	1 Year: Lamp Voltage 234.253 (b)	1 Year: Hold Clear 234.255 (c)	Warning Time 234.259: Expected Results	Warning Time 234.259: Method Used O, C, R	Warning Time 234.259: Actual Results	Warning Time 234.259: Test Results	Time Release / Time: Required Predetermined Time	Time Release / Time: Actual Time	Time Release / Time: Test Results	Line No.
810.1	Now here Street	Boondocks, TX.		GCP3000	123456E	ALL	07-13-08			C	C	A	C			C	C	44	C	C								1*
						XTER																			5'40"	5'55"	C	2
						B10		C	C																			3
						B12		C	C																			4
						Normal West															25	O	26	C				5
						Normal East															25	R	25	C				6
						Standby West															25	O	26	C				7
						Standby East															25	C	25	C				8
																												9*
812.65	Trouble Road	Overland, UT.		HXP-3	789101B	TIA	07-18-08							C														10*
						ALL				S	C	C	C															11*
						B10		S	C																			12
						B16		C	S																			13*
																												14*
5.65	Elsewhere Street	Lyman, CO.		DC	654321A	Flasher A	07-20-08			S			C															15
						2Trk.										S												16*
																												17*
25.20	Jolopy	Car County, CA.		PMD-1	554466F	ALL	07-23-08	C	C	C	C	C	C			S	A		A	C								18
						EOR												S										19
						EOR1												50										20
						RSO									C													21
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FORM 24050-Interlocking Revised 1/09

RECORDING MARK

C - Test complete. Equipment in satisfactory condition.
* A - Adjustment made & test complete. Equipment in satisfactory condition.
* R - Repairs or replacement needed.
* S - Repairs or replacement made. Equipment in satisfactory condition.
* - Explain on back of form.

UNION PACIFIC RAILROAD
AUTOMATIC INTERLOCKING

Test must be made when placed in service, modified or disarranged, and at least once every designated time frame thereafter.

Signature ____________
Headquarters ____________
M.P. to M.P. ____________
Sheet ___ **of** ___ **Sheets**

					2 Year Locking Tests						Annual Time Release			Annual Field Test of Automatic Interlocking											
Location	Date of Test	Entering Signal	Opposing Signal or Exiting Track	Describe Route Tested: For Example: (Sw1 N and Sw2 R)	Indication Locking 236.380	Time Locking 236.378	Approach Locking 236.371	Route Locking 236.379	Mechanical Locking 236.376	Traffic Locking 236.381	Required Predetermined Time	Actual Time	Test Results	1. Shunt approach, verify signal cleared	2. Conflicting signal will not clear	4. Proper aspects following & opposing	5. Appropriate approach signals	6. Time release	7. Time interval effective	8. Relays perform proper function	9. Preference alternates	10. Special devices	11. Approach track circuits LOS	12. Interlocking limits LOS	LINE NO.
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RECORDING MARK

C- Test complete. Equipment in satisfactory condition.

*A- Adjustment made & test complete. Equipment in satisfactory condition.

*R- Repairs or replacement needed.

*S- Repairs or replacement made. Equipment in satisfactory condition.

*- Explain in Comment Field

UNION PACIFIC RAILROAD
SIGNAL DEPT. DOT-RS&I TEST

Relay Test Report Rules 234.263, 236.105 and 236.106

Form 24095 Stars Revised 1/09

Sheet ____ of ____

Subdivision #	
Segment #	
MP #	
Location Name	
Sub Segment	
MP Prefix	
Dot #	
City/State	
Street/Road	

Each relay shall be tested at least once every 4 years except: "AC" centrifugal relays shall be tested every 12 months.

Relay Name	Serial #

Position (see Note)

C	N	E	W	S

Panel	Shelf	Number	
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9
0	0	0	0

Note: C=Center, N=north, E=east W=West, S=South Check only 1 box

Manufacturer	Model	Ohms	Test Type	Action	Contacts
			Line		
GRS/Allstrom	DN11	0.5	Track	Ordinary	1F-1B
US&S/Wabco	DN12	2	Timer	Bias	1F-4NR
WCH	DN22	4	Polar	Slow Rel	2F-2B
Safetran	K	194	1070	Slow PU	2F-4N-4R
EPC	A62262	250	Code	Polar	4F-4B
M.I.	A62277	450	ACCT	Flasher	4N-4R
	400000	500	Flasher	Timer	4F-4B-2F-1B
	PN250B	670	KP	75 Code	6F-5B
	PN150B	1000	Mag	120 Code	6F-6B-4N-4R
	E5	1500	ACVN	180 Code	8F-8B
	DP25	2000	PLTK	LO	8FB-4F-2B

Results	
C	☐
A	☐
R	☐
S	☐

Check those that apply. Use blank lines for items not listed.

COMMENTS:

Tag Values		Drop	PU	Working	Polar Normal	Polar Reverse	% On Time	Timer	Flash Rate
V	A								

Test Values		Drop	PU	Working	Polar Normal	Polar Reverse	% On Time	Timer	Flash Rate
V	A								

Date : ______________

Signature: ______________

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RECORDING MARK

C- Test complete. Equipment in satisfactory condition.
*A- Adjustment made & test complete. Equipment in satisfactory condition.
*R- Repairs or replacement needed.
*S- Repairs or replacement made. Equipment in satisfactory condition.
* - Explain on back of form.

UNION PACIFIC RAILROAD
SIGNAL DEPT. DOT-RS&I TEST
SEMAPHORE OR SEARCHLIGHT SIGNAL MECHANISM RULE 236.102

FORM 24096 REV 11/02/01

Instructions for completing form. Note: Use one form for each mechanism. Completed form must include location; signal number; type or model and serial number of the mechanism.
Test results must include:
Semaphore signals - pickup and release values of slots and current values for motor operation
Searchlight Mechanisms - dropaway, pickup and working values for both normal and reverse

Test of operating characteristics shall be made every 2 years.

SIGNAL NUMBER	MANUFACTURER	MODEL	COIL RESISTANCE	SERIAL NUMBER	SUBDIVISION / LOCATION

		SEARCHLIGHT						SEMAPHORE			RESULTS OF TESTS
		PICKUP		WORKING		DROP-AWAY		SLOTS (HOLD CLEAR)			
DATE OF TEST MM/DD/YY	TAG READINGS (Operating specifications)										
	SIGNATURE OF INSPECTOR	C TO R	C TO L	C TO R	C TO L	R TO C	L TO C	DA	PU	MOTOR CURRENT	

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RECORDING MARK

C- Test complete. Equipment in satisfactory condition.
*A- Adjustment made & test complete. Equipment in satisfactory condition.
*R- Repairs or replacement needed.
*S- Repairs or replacement made. Equipment in satisfactory condition.
* - Explain on back of form.

UNION PACIFIC RAILROAD
SIGNAL DEPT. DOT-RS&I TEST
SEMAPHORE OR SEARCHLIGHT SIGNAL MECHANISM RULE 236.102

FORM24096 REV 11/02/01

Instructions for completing form. Note: Use one form for each mechanism. Completed form must include location; signal number; type or model and serial number of the mechanism.
Test results must include:
Semaphore signals - pickup and release values of slots and current values for motor operation
Searchlight Mechanisms - dropaway, pickup and working values for both normal and reverse

Test of operating characteristics shall be made every 2 years.

SIGNAL NUMBER	MANUFACTURER	MODEL	COIL RESISTANCE	SERIAL NUMBER	SUBDIVISION / LOCATION
132R	US&S	H2	250	L48564	Houston

		SEARCHLIGHT						SEMAPHORE			RESULTS OF TESTS
		PICKUP		WORKING		DROP-AWAY		SLOTS (HOLD CLEAR)			
DATE OF TEST MM/DD/YY	TAG READINGS (Operating specifications)	5.2 V.	5.2 V.	5.5 V.	5.5 V.	2.2 V.	2.2 V.				
	SIGNATURE OF INSPECTOR	C TO R	C TO L	C TO R	C TO L	R TO C	L TO C	DA	PU	MOTOR CURRENT	
11/2/2001	J .S . D œ	5.2 V.	5.3 V.	5.5 V.	5.5 V.	2.2 V.	2.2 V.				C

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RECORDING MARK

C- Test complete. Equipment in satisfactory condition.
*A- Adjustment made & test complete. Equipment in satisfactory condition.
*R- Repairs or replacement needed.
*S- Repairs or replacement made. Equipment in satisfactory condition.
* - Explain on back of form.

FORM24096 REV 11/02/01

UNION PACIFIC RAILROAD
SIGNAL DEPT. DOT-RS&I TEST
SEMAPHORE OR SEARCHLIGHT SIGNAL MECHANISM RULE 236.102

Instructions for completing form. Note: Use one form for each mechanism. Completed form must include location; signal number; type or model and serial number of the mechanism.
Test results must include:
Semaphore signals - pickup and release values of slots and current values for motor operation
Searchlight Mechanisms - dropaway, pickup and working values for both normal and reverse

Test of operating characteristics shall be made every 2 years.

SIGNAL NUMBER	MANUFACTURER	MODEL	COIL RESISTANCE	SERIAL NUMBER	SUBDIVISION / LOCATION
327	GRS	2A	26/2000	B75165813	Wisconsin

		SEARCHLIGHT						SEMAPHORE			RESULTS OF TESTS
		PICKUP		WORKING		DROP-AWAY		SLOTS (HOLD CLEAR)			
DATE OF TEST MM/DD/YY	TAG READINGS (Operating specifications)							3.3 V.	5.5 V.	2.4 A.	
	SIGNATURE OF INSPECTOR	C TO R	C TO L	C TO R	C TO L	R TO C	L TO C	DA	PU	MOTOR CURRENT	
11/2/2001	J .S . D œ							3.3 V.	5.4 V.	2.4 A.	C

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RECORDING MARK

C- Test complete. Equipment in satisfactory condition.
*A- Adjustment made & test complete. Equipment in satisfactory condition.
*R- Repairs or replacement needed.
*S- Repairs or replacement made. Equipment in satisfactory condition.
* - Explain on back of form.

UNION PACIFIC RAILROAD
SIGNAL DEPT. DOT-RS&I TEST

Insulation Resistance Test Rule 236.108 and 234.267

If Resistance Reading of any conductor within a cable is less than 500,000 ohms, list each wire identification and resistance value within each cable.

In no case shall a circuit be permitted to function when resistance is less than 200,000 ohms.

Form 24097 rev. 11/01
Page ___ of ___

Subdivision #	
Segment #	
MP #	
Location Name	
Sub Segment	
MP Prefix	
Dot #	
City/State	
Street/Road	

Cable #	Cable Identification	Cable Size	Test Results	Wires Identification	Resistance	Test Results	Line No.
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Signature: ________________ **Date:** ____________________

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Microprocessor Based Interlocking Alternative Testing

Form MBIAT Rev. 07/08/2014

Date:____________________

M.P.________ To M.P. ________

Subdivision:________________________

Sheet _____ Of _____

Signature:_____________________________

N = Normal	H = Handle	EL = Electric Lock	C to L = Center to Left
R = Reverse	HT = Hand Throw	SF = Slide Fence	C to R = Center to Right
L = Latch	SS = Spring Switch	FD = Flood Detector	

Control System

System Type: ____________ (VHLC, ElectoLogic, Microlok) FSM Verification Yes ☐ / No ☐

Vital Application Software and Configuration Verification is completed using a separate platform specific form (BCFE, BCFM, or BCFV) and is required for each chassis at the location. Alternative testing is only allowed if there have been no changes in the Vital Application Software or Vital Configuration recorded during baseline testing.

Track Verification

List all tracks. Shunt each track individually and verify indication. In coded track systems verify code out.

	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T

Power Switches

Sw. Name:																
Requested Position	Nor.	Rev.	Nor.	Rev.	Nor.	Rev.	Nor.	Rev.	Nor.	Rev.	Nor.	Rev.	Nor.	Rev.	Nor.	Rev.
Breaks:	H N L	H R L	H N L	H R L	H N L	H R L	H N L	H R L	H N L	H R L	H N L	H R L	H N L	H R L	H N L	H R L
Sw. Name:																
Requested Position	Nor.	Rev.	Nor.	Rev.	Nor.	Rev.	Nor.	Rev.	Nor.	Rev.	Nor.	Rev.	Nor.	Rev.	Nor.	Rev.
Breaks:	H N L	H R L	H N L	H R L	H N L	H R L	H N L	H R L	H N L	H R L	H N L	H R L	H N L	H R L	H N L	H R L

Other Device Verification (Hand Throw Switch, Slide Fence, Flood detector, etc...)

Device Name								
Device Type								
Breaks								

Signal Verification

Signal Name															
Clear Signal															
Rock Signal	C to R	C to L	C to R	C to L	C to R	C to L	C to R	C to L	C to R	C to L	C to R	C to L	C to R	C to L	C to R
Signal Name															
Clear Signal															
Rock Signal	C to R	C to L	C to R	C to L	C to R	C to L	C to R	C to L	C to R	C to L	C to R	C to L	C to R	C to L	C to R

Line	Remarks
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Form BCFE Rev. 06/23/2014

Microprocessor Based Interlocking: Baseline Capture Form; Vital Application Software and Vital Configuration for Elogic Platform

Date: ________

M. P. From: ______ M. P. To: ______

Control Point: ____________________

Subdivision: ____________________

Sheet: ______ Of: ______

H = High

L = Low

Cabin Tag # ____________________

Chassis ID : ____________________

Signature : ______________________________

Program Name:		Program Version:		PROM #	PROM #
				CRC :	CRC :
Program Name:		Program Version:		PROM #	PROM #
				CRC :	CRC :

SLOT #3	Left 315	INPUTS				
		6	7	8	9	10
		H L	H L	H L	H L	H L
SLOT #4	RIGHT 315	INPUTS				
		1	2	3	4	5
		H L	H L	H L	H L	H L

SLOT #12	LEFT 313A	GROUP 1				GROUP 2			
		GREEN	YELLOW	RED	AUX	GREEN	YELLOW	RED	AUX
		H L	H L	H L	H L	H L	H L	H L	H L
SLOT #12	LEFT 313A	GROUP 3				GROUP 4			
		GREEN	YELLOW	RED	AUX	GREEN	YELLOW	RED	AUX
		H L	H L	H L	H L	H L	H L	H L	H L
SLOT #13	RIGHT 313A	GROUP 5				GROUP 6			
		GREEN	YELLOW	RED	AUX	GREEN	YELLOW	RED	AUX
		H L	H L	H L	H L	H L	H L	H L	H L
SLOT #13	RIGHT 313A	GROUP 7				GROUP 8			
		GREEN	YELLOW	RED	AUX	GREEN	YELLOW	RED	AUX
		H L	H L	H L	H L	H L	H L	H L	H L

Form BCFE Rev. 06/23/2014

Microprocessor Based Interlocking: Baseline Capture Form; Vital Application Software and Vital Configuration for Elogic Platform

Date: 6/23/2014
M. P. From: 443.9 M. P. To: 444.1
Control Point: CP ANY444
Subdivision: ANYWHERE
Sheet: 1 Of: 1

H = High
L = Low

Cabin Tag # 1234567
Chassis ID : 0000 00001

Signature : John E. Maintainer

Program Name:	1EUPOR1H	Program Version:	C	PROM # 2 CRC : OBEH	PROM # 3 CRC : AEF9
Program Name:	2ORP2	Program Version:	A	PROM # 4 CRC : OBEH	PROM # 6 CRC : AEF9

SLOT #3	Left 315	INPUTS				
		6	7	8	9	10
		1EN_NWPI	1WS_NWPI	2EN_NWPI	2WS_NWPI	2NJP
		H L	H L	H L	H L	H L
SLOT #4	RIGHT 315	INPUTS				
		1	2	3	4	5
		1T	2T	1W20	2W20	1NJP
		H L	H L	H L	H L	H L

SLOT #12	LEFT 313A	GROUP 1				GROUP 2			
		GREEN	YELLOW	RED	AUX	GREEN	YELLOW	RED	AUX
		X	X	X	X	X	X	X	2ENC1
		H L	H L	H L	H L	H L	H L	H L	H L
SLOT #12	LEFT 313A	GROUP 3				GROUP 4			
		GREEN	YELLOW	RED	AUX	GREEN	YELLOW	RED	AUX
		X	X	X	X	X	X	X	2WSC1
		H L	H L	H L	H L	H L	H L	H L	H L
SLOT #13	RIGHT 313A	GROUP 5				GROUP 6			
		GREEN	YELLOW	RED	AUX	GREEN	YELLOW	RED	AUX
		X	X	X	LAMPSON	X	X	X	1ENC1
		H L	H L	H L	H L	H L	H L	H L	H L

Example

Form BCFM Rev. 06/30/2014

Microprocessor Based Interlocking Baseline Capture Form; Vital Application Software and Vital Configuration for Microlok II Platform

Date: ____________________

M. P. From: ________ M. P. To: ________

Control Point: ____________________

Subdivision: ____________________

Sheet: ________ of ________

T = True

F = False

H = Energized

L = De-energized

Cabin Tag # ____________________

Signature: ____________________

PROGRAM NAME:			PROGRAM VERSION:			CRC:		
	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F
	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F
	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F
	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F
	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F
	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F
SOFTWARE STRAPS	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F
	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F
	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F
	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F
	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F
	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F	NAME: T F

Form BCFM Rev. 06/30/2014

Microprocessor Based Interlocking Baseline Capture Form; Vital Application Software and Vital Configuration for Microlok II Platform

T = True
F = False
H = Energized
L = De-energized

Cabin Tag # ____________________

Date: __________
M. P. From: __________ M. P. To: __________
Control Point: ____________________
Subdivision: ____________________
Sheet: __________ of __________
Signature: ____________________

SLOT #	TYPE	ADDRESS	INPUTS							
		1 2 3 4 5 6	1) H L	2) H L	3) H L	4) H L	5) H L	6) H L	7) H L	8) H L
			9) H L	10) H L	11) H L	12) H L	13) H L	14) H L	15) H L	16) H L
		1 2 3 4 5 6	1) H L	2) H L	3) H L	4) H L	5) H L	6) H L	7) H L	8) H L
			9) H L	10) H L	11) H L	12) H L	13) H L	14) H L	15) H L	16) H L
		1 2 3 4 5 6	1) H L	2) H L	3) H L	4) H L	5) H L	6) H L	7) H L	8) H L
			9) H L	10) H L	11) H L	12) H L	13) H L	14) H L	15) H L	16) H L
		1 2 3 4 5 6	1) H L	2) H L	3) H L	4) H L	5) H L	6) H L	7) H L	8) H L
			9) H L	10) H L	11) H L	12) H L	13) H L	14) H L	15) H L	16) H L
		1 2 3 4 5 6	1) H L	2) H L	3) H L	4) H L	5) H L	6) H L	7) H L	8) H L
			9) H L	10) H L	11) H L	12) H L	13) H L	14) H L	15) H L	16) H L
		1 2 3 4 5 6	1) H L	2) H L	3) H L	4) H L	5) H L	6) H L	7) H L	8) H L
			9) H L	10) H L	11) H L	12) H L	13) H L	14) H L	15) H L	16) H L

Form BCFE Rev. 06/23/2014

Microprocessor Based Interlocking: Baseline Capture Form; Vital Application Software and Vital Configuration for Elogic Platform

Date: 6/23/2014
M. P. From: 443.9 M. P. To: 444.1
Control Point: CP ANY444
Subdivision: ANYWHERE
Sheet: 1 Of: 1

H = High
L = Low

Cabin Tag # 1234567
Chassis ID : 0000 00001

Signature : John F. Maintainer

Program Name:	1EUPOR1H	Program Version:	C	PROM # 2 CRC : OBEH	PROM # 3 CRC : AEF9
Program Name:	2ORP2	Program Version:	A	PROM # 4 CRC : OBEH	PROM # 6 CRC : AEF9

		INPUTS				
SLOT #3	Left 315	6	7	8	9	10
		1EN_NWPI	1WS_NWPI	2EN_NWPI	2WS_NWPI	2NJP
		H L	H L	H L	H L	H L

		INPUTS				
SLOT #4	RIGHT 315	1	2	3	4	5
		1T	2T	1W20	2W20	1NJP
		H L	H L	H L	H L	H L

		GROUP 1				GROUP 2			
SLOT #12	LEFT 313A	GREEN	YELLOW	RED	AUX	GREEN	YELLOW	RED	AUX
		X	X	X	X	X	X	X	2ENC1
		H L	H L	H L	H L	H L	H L	H L	H L

		GROUP 3				GROUP 4			
SLOT #12	LEFT 313A	GREEN	YELLOW	RED	AUX	GREEN	YELLOW	RED	AUX
		X	X	X	X	X	X	X	2WSC1
		H L	H L	H L	H L	H L	H L	H L	H L

		GROUP 5				GROUP 6			
SLOT #13	RIGHT 313A	GREEN	YELLOW	RED	AUX	GREEN	YELLOW	RED	AUX
		X	X	X	LAMPSON	X	X	X	1ENC1
		H L	H L	H L	H L	H L	H L	H L	H L

Form BCFM Rev. 06/30/2014

Microprocessor Based Interlocking Baseline Capture Form; Vital Application Software and Vital Configuration for Microlok II Platform

Date: **6/30/2014**
M. P. From: **439.5 M. P. To: 440.5**
Control Point: **CP AW440**
Subdivision: **ANYWHERE**
Sheet: **2 of 2**

T = True
F = False
H = Energized
L = De-energized

Cabin Tag # **9876543**

Signature: *Bill M. Signalman*

SLOT #	TYPE	ADDRESS	INPUTS							
8	IN8 OUT8	1 2 3 4 5 6 0 1 0 0 0 1	1) H L AT	2) H L T	3) H L NWPI	4) H L RWPI	5) H L NJPI	6) H L PTCI1	7) H L PTCI2	8) H L X
			~~9) H L~~	~~10) H L~~	~~11) H L~~	~~12) H L~~	~~13) H L~~	~~14) H L~~	~~15) H L~~	~~16) H L~~
9	IN8 OUT8	1 2 3 4 5 6 0 0 1 0 0 1	1) H L X	2) H L BWS_TP	3) H L EN_NWPI	4) H L AWS_NWPI	5) H L BWS_NWPI	6) H L NWCK	7) H L RWCK	8) H L X
			~~9) H L~~	~~10) H L~~	~~11) H L~~	~~12) H L~~	~~13) H L~~	~~14) H L~~	~~15) H L~~	~~16) H L~~
10	IN16	1 2 3 4 5 6 0 0 1 0 0 1	1) H L 5AT_OS	2) H L 5WST	3) H L 2CWST	4) H L 2NWPI	5) H L 2RWPI	6) H L 2NJPI	7) H L 2NWCK	8) H L 2RWCK
			9) H L 0800_1ENLO	10) H L 0800_2ENLO	11) H L 0800_WSAP	12) H L SPARE	13) H L SPARE	14) H L SPARE	15) H L SPARE	16) H L SPARE
		1 2 3 4 5 6	1) H L	2) H L	3) H L	4) H L	5) H L	6) H L	7) H L	8) H L
			9) H L	10) H L	11) H L	12) H L	13) H L	14) H L	15) H L	16) H L

Form BCFV Rev. 06/24/2014

Microprocessor Based Interlocking; Baseline Capture Form; Vital Application Software and Vital Configuration for VHLC Platform

Date: ______
M.P. ______ To M.P. ________
Control Point : ____________
Subdivision: ____________
Sheet: _______ of _______
Signature: ____________

H = Energized
L = De-energized

Cabin Tag # ____________

PROGRAM NAME:	PROM #	CRC	PROM #	CRC	CHASSIS ID
PROGRAM VERSION:					

SLOT #	MODULE TYPE	INPUTS							
		1	2	3	4	5	6	7	8
		H L	H L	H L	H L	H L	H L	H L	H L
		9	10	11	12	13	14	15	16
		H L	H L	H L	H L	H L	H L	H L	H L
SLOT #	MODULE TYPE	INPUTS							
		1	2	3	4	5	6	7	8
		H L	H L	H L	H L	H L	H L	H L	H L
		9	10	11	12	13	14	15	16
		H L	H L	H L	H L	H L	H L	H L	H L
SLOT #	MODULE TYPE	INPUTS							
		1	2	3	4	5	6	7	8
		H L	H L	H L	H L	H L	H L	H L	H L
		9	10	11	12	13	14	15	16
		H L	H L	H L	H L	H L	H L	H L	H L
SLOT #	MODULE TYPE	INPUTS							
		1	2	3	4	5	6	7	8
		H L	H L	H L	H L	H L	H L	H L	H L
		9	10	11	12	13	14	15	16
		H L	H L	H L	H L	H L	H L	H L	H L

Form BCFV Rev. 06/24/2014

Microprocessor Based Interlocking; Baseline Capture Form; Vital Application Software and Vital Configuration for VHLC Platform

Date: ______

M.P. ______ To M.P. ________

Control Point : ____________________

Subdivision: ____________________

Sheet: _______ of _______

H = Energized

L = De-energized

Cabin Tag # ______________________

Signature: ___________________________

SLOT #	MODULE TYPE	INPUTS							
		1	2	3	4	5	6	7	8
		H L	H L	H L	H L	H L	H L	H L	H L
		9	10	11	12	13	14	15	16
		H L	H L	H L	H L	H L	H L	H L	H L
SLOT #	MODULE TYPE	INPUTS							
		1	2	3	4	5	6	7	8
		H L	H L	H L	H L	H L	H L	H L	H L
		9	10	11	12	13	14	15	16
		H L	H L	H L	H L	H L	H L	H L	H L
SLOT #	MODULE TYPE	INPUTS							
		1	2	3	4	5	6	7	8
		H L	H L	H L	H L	H L	H L	H L	H L
		9	10	11	12	13	14	15	16
		H L	H L	H L	H L	H L	H L	H L	H L
SLOT #	MODULE TYPE	INPUTS							
		1	2	3	4	5	6	7	8
		H L	H L	H L	H L	H L	H L	H L	H L
		9	10	11	12	13	14	15	16
		H L	H L	H L	H L	H L	H L	H L	H L

Form BCFV Rev. 06/24/2014

Microprocessor Based Interlocking; Baseline Capture Form; Vital Application Software and Vital Configuration for VHLC Platform

Date:
M.P. 399.5 To M.P. 400.5
Control Point : CP UP400
Subdivision: RAILROAD
Sheet: 1 of 1

H = Energized
L = De-energized

Cabin Tag # 5555555

Signature: *Joe V. Signalman*

PROGRAM NAME: VLUP984		PROM #	CRC	PROM #	CRC	CHASSIS ID	
PROGRAM VERSION: B		14	88F3	15	E8D9	11100100 00111111	

SLOT #	MODULE TYPE	INPUTS							
8	VGPI08	1	2	3	4	5	6	7	8
		1NWCK	1RWCK	2NWCK	2RWCK	3NWCK	3RWCK	4NWCK	4RWCK
		H L	H L	H L	H L	H L	H L	H L	H L
		9	10	11	12	13	14	15	16
		H L	H L	H L	H L	H L	H L	H L	H L
9	VGPI16	1	2	3	4	5	6	7	8
		1T	2T	3T	1NWPI	1RWPI	2NWPI	2RWPI	3NWPI
		H L	H L	H L	H L	H L	H L	H L	H L
		9	10	11	12	13	14	15	16
		3RWPI	LAMPTEST	4NWPI	4RWPI	2AT	2BT	X	X
		H L	H L	H L	H L	H L	H L	H L	H L
10	VGPI08	1	2	3	4	5	6	7	8
		3WST_ENA	3ENT_ENA	X	X	X	X	X	X
		H L	H L	H L	H L	H L	H L	H L	H L
		9	10	11	12	13	14	15	16
		H L	H L	H L	H L	H L	H L	H L	H L
		1	2	3	4	5	6	7	8
		H L	H L	H L	H L	H L	H L	H L	H L
		9	10	11	12	13	14	15	16
		H L	H L	H L	H L	H L	H L	H L	H L

Example

Form BCFV Rev. 06/24/2014

Microprocessor Based Interlocking; Baseline Capture Form; Vital Application Software and Vital Configuration for VHLC Platform

Date: ______

M.P. ______ To M.P. ________

Control Point : ____________________

Subdivision: ____________________

Sheet: _______ of _______

Signature: ___________________________

H = Energized

L = De-energized

Cabin Tag # ______________________

SLOT #	MODULE TYPE	INPUTS							
		1	2	3	4	5	6	7	8
		H L	H L	H L	H L	H L	H L	H L	H L
		9	10	11	12	13	14	15	16
		H L	H L	H L	H L	H L	H L	H L	H L
SLOT #	MODULE TYPE	INPUTS							
		1	2	3	4	5	6	7	8
		H L	H L	H L	H L	H L	H L	H L	H L
		9	10	11	12	13	14	15	16
		H L	H L	H L	H L	H L	H L	H L	H L
SLOT #	MODULE TYPE	INPUTS							
		1	2	3	4	5	6	7	8
		H L	H L	H L	H L	H L	H L	H L	H L
		9	10	11	12	13	14	15	16
		H L	H L	H L	H L	H L	H L	H L	H L
SLOT #	MODULE TYPE	INPUTS							
		1	2	3	4	5	6	7	8
		H L	H L	H L	H L	H L	H L	H L	H L
		9	10	11	12	13	14	15	16
		H L	H L	H L	H L	H L	H L	H L	H L

Form 24052 Revised 03/25/2015

RECORDING MARK

C - Test complete. Equipment in satisfactory condition.
* A - Adjustment made & test complete. Equipment in satisfactory condition.
* R - Repairs or replacement needed.
* S - Repairs or replacement made. Equipment in satisfactory condition.
* - Explain on back of form.

UNION PACIFIC RAILROAD
SIGNAL DEPT. HUMP YARD TEST

Test must be made when placed in service, modified or disarranged, and at least once every designated time frame thereafter.

EQUIPMENT TESTED = SWITCH, SIGNAL, TIMING DEVICE, BATTERY BUSS, RETARDER, ETC.

Month/year______________
Signature ______________
Headquarters ____________
M.P. to M.P.____________
Sheet___ **of** ____ **Sheets**

		Switches and Derails							Retarders									Detectors			C.R.			Electronics					Additional Items						
DATE OF TEST	EQUIPMENT TESTED	Yard SW Gen. Inspection	GRS Model 6 SW	US&S DA-10 SW	Nortrak Hydraulic SW	RCL Type SW	Blue Flag &/Or Derail	Split Point Derail	Master Retarder	Group Retarder	Tangent Point Retarder	E-160 Retarder	CV or Piston Retarder	Model 50A/50B Retarder	Operable Skate Retarder	AR2 Inert Skate Retarder	HS-2 Unit	Yard DED	Yard Shove Signal	Car Space & Calibration	Hump Computer System	UPS System	Ground Test (C.R)	Rail Lubricator	Weight Rails/Strain Gauge	Crest Equipment	High Freq. Track Circuit	Radar Maintenance	Walking Inspection	Notification	Kept In Good Condition	Sp. Error/Misroutes/Stalls	RCL Zone	Ground Test (Other)	
																																			1
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Chapter 1 Top

Line	Remarks
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Union Pacific Hot Box Detector Tests

Form 24240
Revised 2/01

Recording Mark
C = Test Complete. Equipment in satisfactory condition.
*A = Adjustment made & test complete. Equipment in satisfactory condition.
*R = Repairs or replacement needed.
*S = Repairs or replacement made. Equipment in satisfactory condition.
* = Explain on back of form.

Location ____________
Track ____________
Model ____________
District ____________

	Bi-Weekly										Semi- Annual																
Date	Review Train Data	Rail 1 - Average Temperature	Rail 2 - Average Temperature	Mirrors and Lenses	Inspect Scanners/ Hardware	Scanner Heaters	Transducers	Heat Alarm Test	Dragging Equipment Detector	Other Auxillary Inputs	Scanner Height & Alignment	Calibration	Carrier Levels	Voltages Measured	Wiring/boards/plug/relays	Radio License	Chart Recorders	Board Self Test	Radio Test	Train Direction	Prints, manuals and Instructions	Lightning Protection	Track Structure	DED Deflection Test	Gaskets/ Lubrication	Servo Focal Adj. (as needed)	Initials	Line Number
																												1
																												2
																												3
																												4
																												5
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Line	Remarks
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RECORDING MARK

C- Test complete. Equipment in satisfactory condition.
*A- Adjustment made & test complete. Equipment in satisfactory condition.
*R- Repairs or replacement needed.
*S- Repairs or replacement made. Equipment in satisfactory condition.
* - Explain on back of form.

UNION PACIFIC RAILROAD
Yearly Test of Hazard Detectors

FORM 24039
REV 10/01/08

Date Submitted:______________________

Sheet#_________

Inspected by:______________________

Date of Test (mm/dd/yy)	Mile Post Location	Type of Detector (Fire, Slide, Flood,etc.)	Detector Causes Proper Signal to be Displayed (Yes / No)	Results	Line Number
					1
					2
					3
					4
					5
					6
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					9
					10
					11
					12
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					14
					15
					16
					17
					18
					19
					20

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WCO-32 Voltage Record

	WCO - 33					WCO-35 Harmon PS								Battery Type							
														Battery Size							
Date	+12 VDC (TP)	-12 VDC (TP)	+12 VDC AUX. (Lug)	+5 VDC (TP)		+24 VDC (TB1-3 & TB1-2)	+47 VDC (TB1-7 & TB1-8)	+39 Open (TB1-12 7 TB1-10	+39 Close (TB1-11 7 TB1-10		AC Supply	AC Heaters	AC Inverter Out	Battery Bank	Cell 1	Cell 2	Cell 3	Cell 4	Cell 5	Cell 6	Cell 7	Cell 8

Line	Remarks
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WCO 75 Voltage Record

														Battery Type								
														Battery Size								
Date	+12 VDC (TP)	-12 VDC (TP)	+12 VDC AUX. (Lug)	+5 VDC (TP)		+200 VDC Bias (TB2-10)	-200 VDC Bias (TB2-12)	15 VDC Bolo Bias (TB4-9	+12 VDC / Shutter Suppl		AC Supply	AC Heaters	AC Inverter Out	Battery Bank	Cell 1	Cell 2	Cell 3	Cell 4	Cell 5	Cell 6	Cell 7	Cell 8

Line	Remarks
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Servo 9000 Voltage Record

Date	Bolo Bias +300VDC (TB2-2 & Ground)	Bolo Bias -300VDC (TB2-2 & Ground)	Shutter +12VDC (TB3-6 & Ground)	Unregulated +18VDC (TB3-5 & Ground)	Relay Drive +12VDC (TB3-5 & Ground)	Regulated +5VDC (TB3-4 & Ground)	Regulated +24VDC (TB3-11 & Ground)	Source AC (TB1-A & B)	Case Heater (TB1-3 & 4)	Integrity Heater (TB1-3 & 10)	Trans. Threshold (TP3 & Ground)	Rail 1 Threshold (TP9 & Ground)	Rail 2 Threshold (TP9 & Ground)	Rail 1 Sky Shot (TP18 & Ground)	Rail 2 Sky Shot (TP19 & Ground)	Battery Type								
																Battery Size								
																Bank	Cell 1	Cell 2	Cell 3	Cell 4	Cell 5	Cell 6	Cell 7	Cell 8

Line	Remarks
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Cyberscan 2000 Voltage Record

Date	D Board +5V LED	D Board +12V LED	D Board -12V LED	D Board + 24 V LED	Scanner Case Heater LE				Inverter AC	Source AC				Battery Type								
														Battery Size								
														Battery Bank	Cell 1	Cell 2	Cell 3	Cell 4	Cell 5	Cell 6	Cell 7	Cell 8

Line	Remarks
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Southern Technologies Voltage Record

									Battery Type													
									Battery Size													
Date	Float Voltage DC Power Supply TPs	Float Voltage AC Ripple Power Supply TPs	Source AC	(+) 5V VDC LED	(-) 12 VDC LED	(+) 12V LED	120 VAC LED	COP LED	Battery Bank	Cell 1	Cell 2	Cell 3	Cell 4	Cell 5	Cell 6	Cell 7	Cell 8	Cell 9	Cell 10	Cell 11	Cell 12	

Power Supply AC Ripple Test - Place a digital meter in the AC position, remove the battery box fuse, and record the AC voltage. On a good power supply, the reading will be below 20 milivolts AC. On a deteriorating power supply, the reading will be great

Chapter 1 Top

Line	Remarks
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Carrier Levels and Voltage Record

														Battery Type										
														Battery Size										
Date	+12VDC	-12VDC	Transmit Level (ONLINE) d	Transmit Level (TP)	Receive Level (ONLINE) d	Receive Level @ (TP)	Transmit Frequency HZ	Receive Frequency Hz						Battery Bank	Cell 1	Cell 2	Cell 3	Cell 4	Cell 5	Cell 6	Cell 7	Cell 8	Cell 9	Cell 10

Line	Remarks
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Disabling and Enabling Procedure Job Aid

Confirm with Dispatcher, SOC or EIC that alternative protection is in place prior to using any disabling measures.

Disabling Procedure:

☐ 1. Review this entire section of instructions and CEB 137 before any portion is acted upon.

☐ 2. Perform a job briefing with all involved employees and review all applicable rules, safety concerns, circuit plans, disabling, and enabling procedures.

☐ 3. List each crossing to be disabled in the job briefing book.

☐ 4. Crossings to be disabled as a consequence of track work, damage, or malfunctioning must be protected with one of the following; confirm with the EIC of track work, which form of protection is to be used at each affected crossing (CEB 137.2.3.A.2):

- Stop and Protect Form C track bulletin.
- Closing grade crossings (CEB 137.2.4)
- Flaggers (CEB 137.2.5)

NOTE: When it is known that no trains will be operating over the crossing(s) on any track, disabled crossings may be protected using exclusive track occupancy (track and time, track warrant, etc.) without the issuance of a Form C track bulletin or providing flaggers. (CEB 137.2.3.B.5)

NOTE: When interconnected to parallel UPRR, another railroad crossing(s), alternative means of protection must be provided on the other crossing(s) by one of the following methods:

- Stop and Protect Form C track bulletin.
- Closing grade crossings (CEB 137.2.4)
- Flaggers (CEB 137.2.5)

☐ 5. Determine which disabling procedures will maintain normal operation on as many tracks and approaches as possible. Verify that interconnected crossing(s) not intended to be disabled continue to provide warning and traffic preemption(s) continues to function as intended.

☐ 6. Confirm proper authority (Form B track bulletin, track and time, track warrant, track permit, etc.) is acquired from the dispatcher before applying a track shunt or dummy load (an inductor applied across track wire terminals) to disable a crossing. Regardless of the type of authority used, all train movements within these limits will be governed by the EIC after job briefing with the signalman to ensure safe train movements.

☐ 7. Ensure all jumpers are approved as indicated in the Approved Jumper section of 8.1.15. Each must have a numbered owner ID tag and reminder tag. Dummy loads must have an approved jumper attached to them.

☐ 8. Mark each circuit to be disconnected or equipment to be disabled by programming, with a conspicuously placed approved jumper.

☐ 9. Reconfirm, as needed, with the EIC and the dispatcher, that all necessary protection is in effect.

☐ **10. PERFORM THE SELECTED DISABLING PROCEDURES.**

☐ 11. Ensure that each track selected to be disabled is disabled and that all other tracks function normally.

☐ 12. Complete a Crossing Disabling Form for each disabled crossing. (Crossing Disable Planning / Briefing Worksheet book)

FORM 20129 Rev.05/12/2015

Disabling and Enabling Procedure Job Aid

☐ 13. Keep a copy of the form at each crossing location and the original in your possession until 24 hours after the crossings are restored to normal operation.

☐ 14. Attach all Reminder Tags to the Jumper Kit bag and retain until enabling procedure is complete.

NOTE: If the signal employee who disabled crossing will not be available to enable the crossing, Reminder Tags must be left in a conspicuous location at the disabled crossing.

☐ 15. Notify SOC, if the work is unplanned or is interconnected to parallel UPRR or another railroad crossing(s), and have a ticket created for each disabled crossing. (An example of unplanned work is failure to request a Form B, along with a Form C, at least 12 hours in advance.)

☐ 16. Insert a standard LO/TO tag through the door lock on each affected crossing case/house.

☐ 17. Notify the EIC that all applicable crossings have been properly disabled and tested as per the job briefing.

NOTE: If there is a need to handoff the enabling and testing of the crossing to another employee:

- Complete Form 24235 indicating that a thorough job briefing of all existing disabling measures was performed. The job briefing must include designated location to return Form 24235, all existing disabling measures, and Reminder Tags.
- The employee being briefed, accepts responsibility for the enabling and testing of the crossing, and has received the Reminder Tags
- Record the handoff in your job briefing book, including date, time, employee ID, and worksheet number before releasing Form 24235 to that employee

Enabling Procedure:

☐ 1. Verify, with the EIC of track work, that the need for the crossing warning devices to be disabled is no longer required.

☐ 2. Review the documentation of jumpers, track shunts, or other disabling procedures, used to disable each crossing.

☐ 3. Remove and account for each jumper and/or track shunt used in disabling each crossing, reattaching the reminder tags to the jumpers.

☐ 4. Ensure that all approaches on all affected tracks and all crossings are functioning normally. Verify that all interconnects and traffic preemptions are functioning properly.

☐ 5. Remove all reminder job aids and LO/TO tags.

☐ 6. Notify the EIC of track work that each crossing has been restored to normal operation. If crossing(s) are interconnected, notify SOC that the crossing(s) have been restored and are functioning as intended.

☐ 7. Advise the Dispatcher of each disabled crossing that has been restored to normal operation and instruct the Dispatcher to remove each applicable "Stop and Protect" order.

NOTE: When a signalman disables a crossing warning device, only a signalman may remove the "Stop and Protect" order from the Form C track bulletin.(CEB 137.2.3.A.5, 137.2.3.B.6, 137.2.6.A.2)

☐ 8. Release track and time or track permit, etc., if applicable.

☐ 9. Advise SOC (on unplanned track work) that each disabled crossing has been properly tested and is operating as intended.

☐ 10. The completed yellow copy of Form 24235 must remain at the crossing until a recorded monthly crossing test and inspection is performed more than 7 days after the crossing was enabled.

FORM 20129 Rev.05/12/2015

UPRR XXXXX

Crossing Disable Planning / Briefing Worksheet

FORM 24235
Rev. 02/26/15

This form must be filled out completely. (Circle answer to confirm step completed)

I have reviewed Yellow Book Instruction 8.1.15 before completing any portion of this form: Yes Employee ID: ________________

Date:______________ Name: ______________________________ Gang No.:________ Subdivision: ______________________

SOC Ticket No.: ____________________ Tech Initials: ______________ Dispatcher Notified: Yes No

MP:______________ Street/Road/Hwy:____

EIC/Signal: ______________ EIC/Track: ______________ On Track Authority No. ______________

Alternate Method of Protecting Crossing ______________________ NCC OOS Signs Used (YB 8.1.18): Yes / No

DISABLING PROCEDURES (Yellow Book 8.1.15) CROSSING VALUES BEFORE WORK: Values on Unit ____=____/____ Values on Unit ____=____/____

Values on Unit ____=____/____ Values on Unit ____=____/____ Values on Unit ____=____/____ Values on Unit ____=____/____

1. Apply Track Shunt: Yes No Time Applied: ____:____ Track(s) Affected: ______________

2. Apply Jumper(s): Yes No Time Applied: ____:____ Track(s) Affected: ______________

If disabling by Program [P], Dummy Load [DL], or Mechanical [M], place an "X" in the appropriate box next to the Jumper to be used.

[M] [DL] [P] Jumper No.____ Circuit ________ [M] [DL] [P] Jumper No.____ Circuit ________ [M] [DL] [P] Jumper No.____ Circuit ________

[M] [DL] [P] Jumper No.____ Circuit ________ [M] [DL] [P] Jumper No.____ Circuit ________ [M] [DL] [P] Jumper No.____ Circuit ________

3. Affected Track(s) Tested: Yes 4. Non-Affected Track(s) Tested: Yes 5. Has Remote(s): Yes / No Affected by Disabling: Yes / No Tested: Yes / N/A

6. Interconnect(s): Yes / No Interconnect Type(s): Parallel Crossing / Other Railroad / Traffic Preempt Protected: Parallel Crossing / Other Railroad Tested: Yes / N/A

I have performed a job briefing of all disabling measures with the employee listed below. Date: ________ Time: ____:____ Signature ______________

I have received a job briefing and accept responsibility for enabling and testing the crossing. Employee ID: __________ Signature ______________

ENABLING PROCEDURES (Yellow Book 8.1.15) CROSSING VALUES AFTER WORK: Values on Unit ____=____/____ Values on Unit ____=____/____

Values on Unit ____=____/____ Values on Unit ____=____/____ Values on Unit ____=____/____ Values on Unit ____=____/____

1. Remove Track Shunt(s): Yes N/A Time Removed ____:____ 1A. Remove Jumper(s): Yes N/A Time Removed ____:____

2. List of Shunts/Jumpers Removed ______________________________

3. **Affected Track(s) Tested: Yes** 4. **Non-Affected Track(s) Tested: Yes** 5. **Remotes Tested: Yes / N/A** 6. **Interconnect(s) Tested: Yes / N/A**

7. Method Used to Test Crossing ______________ 8. Notify EIC: Yes Time ____:____ 9. On Track authority Released: Yes Time ____:____

10. Notify SOC Crossing Tested and Returned to Service: Yes / N/A Time ____:____ 11. Remove Alternate Protection: Yes Time ____:____

White (original) – to remain with employee *Yellow – to be left at crossing after returning to normal service* *Pink – to be left at crossing while crossing is disabled*

Example

UPRR XXXXX

Crossing Disable Planning / Briefing Worksheet

FORM 24235
Rev. 02/26/15

This form must be filled out completely. (Circle answer to confirm step completed)

I have reviewed Yellow Book Instruction 8.1.15 before completing any portion of this form: Yes Employee ID: ________________

Date:______________ Name: ______________________________ Gang No.:________ Subdivision: ______________________

SOC Ticket No.: ____________________ Tech Initials: ______________ Dispatcher Notified: Yes No

MP:______________ Street/Road/Hwy:____

EIC/Signal: ______________ EIC/Track: ______________ On Track Authority No. ______________

Alternate Method of Protecting Crossing ______________________ NCC OOS Signs Used (YB 8.1.18): Yes / No

DISABLING PROCEDURES (Yellow Book 8.1.15) CROSSING VALUES BEFORE WORK: Values on Unit ____=____/____ Values on Unit ____=____/____

Values on Unit ____=____/____ Values on Unit ____=____/____ Values on Unit ____=____/____ Values on Unit ____=____/____

1. Apply Track Shunt: Yes No Time Applied: ____:____ Track(s) Affected: ______________

2. Apply Jumper(s): Yes No Time Applied: ____:____ Track(s) Affected: ______________

If disabling by Program [P], Dummy Load [DL], or Mechanical [M], place an "X" in the appropriate box next to the Jumper to be used.

[M] [DL] [P] Jumper No.____ Circuit ________ [M] [DL] [P] Jumper No.____ Circuit ________ [M] [DL] [P] Jumper No.____ Circuit ________

[M] [DL] [P] Jumper No.____ Circuit ________ [M] [DL] [P] Jumper No.____ Circuit ________ [M] [DL] [P] Jumper No.____ Circuit ________

3. Affected Track(s) Tested: Yes 4. Non-Affected Track(s) Tested: Yes 5. Has Remote(s): Yes / No Affected by Disabling: Yes / No Tested: Yes / N/A

6. Interconnect(s): Yes / No Interconnect Type(s): Parallel Crossing / Other Railroad / Traffic Preempt Protected: Parallel Crossing / Other Railroad Tested: Yes / N/A

I have performed a job briefing of all disabling measures with the employee listed below. Date: ________ Time: ____:____ Signature ______________

I have received a job briefing and accept responsibility for enabling and testing the crossing. Employee ID: __________ Signature ______________

ENABLING PROCEDURES (Yellow Book 8.1.15) CROSSING VALUES AFTER WORK: Values on Unit ____=____/____ Values on Unit ____=____/____

Values on Unit ____=____/____ Values on Unit ____=____/____ Values on Unit ____=____/____ Values on Unit ____=____/____

1. Remove Track Shunt(s): Yes N/A Time Removed ____:____ 1A. Remove Jumper(s): Yes N/A Time Removed ____:____

2. List of Shunts/Jumpers Removed ______________________________

3. **Affected Track(s) Tested: Yes** 4. **Non-Affected Track(s) Tested: Yes** 5. **Remotes Tested: Yes / N/A** 6. **Interconnect(s) Tested: Yes / N/A**

7. Method Used to Test Crossing ______________ 8. Notify EIC: Yes Time ____:____ 9. On Track authority Released: Yes Time ____:____

10. Notify SOC Crossing Tested and Returned to Service: Yes / N/A Time ____:____ 11. Remove Alternate Protection: Yes Time ____:____

White (original) – to remain with employee *Yellow – to be left at crossing after returning to normal service* *Pink – to be left at crossing while crossing is disabled*

!!WARNING!!

Form 24412

This location has an Interconnection to a Highway Traffic Controller or Foreign Railroad from the Railroad Grade Crossing System

Check one

This Interconnection provides:
_______ SIMULTANEOUS PREEMPTION
_______ ADVANCED PREEMPTION of _______ Sec.
_______ RAILROAD INTERCONNECTION

Railroad, Do Not Modify the Warning Time as designed for the Crossing Signals or Advanced Preemption time.

Highway, Do Not Modify any Sequence Time as designed in the Traffic Light Controller.

The following appropriate party(s) must be notified, and written authority from such appropriate party(s) received, if required by law, before any change is made:

1. State Agency: ____________________
   Phone: ____________________
2. Road Authority: ____________________
   Phone: ____________________
3. Railroad: ____________________
   Phone: ____________________
4. Railroad: Union Pacific
   Phone: 1-800-848-8715

DOT Inventory No. ____________________

Street Name: ____________________

RR Milepost: ____________________

City / State: ____________________

Subdivision: ____________________

Date In Service: ____________________

Date of Joint Testing

Date:	By:

This form must be placed in a conspicuous location within the UPRR crossing cabin. A copy of this form will be provided to the road authority or interconnected railroad upon request

Rev. 10/10/2013

Chapter 2 Switches

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2.1 General Switch Instructions

2.1.1 Adjustment, Installation and Protection

Rev. 08/96

A. **Closely Approaching or Passing Trains.** Rev. 01/09

Employees must not unlock, adjust, or operate switches that will in any way affect closely approaching or passing train or engine movements. Non-interlocked switches in main tracks, or leading to main tracks, must be locked in the normal position when not in use.

B. **Repair, Replace and Adjust.** Rev. 01/09

Switches must be adjusted and maintained in accordance with test instructions. When repair, replacement, or adjustment is made to parts of switch layouts or facing point locking of switches, proper tests must be made **before** the switch is restored to normal service. In addition, when a switch or switch machine has been replaced, visually ensure that governing signal(s) display proper aspect corresponding to the position of the switch. On power operated switches, verify with the Dispatcher or Control Operator that switch indications and route correspond with field apparatus.

Ensure that the new insulated rail joints (polarity joints) in the turnout are not staggered more than four feet six inches; turnout joints not meeting this standard must be corrected. (See Standard Drawings)

C. **Switch and Track Construction.** Rev. 08/96

The FRA requires that before a switch under construction is left unattended, protection must be provided by spiking the switch point and applying a switch point clamp with a signal padlock inserted in the clamp. The track installed must also be bonded to the clearance point.

In addition to the FRA requirement mentioned above, a switch circuit controller connected to the switch point must be installed. During the time that the switch is under construction, the track shunt configuration may be used to wire the switch circuit controller. (See Standard Drawings) No train or engine may use the track that is associated with the switch except a train or engine that is engaged in the construction of the switch and associated track.

D. **New Switch Placed In Revenue Service.** Rev. 08/96

When a new switch or switch point is placed in service in a signaled track, **before** the switch is left unattended, protection shall be provided by means of a switch circuit controller connected to the switch point and the track bonded to the clearance point. Protection must be provided by opening a track or line circuit with a circuit controller.

2.1.2 When Necessary to Disconnect Switch Stand, Controller, etc.

Rev. 08/96

When necessary to disconnect a switch, switch stand, switch controller, hand throw switch, movable point frog, derail or associated apparatus (hereinafter called “switch”) from the operating mechanism, or to disconnect the No. 1 rod, the following, in addition to providing complete protection for trains, must be done:

1. The closed point must be held securely against the stock rail by a spike driven into the tie against the point and the first tie back of the point (head block ties) and where possible, through the plates, except where a locking clamp is used as provided in the following paragraph.
2. No movement will be allowed over a switch if either the first or second tie behind the switch point are removed unless the following precautions are taken:

   A. The closed switch point must be secured to the stock rail with a switch point clamp.

   B. The remaining tie is secured with a spike.

Note: Under no circumstances will movement be permitted over a switch if both the first and second ties behind the switch point are removed.

If the power-operated switch is in an interlocking, the following must also be done:

1. The locking dog or plunger must be inserted in the lock rod if possible.
2. The controlling lever of the interlocking machine, or the lever in a traffic control machine, must be placed in the position corresponding to that of the switch points. Interlocking levers must be secured by lever blocking devices which must not be removed, nor levers operated until instructions to do so are received from the signal employee in charge.
3. The power applied to power-operated switches must be cut off and in addition:

   A. At a pneumatic switch, a blow off cock or union must be opened to prevent possible accumulation of pressure through leaky valves.

   B. At an electric switch, the motor brushes must be raised and so secured that they cannot come in contact with the commutator, or the fuse must be removed from the circuit supplying power to the master controller.

4. Power-operated switches must be kept spiked or otherwise secured until the power is again turned on so that an accidental change in the position of the valves, controlling apparatus, or connections cannot cause the machine to operate the switch points.

Note: When necessary to disconnect a pipe-connected switch, derail or other unit, disconnection should be made at the crank nearest the unit.

2.1.3 Maintenance of Switches

Rev. 02/01

A. **Kept Tight.** Rev. 08/96

All nuts and bolts on rail braces, plates, front rods, head rods, point detector rods, lock rod lever stands, and machines will be kept tight. Ensure cotter pins are properly placed and that grip or lock nuts are in good condition and tight. Ensure devices and bolts do not have any excessive wear.

B. **Kept Clean.** Rev. 08/96

Controller compartments, junction boxes, tags, and all wiring will be kept clean, with adequate clearance from all moving parts. Conduit will be fitted properly and be sealed. (Caution: The use of flammable products for cleaning is prohibited).

C. **Properly Lubricated.** Rev. 09/06

All components will be properly lubed and oiled with approved lubrication.

D. **Switch Point Tension.** Rev. 09/06

Each switch point must fit properly against the stock rail. Proper point pressure against the stock rail must be provided in both the normal and reverse positions. When adjustment of switch point pressure is necessary, inspect switch layout for excessive wear or movement. Areas to inspect for lost motion would include: stock rail movement, machine movement in plates, switch stand movement, pin and connection wear, etc. Eliminate or reduce all lost motion before performing required tests.

E. **Switch Circuit Controller Inspection.** Rev. 09/06

Determine that circuit controller:

- Contacts are clean, silver plated, uniform, and that springs are in place to ensure sufficient wipe and not less than 1/8 inch when fully open.
- Rollers are not worn, cracked or have flat spots.
- Linkage and roller pins are in the proper position, securely fastened, and are not worn or cracked.
- Terminal block is securely mounted to the enclosure with mounting bolts tight and nut locking devices effective.

- Shaft, cams, and bushings do not have excessive wear and are properly lubricated.
- Ensure full bearing surface of roller is on cam.
- Where applicable, ensure centering device is effective.

F. **Procedure for Testing the Centering Device.** Rev. 09/06

Remove the controller rod at the switch lug and determine that the contacts are opened or shunted.

2.1.4 Inspection of Rods, Plates, Transit Clips, Overtees, and Track Material Rev. 01/09

A. **Inspect Insulation.** Rev. 08/96

Inspect the insulation in gauge plates, rods and insulated joints; prompt action must be taken to correct any exceptions.

B. **Sufficient Clearance.** Rev. 01/09

Maintain sufficient clearance between switch ties and rods, and also between rods and ballast. On Hollow Steel Tie Switches (HST), ensure transit clips are centered over the tie.

C. **Work with Track Forces.** Rev. 05/15

Every effort should be made to work with track maintenance forces to eliminate running rail, loose rail braces, poor track surface, drainage problems, proper rod clearances, proper overtee adjustment, frog point bolts problems (EFMHB 5.5.14 C) or other conditions which may cause switch failures.

2.2 Power Switches

2.2.1 Additional Instructions for Maintenance of Power Switches

Rev. 09/06

A. **Keep Switch Plates Clean and Lubricated.** Rev. 08/96

Keep the switch plates clean and lubricated. Inspect and ensure that switch plates are not cracked or broken.

B. **Annual Motor Brushes Inspection.** Rev. 05/15

Annually inspect motor brushes for wear, ensuring connections are tight, and proper tension is applied. If applicable, ensure that the commutator is clean.

Note: This instruction does not apply to permanent magnet motors.

C. **Monthly Inspection of "OS" Track Circuits.** Rev. 02/15

At least monthly, walk and inspect the "OS" track, and check the condition of bootlegs and bonds as prescribed in 9.1.2 Bonding Inspection and Installation on page 9-11 and 9.1.3 Insulation Inspection and Tests on page 9-13. Correct any defects.

D. **Clutch Adjustment** Rev. 01/09

At least once every three months verify that the clutch slips slightly at the completion of each stroke. Additionally, where overload relays are used, place an obstruction 1 inch or wider between the switch point and stock rail; then operate the switch against the obstruction both normal and reverse. Maintain overload (blow-down) of power operated switches (normal and reverse) at 4-6 seconds. Make adjustments if necessary.

Switches using Timers or Timing Devices. At least once every three months on switches where timer relays or timing devices are used, place an obstruction 1 inch or wider between the switch point and stock rail; place an ammeter in series with the motor control circuit; then operate the switch against the obstruction; clutch should just begin to slip at 12 to 15 amps of current; both normal and reverse. *Make adjustments if necessary.

***Note**: When switch performance data requires an adjustment of more than 15 amps of current, ensure clutch slips slightly at the completion of each stroke.

E. **Timers or Timing Devices.** Rev. 05/15

Switches utilizing adjustable timers or timing devices must run long enough to allow the switch sufficient time to throw normal and reverse. On switch applications where multiple switch machines are controlled by the same timer, measurement of throw time must be made at each switch machine. Timer should be adjusted to allow:

- sufficient time for the switch machine requiring the greatest amount of time to throw

or

- the switch farthest from the signal enclosure or controlling battery source to throw.

The following procedure may be used to properly adjust timers and timing devices:

1. Ensure clutch has been adjusted properly.
2. Measure the time required to throw the switch from normal to reverse; then add 10 seconds to this value.
3. Measure the time required to throw the switch from reverse to normal; then add 10 seconds to this value.
4. Adjust timer to the larger of the two values found in steps 2 and 3.

F. **Switch Point Tension.** Rev. 01/09

Each switch point must fit properly against the stock rail. Throw rod must be adjusted to provide proper point pressure against the stock rail in both the reverse and normal positions. A properly adjusted switch point will not have a gap between the point and the stock rail, from the throw rod to the end of the point. On Hollow Steel Tie applications, where composite rods are used, point pressure may be checked by attempting to move the closed point side operating rod pin in the transit clip. This must be done when the switch is in the normal and reverse position. If the pin moves easily in the transit clip, the overtees, may require adjustment. It is permissible for the open point pin to be loose in the transit clip.

G. **Lock Rod Notch Faces.** Rev. 01/09

While making inspections, ensure that the lock rod notch faces are square and not shaved more than 1/16 inch. Use a mirror to inspect the normal side of the lock rod in US&S switch machines.

H. **Changing or Installing Lock Rods.** Rev. 01/09

When changing or installing lock rods, ensure that the lock rod is installed properly. In US&S machines (M-22, 23), the locking dog must pass through the narrow notch of the lock rod first. Additionally ensure the lock rod bolt is tight and the shouldered adjusting nut does not have more than 1/32 inch play.

I. **Eliminate Lost Motion.** Rev. 01/09

Inspect for signs of lost motion that would affect switch adjustment. Corrections to eliminate any lost motion must be performed prior to making the throw rod, lock rod and point detector rod adjustments. Checks will include the switch machine, supporting ties, points, rods, transit clips, overtees, pins, connections, rail braces, and fasteners.

J. **Inspect Contacts, Terminal Blocks, Clips, Rollers, and Pins.** Rev. 01/09

Inspect to ensure the following conditions are met: Contacts are clean and have sufficient wipe; terminal blocks are securely mounted and properly positioned; bushings, rollers, and roller pins are not worn, cracked or have flat spots and that GRS lock rod arm clips are properly installed and secure.

K. **Verify Machine is Properly Timed.** Rev. 01/09

Test dual control switch machines without switch- and-lock movements in the hand throw position (e.g. GRS Model 5) when placed in service, disarranged, and annually thereafter. Test to ensure the proper timing in GRS machines by performing the following:

1. Place the dual control selector lever in the "HAND" position;
2. Operate the hand throw lever to throw the switch points to the opposite position. (do not use the "HAND CRANK") Make a reference mark on the inside bottom of the switch machine case relative to the position of the locking bar. (e.g. mark the position of the locking dog on the inside bottom of the machine case, etc.)
3. With the selector lever in the hand position, the locking bar and dogs being in the disengaged position, and the foot pedal on the lock stand depressed (allowing for movement of the hand throw lever), use a pry-bar (36 inches to 72 inches in length) and attempt to pry the switch points open. The switch points must be held closed by the machine.
4. Operate the hand throw lever to throw the switch points to the opposite position. (do not use the "HAND CRANK") Make a reference mark on the inside bottom of the switch machine case relative to the position of the locking bar. (e.g. mark the position of the locking dog on the inside bottom of the machine case, etc.)
5. With the selector lever in the hand position, the locking bar and dogs being in the disengaged position, and the foot pedal on the lock stand depressed (allowing for movement of the hand throw lever), use a pry-bar (36 inches to 72 inches in length) and attempt to pry the switch points open. The switch points must be held closed by the machine.

Note: If the locking bar does not return to the same reference mark for both normal and reverse while in the hand throw position or the switch points open with the pry-bar, this is an indication that the switch machine is not properly timed. If either of these situations exist, immediate corrective action must be taken.

L. **Check Drain Plugs.** Rev. 01/09

U.S.&S. "M" style switch machines must have the drain plugs removed in snow and freeze areas to prevent switches from becoming frozen due to snow and ice. Safetran SML-20 drain plugs are too large; the hole could be a potential rodent entrance. Instead of removing the plug, drill a 3/8 inch hole in the plug.

Rule 236.327 and 382 - Switch Obstruction

Rev. 01/09

Record	Interval	Retention
Form 24094 FSM	Monthly	Until Next Record is Filed - in no case less than 1 year

Distribution

Test By	Original	Copies
Mtr.	MSM	Mtr.

Purpose

This test is to ensure that the switch cannot be locked normal or reverse if the switch points are prevented from closing to within 3/8 inch.

Frequency

When placed in service and thereafter when modified, disarranged, or at least once every month. Conditions or performance data may warrant more frequent inspections and tests.

Precautions

The employee(s) making the test must have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

Description of Test

Open the switch point and insert a 3/8 inch gauge six (6) inches from the end of the reverse switch point. Close the point against the gauge and stock rail; if the switch will lock or if the indication contacts close with the specified obstruction, adjustments must be made immediately. This test must be made for both the reverse and normal positions.

M-22 and M-23 Switch Machines:

Do not exceed 150 lbs. of pressure on the hand throw lever and determine that the locking dog or slide bar will not pass through the lock rod. It may be necessary to loosen the basket rod nuts to allow the locking dog or slide bar to strike the lock rod.

Note: Mid-point switch machines used in #30 high speed turnouts will be tested as per instructions for point machines.

Switch machines that do not have switch and lock movement in hand throw (e.g. M23B and GRS Model 5) will have to be cranked by hand to perform this test.

Grandmaster 4000

Switch will complete its throw, however verify that the slip link of the cam bar separates and indication circuit is open.

Exception: Use a 1/4 inch obstruction gauge when performing this test for the following machines:

- GRS Model 4 Switch Machines
- GRS Model 5 Switch Machines (Narrow Notch Lock Rod 2 1/8 inch)

All Switches

During this test, inspect switch layout for excessive wear or movement, including but not limited to: pin and connection wear, stock rail, switch machine, or switch stand movement, etc. Eliminate or reduce all lost motion before final adjustment and testing.

Rule 236.103 and 334 - Point Detector

Rev. 01/09

Record	**Interval**	**Retention**
Form 24094 FSM	3 Months	Until Next Record is Filed - in no case less than 1 year

Distribution

Test By	**Original**	**Copies**
Mtr.	MSM	Mtr.

Definition

A circuit controller which is part of the switch operating mechanism to indicate the points are within a specified distance from the stock rail.

Purpose

This test ensures that the switch shall not assume the position corresponding to switch closure if the switch points are prevented from closing to within 1/4 inch without latch out device and 3/8 inch if equipped with a latch out device that is functioning properly. This rule requires the point detector be maintained so the contacts cannot be opened manually by applying force to the closed point when the switch is locked either normal or reverse.

Frequency

When placed in service and thereafter when modified, disarranged, or at least once every three months. Conditions or performance data may warrant more frequent inspections and tests.

Precautions

The employee(s) making the test must have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

Description of Test

All tests will be made in both the normal and reverse positions. If adjustments are required, adjust the reverse side and then the normal side.

US&S M-22, M-23 and Similar Style Switch Machines:

Procedure	**Results Expected**
Inspect and test the controller assembly to verify it is securely fastened and there are no loose or cracked connections. Ensure that the normal and reverse indication contacts' Bakelite and rollers are secured. Verify that all cotter keys are in place and roller assembly screws (See Figure 2-3 on page 2-14) are sealed. Test contact assembly for lost motion without pressure on the assembly (full normal and full reverse).	No lost motion between controller assembly components and no cracks or breaks in the controller assembly or contact Bakelite. All cotter keys in place. **Note:** If the roller assembly screws are not properly sealed, ensure screws are tight and seal screw heads with Clear Rubber Silicon - Dow Corning RTV734 (Item #350-2770) or equivalent.
Place the feeler gauge end of the standard point detector gauge between the point detector bar and point detector roller. Inspection shall be made in both the reverse and normal positions.	Adjustment should be the same width as feeler gauge. M-22 (See Figure 2-2 on page 2-14) point detector gauge, piece # N250288. M-23 (See Figure 2-1 on page 2-13 Note #1) point detector gauge, piece # N295326
Put switch points in mid-stroke.	Indication contacts should be shunted.
The large end of the standard point detector gauge should be placed between the point detector bar and the point roller, then close the switch.	Indication contacts should be shunted.
With the switch closed remove the gauge.	(Machines equipped with a latch out device) Indication contacts should remain open. Once it is verified that the indication contacts are open, take pressure off the latch out device and release.
With the switch lined and locked, attempt to pry the closed point away from the stock rail with a 36 inch to 72 inch pry bar. Test in both the normal and reverse position.	Indication contacts must remain closed, energizing the appropriate WPR.

On M-23 machines, point detector rollers should be maintained to clear (not touch) the small diameter of the point detector bar, but not by more than 1/32 inch. If necessary, adjust the screwing eyebolts in or out. Figure 2-1 on page 2-13, Note #2 for this inspection.

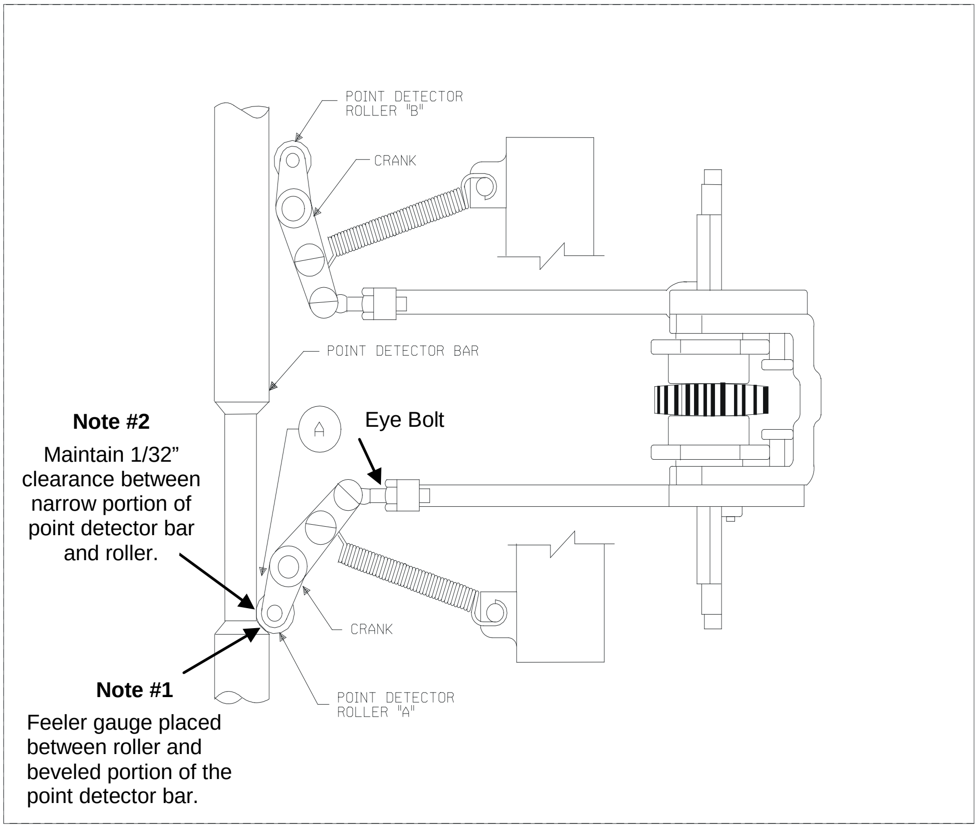

Figure 2-1
M-23 Style Detector

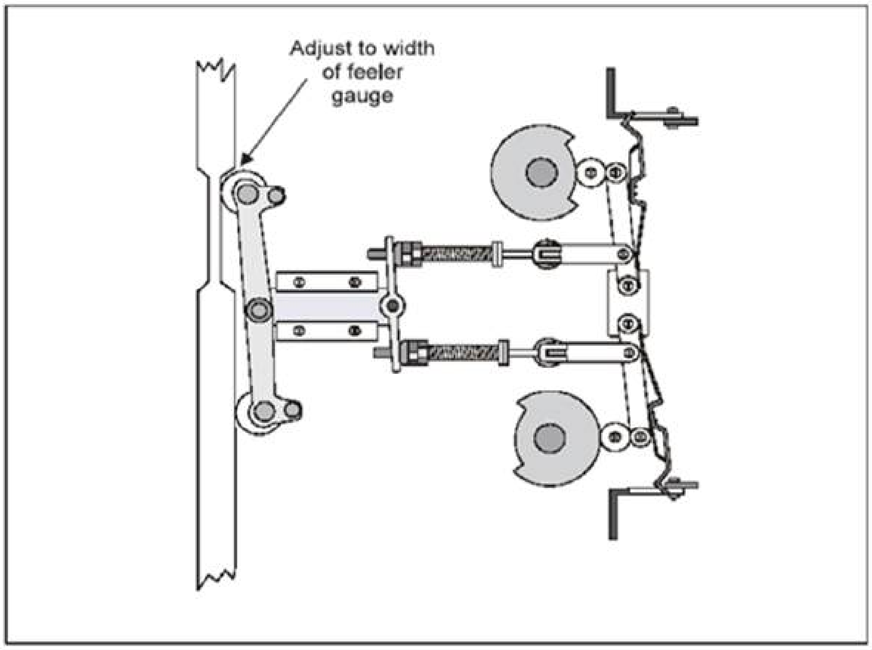

Figure 2-2
M-22 Detector

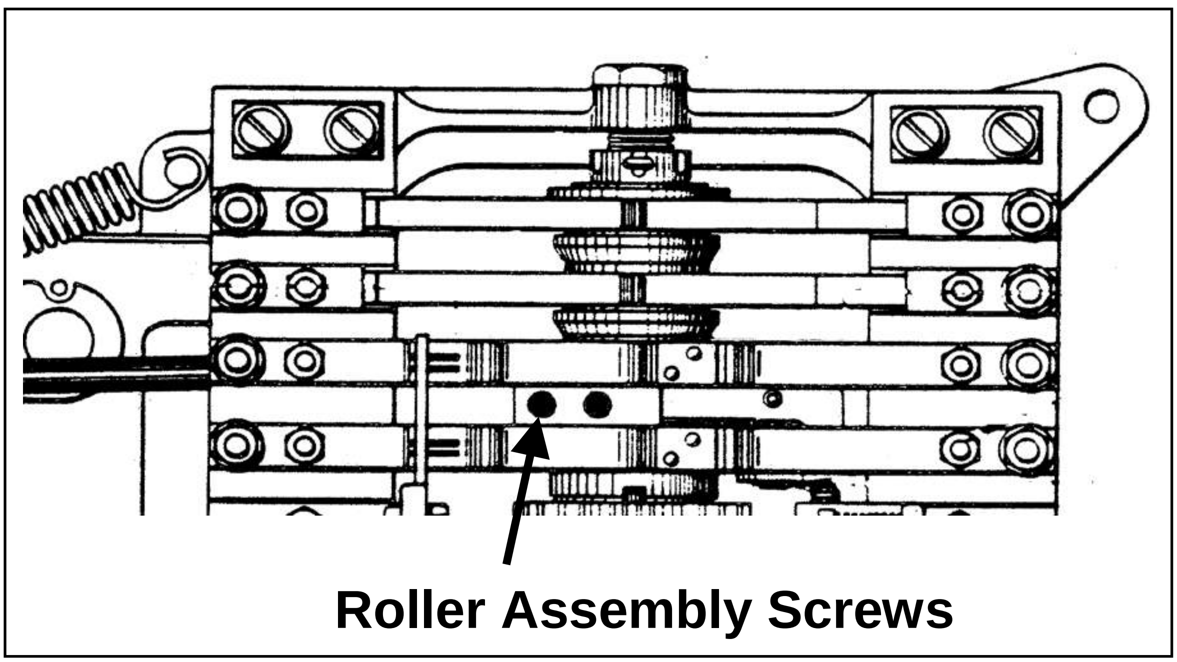

Figure 2-3
M-23 Style Detector

GRS Model 5 Switch Machine (Narrow Notch Lock Rod 2 1/8 inch)

Verify that the switch machine is equipped with a narrow notch lock rod.

Adjust the throw rod so that the points have the proper pressure against the stock rail in both the normal and reverse positions.

While performing tests, disconnect the battery to the switch machine motor circuit by opening the knife switch and/or crank contact and proceed as follows:

Reverse Point Detector

1. Hand crank the switch to the full reverse position.
2. Loosen the track-side nuts on the long (reverse) detector rod more than 1/4 inch at the detector rod lug. Refer to Figure 2-4 on page 2-16.
3. Push the long (reverse) detector rod toward the switch machine.
4. Place the 1/4 inch point detector gauge (GRS catalog number P85-1216 or equivalent) between the detector rod lug and the machine-side nuts.
5. Tighten the track-side detector rod nuts against the detector rod lug with the gauge in place.
6. Verify that the reverse point detector contacts have approximately 1/16 inch opening, if so, go to step 0, otherwise proceed as follows:
   a. If the reverse point detector contacts are open greater than 1/16 inch, loosen the machine-side nuts and tighten the track-side nuts to obtain a 1/16 inch opening; then, tighten the machine-side nuts; or,

   b. If the reverse point detector contacts are open less than 1/16 inch or closed, loosen the track-side nuts and tighten the machine-side nuts to obtain a 1/16 inch opening.
7. Slightly loosen the track side nuts, remove the gauge and tighten the track side nuts.

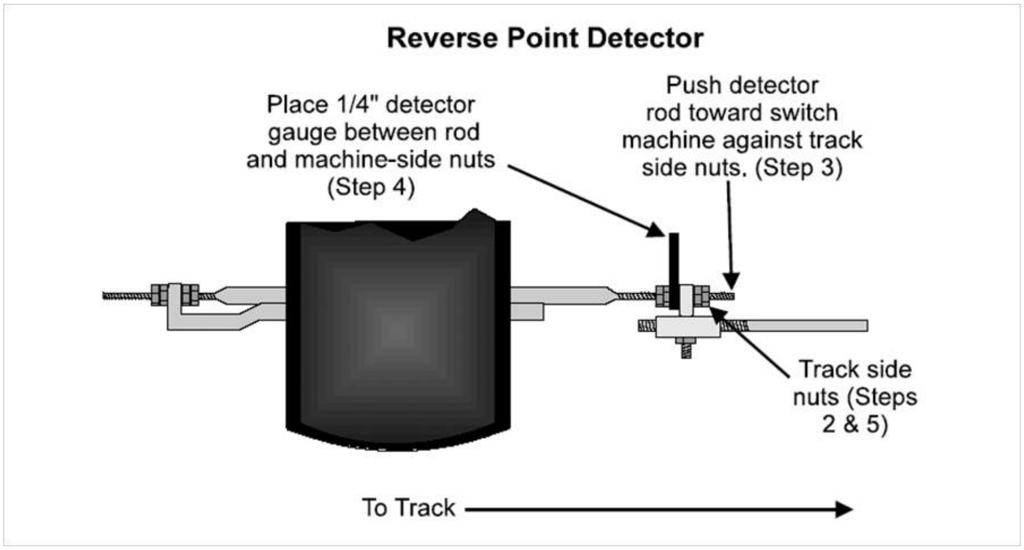

Figure 2-4 Reverse Point Detector

Normal Point Detector

1. Hand crank the switch to the full normal position.
2. Loosen the machine-side nuts for the short (normal) detector rod more than 1/4 inch at the detector rod lug; do not disturb the field-side nuts. Refer to Figure 2-5 on page 2-17.
3. Push the short (normal) detector rod toward the track.
4. Place the 1/4 inch point detector gauge between the detector rod lug and the field-side nuts.
5. Tighten the machine-side detector rod nuts against the detector rod lug with the gauge in place.
6. Verify that the normal point detector contacts have approximately 1/16 inch opening, if so, go to step 7, otherwise proceed as follows:
   a. If the normal point detector contacts are open greater than 1/16 inch, loosen the field-side nuts and tighten the machine-side nuts to obtain a 1/16 inch opening; then, tighten the field-side nuts; or,
   b. If the normal point detector contacts are open less than 1/16 inch or closed, loosen the machine-side nuts and tighten the field-side nuts to obtain a 1/16 inch opening.
7. Slightly loosen the machine-side nuts, remove the gauge and tighten the machine-side nuts.

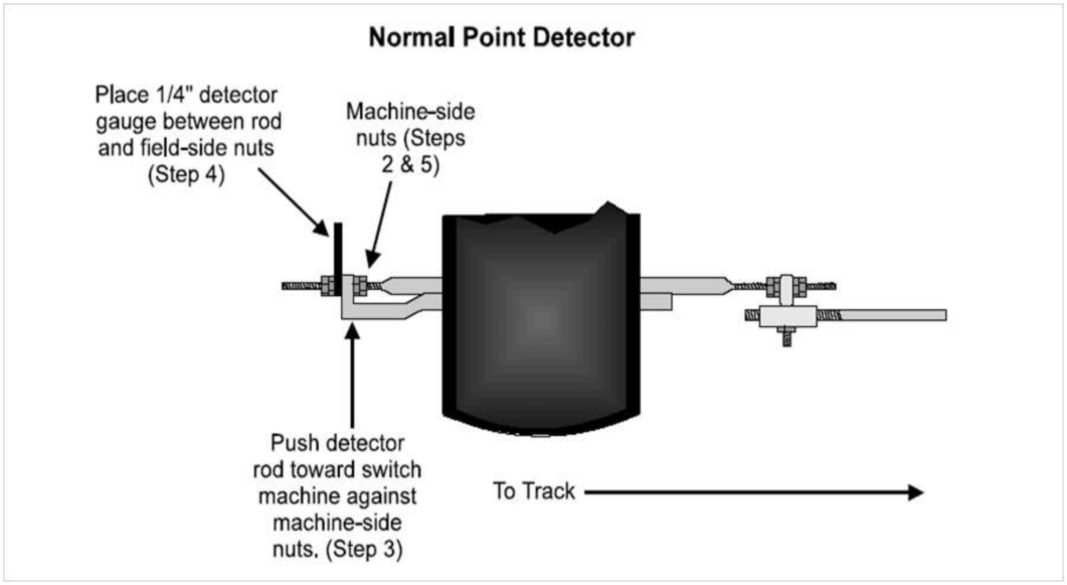

Figure 2-5
Normal Point
Detector

GRS Model 5 Switch Machine (Wide Notch Lock Rod 2 5/16 inch)

1. Determine that the machine is equipped with the wide notch lock rod.
2. Adjust the throw rod so that the points have the proper pressure against the stock rail in both the normal and reverse positions.
3. While performing tests, disconnect the battery to the switch machine motor circuit by opening the knife switch and/or crank contact.

Adjust the long (reverse) lock rod and detector rod as follows:

1. Crank open the switch point associated with the long lock rod and insert a 1/4 inch obstruction gauge between the open switch point and the stock rail six (6) inches back from the tip of the point.
2. Crank the switch machine and adjust the long lock rod to allow the switch machine to lock up with the 1/4 inch obstruction between the switch point and the stock rail.
3. With the machine locked, adjust the long lock rod so that the effective side of the notch is snug against the lock dog. Be careful when tightening the lock rod so that excessive pressure is not applied to the lock dog. To ensure that the lock rod is adjusted in the proper direction, verify that the long rod mark extends as far as possible outside the switch machine.
4. Adjust the long detector rod so that the point detector contacts are open approximately 1/16 inch. After the rod nuts are tightened ensure that the contacts are still open.

5. Crank the switch point open and remove the 1/4 inch gauge, then crank the switch point closed and ensure that the machine locks up and the indication contacts are properly made.
6. Crank the switch point open and install the 3/8 inch obstruction gauge between the open point and the stock rail six (6) inches back from the tip of the point.
7. Crank the switch point closed and ensure that the lock dog fouls the long lock rod. Open the switch point and remove the 3/8 inch gauge.
8. This completes the adjustment of the long lock rod to allow for the adjustment of the long detector rod.

Adjust the short (normal) lock rod and detector rod as follows:

1. Crank open the switch point associated with the short lock rod and insert a 1/4 inch obstruction gauge between the open switch point and the stock rail six (6) inches back from the tip of the point.
2. Crank the switch machine and adjust the short lock rod to allow the switch machine to lock up with the 1/4 inch obstruction between the switch point and the stock rail.
3. With the machine locked, adjust the short lock rod so that the effective side of the notch is snug against the lock dog. Be careful when tightening the lock rod so that excessive pressure is not applied to the lock dog. To ensure that the lock rod is adjusted in the proper direction, verify that the short rod mark extends as far as possible outside the switch machine.
4. Adjust the short detector rod so that the point detector contacts are open approximately 1/16 inch. After the rod nuts are tightened ensure that the contacts are still open.
5. Crank the switch point open and remove the 1/4 inch gauge, then crank the switch point closed and ensure that the machine locks up and the indication contacts are properly made.
6. Crank the switch point open and install the 3/8 inch obstruction gauge between the open point and the stock rail six (6) inches back from the tip of the point.
7. Crank the switch point closed and ensure that the lock dog fouls the short lock rod. Open the switch point and remove the 3/8 inch gauge.
8. This completes the adjustment of the short lock rod to allow for the adjustment of the long detector rod.

Note: With the switch lined and locked, attempt to pry the closed switch point away from the stock rail with a 36 inch to 72 inch pry bar and verify that the indication contacts remain closed. This test must be performed with the switch in both the normal and reverse positions.

GRS Grandmaster 4000 Point Detector Adjustment

Refer to Figure 2-6 on page 2-20 while performing the following:

1. Operate the machine to mid-stroke and place the 3/8 inch end of the point detector spoon gauge into the narrow portion on the track side end of the point detector rod.
2. Operate the machine to close and lock the far (typically reverse) switch point. With the lever against the spoon gauge, adjust point detector rod at the lug end until LED on the point detector switch module turns off. Continue adjusting until latch-out occurs. Tighten nuts to hold adjustment and remove the spoon gauge. Release the latch-out condition by applying a light force to the end of the latch-out dog.
3. Operate the machine to mid-stroke and position the 3/8 inch end of the point detector spoon gauge into the narrow portion on the field side end of the point detector rod.
4. Operate the machine to close and lock the near (typically normal) switch point. With the lever against the spoon gauge, adjust the free end of the point detector rod until LED on the point detector switch module turns off. Continue adjusting until latch-out occurs. Tighten nuts to hold adjustment and remove the spoon gauge. Release the latch-out condition by applying a light force to the end of the latch-out dog.
5. With the switch lined and locked, attempt to pry the closed point away from the stock rail with a 36 inch to 72 inch pry bar. Test in both the normal and reverse position. Switch point should not move away from the stock rail more than 1/8 inch and indication circuit must remain closed.

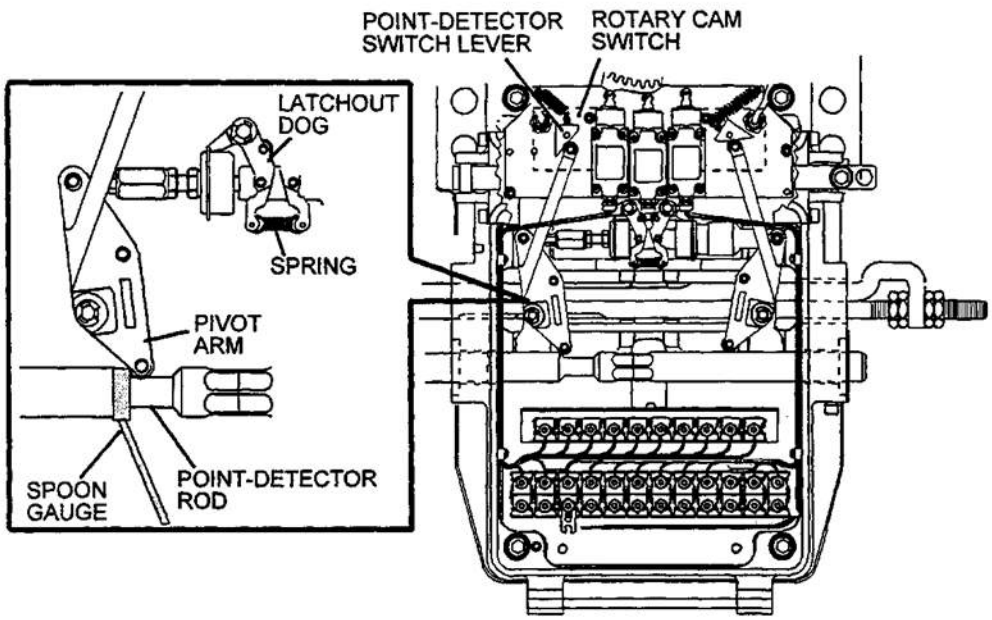

Figure 2-6

GRS Grandmaster 4000 Point Detector Test

1. Place 3/8 inch spoon gauge against the point detector bevel in both the normal and reverse positions and verify that the machine has latched-out and that the indication circuit is open.
2. If the machine does not latch-out or the indication circuit does not open, adjust the point detector rod as described earlier and test again.

2.3 Electric Locks

Rule 236.6, 236.103 and 236.382
As They Apply to T-20 & T-21 Switch Stands

Rev. 01/09

Record	Interval	Retention
Form 24094 FSM	Monthly	Until Next Record is Filed - in no case less than 1 year

Distribution

Test By	Original	Copies
Mtr.	MSM	Mtr.

Purpose - (Lock Rod)

Test to ensure that the switch cannot be locked normal if the switch points are open 1/4 inch or more. (The "Recording Mark" is placed in the Monthly Switch Obstruction Column.)

Purpose - (Switch Circuit Controller)

Test to ensure that track or control circuits are opened or shunted or both when switch point is open 1/4 inch or more. (The monthly test "Recording Mark" is placed in the "3 Months" Switch Circuit Controller Column.)

Frequency

When placed in service and thereafter when modified, disarranged, or at least once every month. Conditions or performance data may warrant more frequent inspections and tests.

Precautions

The employee(s) making the test must have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

Description of Tests

1. With the switch lined normal and the operating lever down, ensure that the space between the roller and the bevel of the point detector bar will just permit insertion of feeler gauge PC. 250289.
2. Ensure that the space between the point detector lever and the adjusting screw (cone) is approximately 1/64 inch.
3. Hold the detector rod lock nut in place while turning the detector rod inward until the latch-out feature engages and the point detector contacts are open. The latch-out feature must be engaged when the distance between the lock nut and the detector rod is 3/8 inch. Move the detector rod back to the lock nut, the point detector lever must remain latched out with the point detector contacts open. The latch-out feature may be adjusted by turning the latch screw. (See Figure 2-7 on page 2-23)
4. Depress the point detector lever until the contacts just open. Note the position of the point detector lever relative to the latch screw and make a pencil mark horizontally on the latch screw face. (This will mean that when the point detector bar is at or below the mark, the point detector contacts will be open.)
5. Open the switch point and insert a 1/4 inch gauge between the point and stock rail six (6) inches from end of point. Close the point against the gauge with enough pressure to prevent the removal of the gauge. Observe the position of the point detector lever relative to the pencil mark on the latch screw face. If the point detector lever is not at or below the mark, further adjustment of the switch or fittings must be made.
6. (Lock rod) With 1/4 inch gauge still inserted and without significantly increasing the pressure on the gauge, loosen the basket rod enough to allow the operating handle to move down to determine that the locking dog will not enter the lock rod notch. Remove the gauge and restore the basket rod tension to its original position

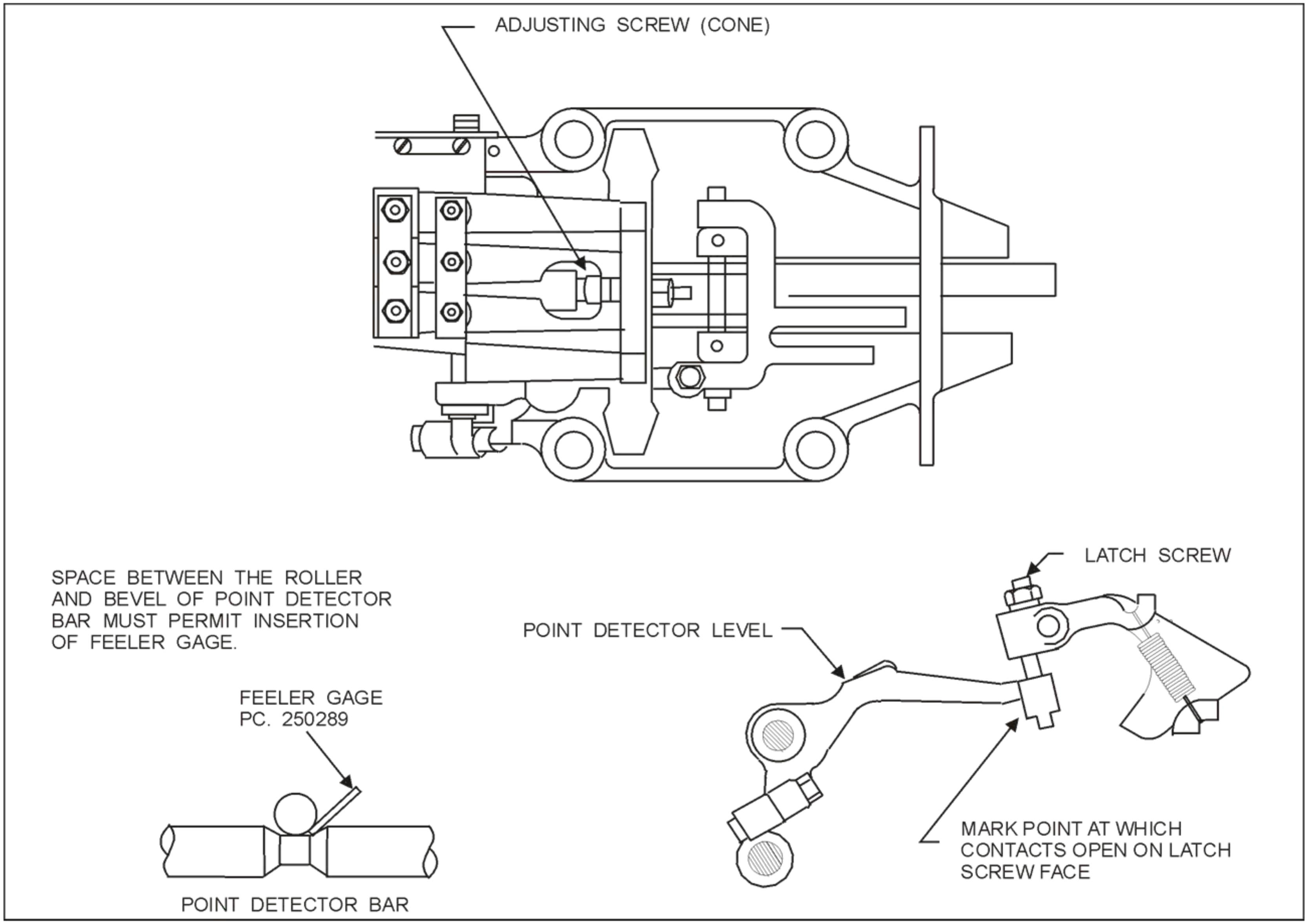
ADJUSTING SCREW (CONE)
SPACE BETWEEN THE ROLLER AND BEVEL OF POINT DETECTOR BAR MUST PERMIT INSERTION OF FEELER GAGE.
FEELER GAGE PC. 250289
POINT DETECTOR BAR
LATCH SCREW
POINT DETECTOR LEVEL
MARK POINT AT WHICH CONTACTS OPEN ON LATCH SCREW FACE

Figure 2-7

2.3.1 Additional Instructions for Maintenance of Electric Locks

Rev. 12/97

A. **Quick Release.** Rev. 12/97

On electric locks equipped with a quick release circuit: Test every 3 months by placing a zero ohm shunt at the switch points and ensure the release is not activated. This verifies the release does not extend past the switch points into the fouling. Main track release circuits must not extend beyond the range of vision, as viewed from the switch.

B. **Model 10 Wear Check.** Rev. 08/96

At least quarterly, the Model 10 switch lock should be checked for wear using the following procedure:

1. With the electric switch lock in the locked position and the padlock removed:
2. Pull up on the “Depress to Apply Padlock” pedal and attempt to remove the handle from the cradle.
3. The “Depress to Apply” pedal pawl should prevent the switch operating lever from being removed from the machine lock by a minimum of 1/8 inch while the switch operating lever is driven toward the shimmed side of its opening. (See Figure 2-8 on page 2-25)
4. If the pedal pawl restraint is less than 1/8 inch, the electric lock should be replaced. Do not change mechanical parts of Model 10, shop the entire unit.

Refer to Figure 2-8 on page 2-25.

There should be no more than 1/8 inch total clearance between the sides of the switch operating lever and the sides of the switch lock. Add shims if necessary to reduce the clearance to 1/8 inch. The old style Model 10 electric lock is not equipped with shims.

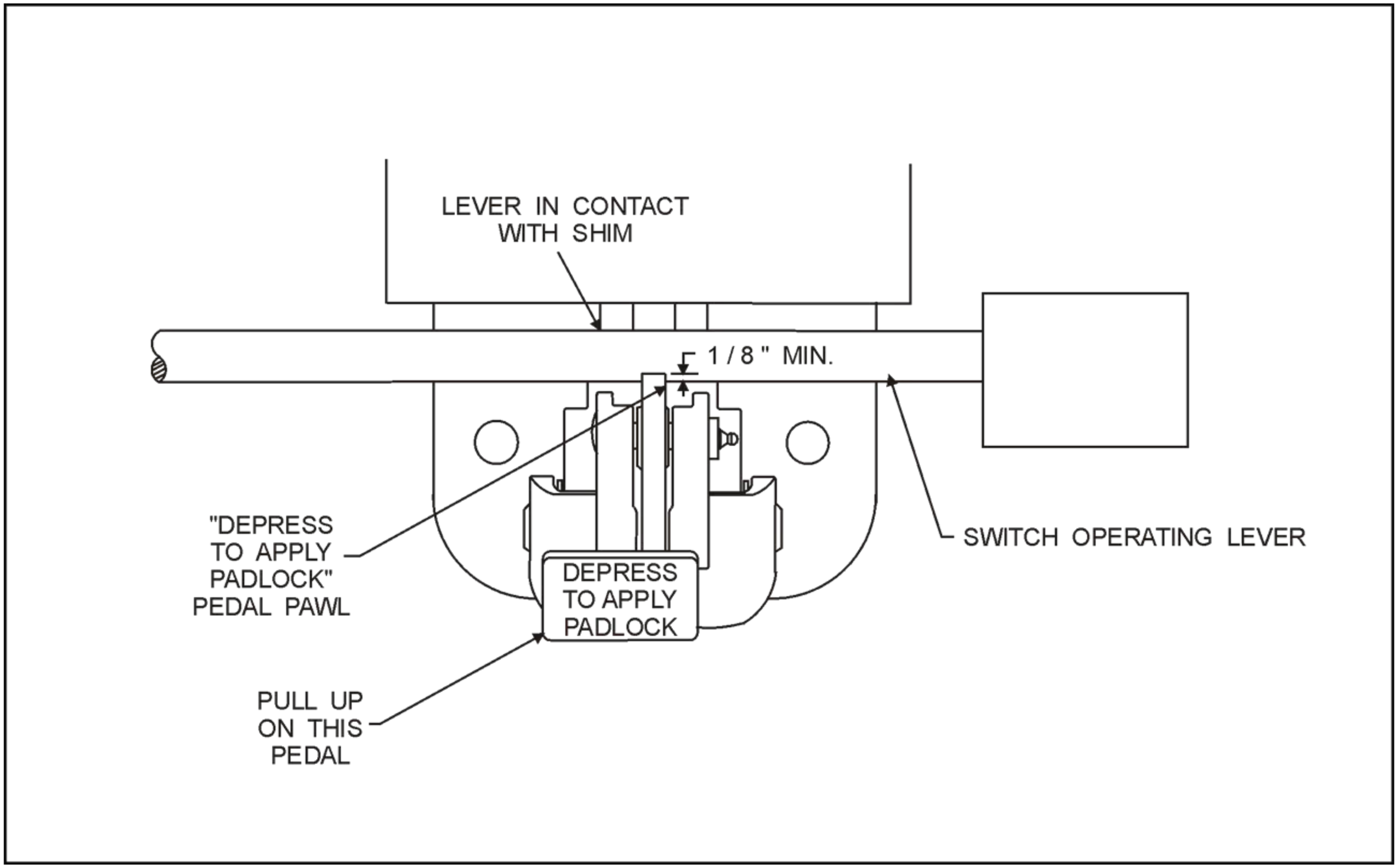
LEVER IN CONTACT
WITH SHIM
1 / 8 " MIN.
"DEPRESS
TO APPLY
PADLOCK"
PEDAL PAWL
DEPRESS
TO APPLY
PADLOCK
SWITCH OPERATING LEVER
PULL UP
ON THIS
PEDAL

Figure 2-8

2.3.2 Kept Secure

Rev. 02/01

Electric locks and time releases must be kept locked or sealed to prevent unauthorized entry. Emergency releases must be sealed.

2.3.3 Other Inspections For Electric Locks

Rev. 08/96

A. **Regularly Inspected.** Rev. 08/96

Electric locks and hand-operated switch mechanisms must be regularly inspected to ensure that all parts are intact and operating properly.

B. **Edges Square.** Rev. 08/96

Plungers and locking dogs must be full size at the locking end. Corners of plungers and locking dogs and the edges of openings in lock rods must be kept sufficiently square to prevent the switch from locking with a 1/4 inch gauge between the stock rail and the switch point. The small openings in lock rods must not exceed the width of the rectangular locking dog or plunger by more than 3/8 inch.

C. **Use of Oil.** Rev. 08/96

The use of oil on latches, segments or trunnions of electric locks is prohibited.

D. **Holes in Lock Rods.** Rev. 01/09

Holes in lock rods shall have square edges (not beveled or battered) and shall not be more than 1/8 inch larger than the round plunger.

E. **Driving Bar.** Rev. 08/96

The driving bar of the switch and lock movement shall move both normal and reverse so that the locking dog will pass through the lock rod 1/2 inch or more.

F. **SL-6, SL-7 and Model 9.** Rev. 12/97

On a switch equipped with a SL-6, SL-7 or Model 9 lock, attempt to throw the switch against the lock rod. The point should not open more than 3/16 inch. Adjust if necessary.

G. **S20 and S21.** Rev. 08/96

S20 and S21 low stands associated with electric locks will be inspected to ensure that the locking plunger is adjusted properly. Over travel of the plunger will open the contacts. The end of the plunger should extend approximately 1/4 inch beyond the edge of the lock rod.

2.4 Hand Throw Switches, Spring Switches and Derails

Rule 236.6 and 236.103 - Switch Circuit Controller

Rev. 05/15

Record	Interval	Retention
Form 24094 FSM	3 Months	Until Next Record is Filed - in no case less than 1 year

Distribution

Test By	Original	Copies
Mtr.	MSM	Mtr.

Definition

A switch circuit controller is a device for opening and closing electric circuits operated by a rod connected to a switch, derail or movable point frog.

Purpose

Test to ensure that switch circuit controllers are in condition to function properly and accommodate safe train movements over switches.

Frequency

When placed in service and thereafter when modified, disarranged, or at least once every three months. Conditions or performance data may warrant more frequent inspections and tests.

Precautions

The employee(s) making the test must have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

Description of Test

When performing tests and adjusting a SWCC that is connected to a spring switch, insert gauge between the point and stock rail, and move the switch stand handle to the locked position.

Shunt Switches

When performing the following test, **do not** connect the voltmeter to the wires or connections that lead to the switch circuit controller, or any connections associated with the junction box or switch circuit controller.

1. Connect a TS-111 voltmeter (or equivalent) to the rails of the main track, or if practical, observe the indication of the governing signal and verify that the main track circuit is energized. If the voltmeter or the signal indicates the main track circuit is energized, open the switch and insert a 1/4 inch gauge between the normally closed point and stock rail six (6) inches from end of point.
2. Move the switch point firmly against the gauge, the track circuit must be shunted. Track circuit voltage must not exceed .1 volt, except track circuits with 2 ohm or less relays must not exceed .05 volts. If the track circuit voltage exceeds these values with the shunt applied, the tester must observe that the track circuit relay, or device that functions as a track relay, is de-energized; if not de-energized, corrective action must be taken immediately. The track relay, or device that functions as a track relay, must be de-energized and remain de-energized when the switch is thrown to the full reverse position.
3. Restore the switch to its normal position (non-shunting), and verify that each individual contact will effectively shunt the main track circuit.

Electro Code track circuits.

Ensure that track circuits are de-energized by observing the indication of the governing signal or the indication of the track relay or device that functions as a track relay.

Microtrax track circuits.

Ensure that only the First Half (A) track is coding. The Second Half (B) track must be de-energized. Testing by use of signal indication or device that functions as a track relay is acceptable.

Relay based coded track circuits.

Track circuit voltage must not exceed 0.08 volts. If the track circuit voltage exceeds 0.08 volts, the tester must observe that the track relays, or devices that function as track relays, under test are de-energized; if not de-energized, corrective action must be taken immediately.

Note: If the switch is located in ATC (Automatic Train Control), or ACS (Automatic Cab Signal) territory, when the switch point is open 1/4 inch verify a restrictive condition with an AC ammeter (less than 280 mA.) Care must be taken that other overlay circuits are not being read. The restrictive condition must be effective to within 300 feet of the switch points (i.e. hot track or permissive cab over an open switch is permissible as long as there is a restrictive condition to within 300 feet of the open switch as approached by a train or engine).

Series Shunt On Conventional Track Circuits

(Open Battery, Shunt Relay)

1. Connect a TS-111 voltmeter (or equivalent) across the rails on the relay side of the insulated joints, or if practical, observe the indication of the governing signal and verify that the track circuit is energized. If the voltmeter or the signal indicates the main track circuit is energized, open the switch and insert a 1/4 inch gauge between the normally closed point and stock rail six (6) inches from end of point.
2. Move the switch point firmly against the gauge. Track circuit voltage on the relay side of the insulated joints should read 0 volts, however in all cases must not exceed .1 volt, except track circuits with 2 ohm or less relays must not exceed .05 volts. If the track circuit voltage exceeds these values with the track circuit open, the tester must observe that the track circuit relay, or device that functions as a track relay, is de-energized; if not de-energized, corrective action must be taken immediately.
3. Move the switch points open beyond the 1/4 inch position and verify that the voltage on the battery side of the insulated joints remains higher than normal, indicating an open circuit condition. The track relay, or device that functions as a track relay, must be de-energized and remain de-energized when the switch is thrown to the full reverse position.

Note: If the switch is located in ATC (Automatic Train Control), or ACS (Automatic Cab Signal) territory, when the switch point is open 1/4 inch verify a restrictive condition with an AC ammeter (less than 280 mA.) Care must be taken that other overlay circuits are not being read. The restrictive condition must be effective to within 300 feet of the switch points (i.e. hot track or permissive cab over an open switch is permissible as long as there is a restrictive condition to within 300 feet of the open switch as approached by a train or engine).

Bi-directional Series Shunt

(Open and Shunt In Both Directions) Used in bi-directional coded track circuits only.

Electro Code track circuits.

1. Connect a TS-111 voltmeter (or equivalent) across the rails of the circuit under test and ensure that the track circuit is energized. Once it is determined that the track circuit is energized, peak the meter needle at that voltage level.
2. Insert a 1/4 inch gauge between the normally closed switch point and the stock rail, six (6) inches from the end of the point; move the switch point up firmly against the gauge. The track voltage must increase to indicate that the track circuit is open.
3. Move the switch points open beyond the 1/4 inch position; note that the circuit is shunted and, that the voltage on both sides of the insulated polarity joints of the circuit under test does not exceed 0.08 volts; additionally, the circuit must remain shunted when the switch points are moved to the full reverse position. If the track circuit voltage exceeds 0.08 volts, the tester must observe that the track relays or track receivers under test are de-energized; if not de-energized, corrective action must be taken immediately.

Note: If the switch is located in ATC (Automatic Train Control), or ACS (Automatic Cab Signal) territory, when the switch point is open 1/4 inch verify a restrictive condition with an AC ammeter (less than 280 mA.) Care must be taken that other overlay circuits are not being read. The restrictive condition must be effective to within 300 feet of the switch points (i.e. hot track or permissive cab over an open switch is permissible as long as there is a restrictive condition to within 300 feet of the open switch as approached by a train or engine).

Microtrax track circuits.

Note: Microtrax track circuits are slow to respond, allow sufficient time for code changes.

1. Connect a TS-111 voltmeter (or equivalent) using VDC across the rails of the circuit under test and ensure that the track circuit is coding in both directions. Once it is determined that the track circuit is energized, peak the meter needle at that voltage level.
2. Insert a 1/4 inch gauge between the normally closed switch point and the stock rail, six (6) inches from the end of the point; move the switch point up firmly against the gauge. The track voltage on the First Half (A) track side of the insulated joints must increase to indicate that the track circuit is open.
3. Move the meter to the Second Half (B) track side of the insulated joints. No voltage should be present on the Second Half (B) track side of the insulated joints.

4. Move the switch points open beyond the 1/4 inch position; note that the First Half (A) track side is shunted and, that the voltage drops significantly. Additionally, the First Half (A) and Second Half (B) track circuits must remain shunted when the switch points are moved to the full reverse position. If the track circuit voltage does not decrease, the tester must observe that the track relays and/or track receivers under test are de-energized; if not de-energized, corrective action must be taken immediately.

Note: If the switch is located in ATC (Automatic Train Control), or ACS (Automatic Cab Signal) territory, when the switch point is open 1/4 inch verify a restrictive condition with an AC ammeter (less than 280 mA.) Care must be taken that other overlay circuits are not being read. The restrictive condition must be effective to within 300 feet of the switch points (i.e. hot track or permissive cab over an open switch is permissible as long as there is a restrictive condition to within 300 feet of the open switch as approached by a train or engine).

Relay-based Track Circuits (perform test with no signal request)

1. Connect a TS-111 voltmeter (or equivalent) across the rails of the circuit under test and ensure that the track circuit is energized and, that voltage is measured on both sides of the insulated joints ahead of the switch points.
2. Insert a 1/4 inch gauge between the normally closed switch point and the stock rail, six (6) inches from the end of the point; move the switch point up firmly against the gauge. Verify that the track voltage is coding (aspect control information is present); additionally, verify that the voltage on the opposite side of the insulated polarity joints of the circuit under test is not coding (absence of aspect control information) to indicate that the track circuit is open. If these conditions are not observed with the 1/4 inch gauge inserted, corrective action must be taken immediately.
3. Move the switch points open beyond the 1/4 inch position; note that the circuit is shunted and, that the voltage on both sides of the insulated polarity joints of the circuit under test does not exceed 0.08 volts; additionally, the circuit must remain shunted when the switch points are moved to the full reverse position. If the track circuit voltage exceeds 0.08 volts, the tester must observe that the track relays, or devices that function as track relays, under test are de-energized; if not de-energized, corrective action must be taken immediately.

Note: If the switch is located in ATC (Automatic Train Control), or ACS (Automatic Cab Signal) territory, when the switch point is open 1/4 inch verify a restrictive condition with an AC ammeter (less than 280 mA.) Care must be taken that other overlay circuits are not being read. The restrictive condition must be effective to within 300 feet of the switch points (i.e. hot track or permissive cab over an open switch is permissible as long as there is a restrictive condition to within 300 feet of the open switch as approached by a train or engine).

Repeater Circuit Switches (NWP and/or RWP)

1. Connect a TS-111 meter (or equivalent), to the relay end of the normal switch repeater circuit and determine that it is energized. If train movement over the switch is governed by signal indication, open the switch point and insert a 1/4 inch gauge between the point and stock rail, six (6) inches from the end of the point.
2. Move the switch point firmly against the gauge. The normal switch repeater circuit must be open and remain open when the switch is moved to full reverse position.
3. If the switch has a reverse switch repeater circuit, connect a TS-111 voltmeter (or equivalent), to the relay end of the reverse switch repeater circuit and determine that it is energized. If train movement over the switch is governed by signal indication, open the switch point and insert a 1/4 inch gauge between the point and stock rail, six (6) inches from the end of the point.
4. Move the switch point firmly against the gauge. The reverse switch repeater circuit must be open and remain open when the switch is moved to full normal position.

Note: The switch circuit controller must be attached to the normally closed point. If a signal indication is provided over the normally open point, a front rod is required.

Note: To ensure a valid test when a switch circuit controller is used in conjunction with an electric lock, it may be necessary to card the contacts individually in the switch circuit controller and the electric lock to verify each set of contacts are effective.

Note: If the switch is located in ATC (Automatic Train Control), or ACS (Automatic Cab Signal) territory, when the switch point is open 1/4 inch verify a restrictive condition with an AC ammeter (less than 280 mA.) Care must be taken that other overlay circuits are not being read. The restrictive condition must be effective to within 300 feet of the switch points (i.e. hot track or permissive cab over an open switch is permissible as long as there is a restrictive condition to within 300 feet of the open switch as approached by a train or engine).

Inside switch leading to the mainline with a switch circuit controller where movement over the switch is not governed by signal indication

When the normally closed point is 1/2 inch or more open, the control circuit will open or track circuit will be shunted. Track circuit voltage must not exceed .1 volt except track circuits with 2 ohm or less relays, and they must not exceed .05 volts. Control circuits must remain open or track circuits shunted when the points are moved to the full reverse position.

Switch circuit controllers operated by derails where movement over the derail is not governed by signal indication

All derails must be adjusted and tested as outlined below to determine that circuits are open or shunted and remain open or shunted anytime the derail is not in the proper derailing position.

1. **Block Derails With Switch Stand -** When the derail block is moved to 1 inch from gauge of the rail (See Figure 2-10 on page 2-36), the control circuit must be open or track circuit shunted. Track circuit voltage must not exceed .1 volt, except track circuits with 2 ohm or less relays must not exceed .05 volts. If the track circuit voltage exceeds these values, the tester must observe that the track relay or device that functions as track relay, under test is de-energized; if not de-energized, corrective action must be taken immediately. Control circuit must remain open or track circuit must remain shunted when the derail is moved to the full reverse (non-derailing) position.

2. **Double Switch Point Derail -** When the normally closed (derailing) point is 1/2 inch or more open, (See Figure 2-11 on page 2-37) the control circuit must open or track circuit shunted. Track circuit voltage must not exceed .1 volt except track circuits with 2 ohm or less relays must not exceed .05 volts. If the track circuit voltage exceeds these values, the tester must observe that the track relay or device that functions as track relay, under test is de-energized; corrective action must be taken immediately. Control circuits must remain open or track circuit must remain shunted when the points are moved to the full reverse (non-derailing) position.

3. **Single Switch Point Derail -** When the normally open (derailing) point is 3 inches or less from the stock rail, (See Figure 2-12 on page 2-38) the control circuits must open or track circuit shunted. Track circuit voltage must not exceed .1 volt, except track circuits with 2 ohm or less relays and they must not exceed .05 volts. If the track circuit voltage exceeds these values, the tester must observe that the track relay or device that functions as track relay, under test is de-energized; if not de-energized, corrective action must be taken immediately. Control circuits must remain open or track circuits must remain shunted when the point is moved to the full reverse (non-derailing) position.

Switch circuit controllers operated by derails where movement over the derail is governed by signal indication-

1. **Block Derails With Switch Stand -** With the block derail in full normal or derailing position (See Figure 2-9 on page 2-35), determine the normal repeating circuit is energized. When the block derail is moved to 1 inch from gauge of rail (See Figure 2-10 on page 2-36), the normal repeating circuit must be open and remain open when the derail is moved to the full reverse or non-derailing position. Determine the reverse repeating circuit is energized. When the block derail moves 1 inch or more from the full reverse or non-derailing position, the reverse repeating circuit must be open and remain open when the derail is moved to the full normal or derailing position.
2. **Double Switch Point Derail -** When the normally closed derailing point is 1/2 inch or more open, (See Figure 2-13 on page 2-39) the normal repeating circuit must be open and remain open when the derail points are moved to the full reverse (non-derailing) position. With the derail full reverse, verify the reverse repeating circuit is energized. When the points are moved 1/4 inch from the full reverse (non-derailing) position, the reverse repeating circuit must be open and remain open when the derail is moved to the full normal (derailing) position.
3. **Single Switch Point Derail -** When the normally open (derailing) point is 3 inches or less from the stock rail, (See Figure 2-14 on page 2-40) the normal repeating circuit must be open and remain open when the derail point is moved to the full reverse (non-derailing) position. When the points are moved 1/4 inch from the full reverse (non-derailing) position the reverse repeating circuit must be open and remain open when the derail is moved to the full normal (derailing) position.

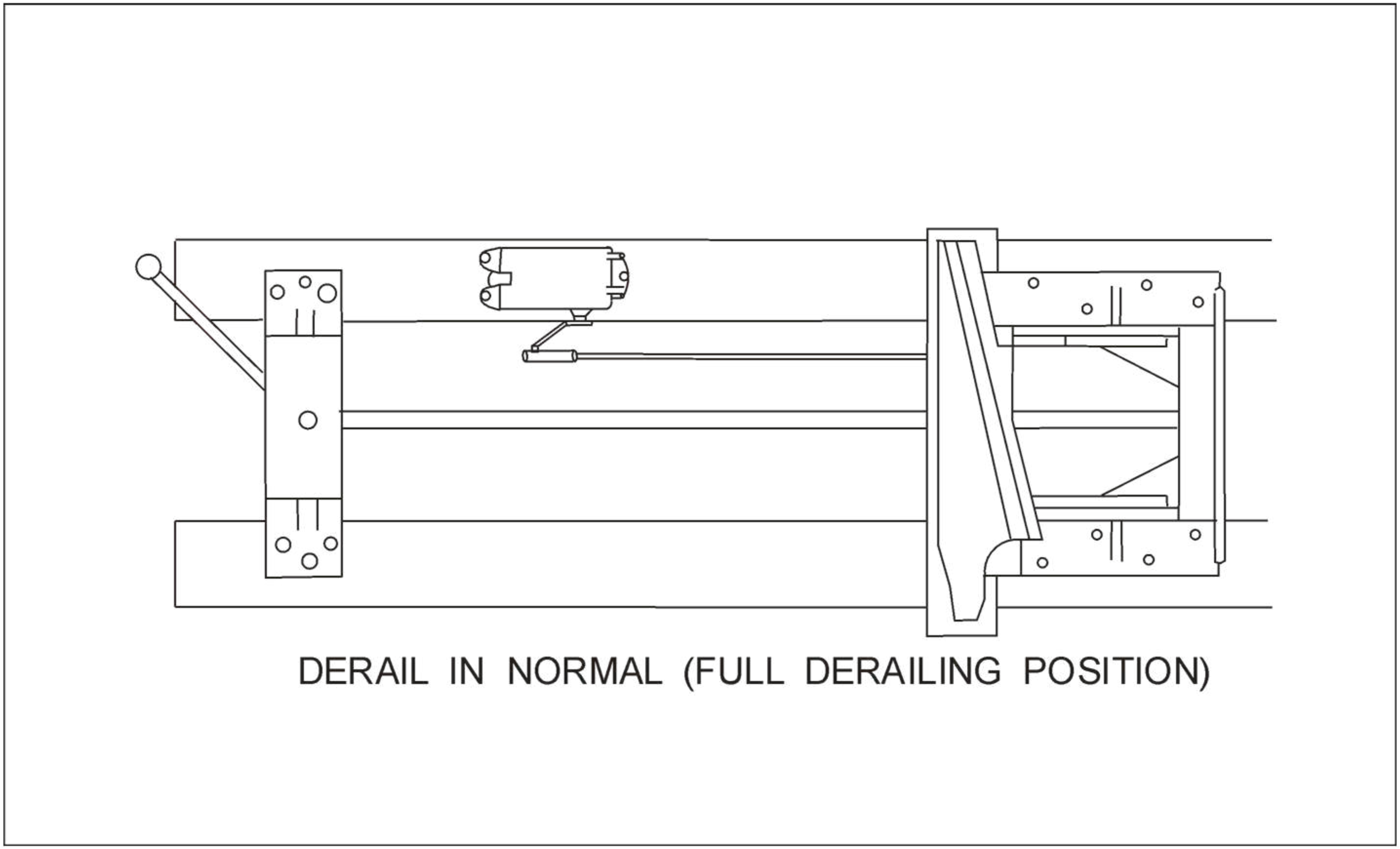

Figure 2-9

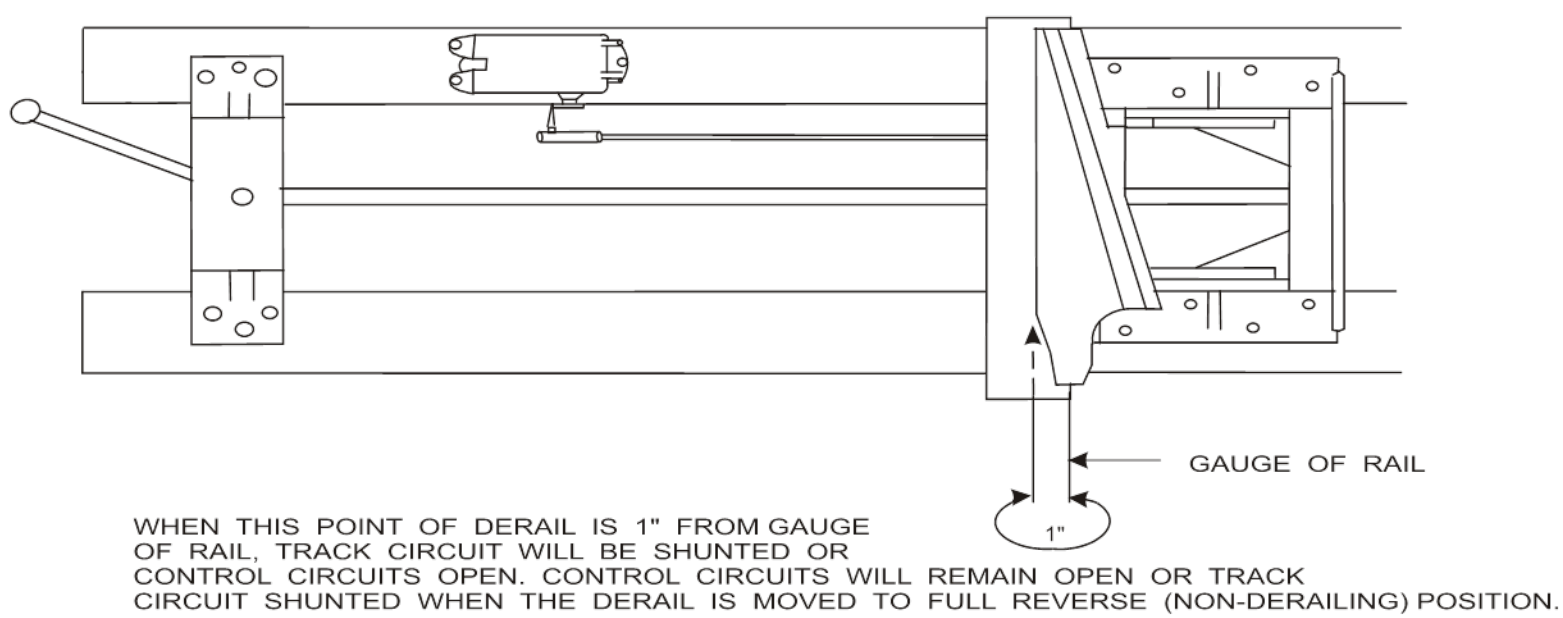
GAUGE OF RAIL
1"
WHEN THIS POINT OF DERAIL IS 1" FROM GAUGE OF RAIL, TRACK CIRCUIT WILL BE SHUNTED OR CONTROL CIRCUITS OPEN. CONTROL CIRCUITS WILL REMAIN OPEN OR TRACK CIRCUIT SHUNTED WHEN THE DERAIL IS MOVED TO FULL REVERSE (NON-DERAILING) POSITION.

Figure 2-10

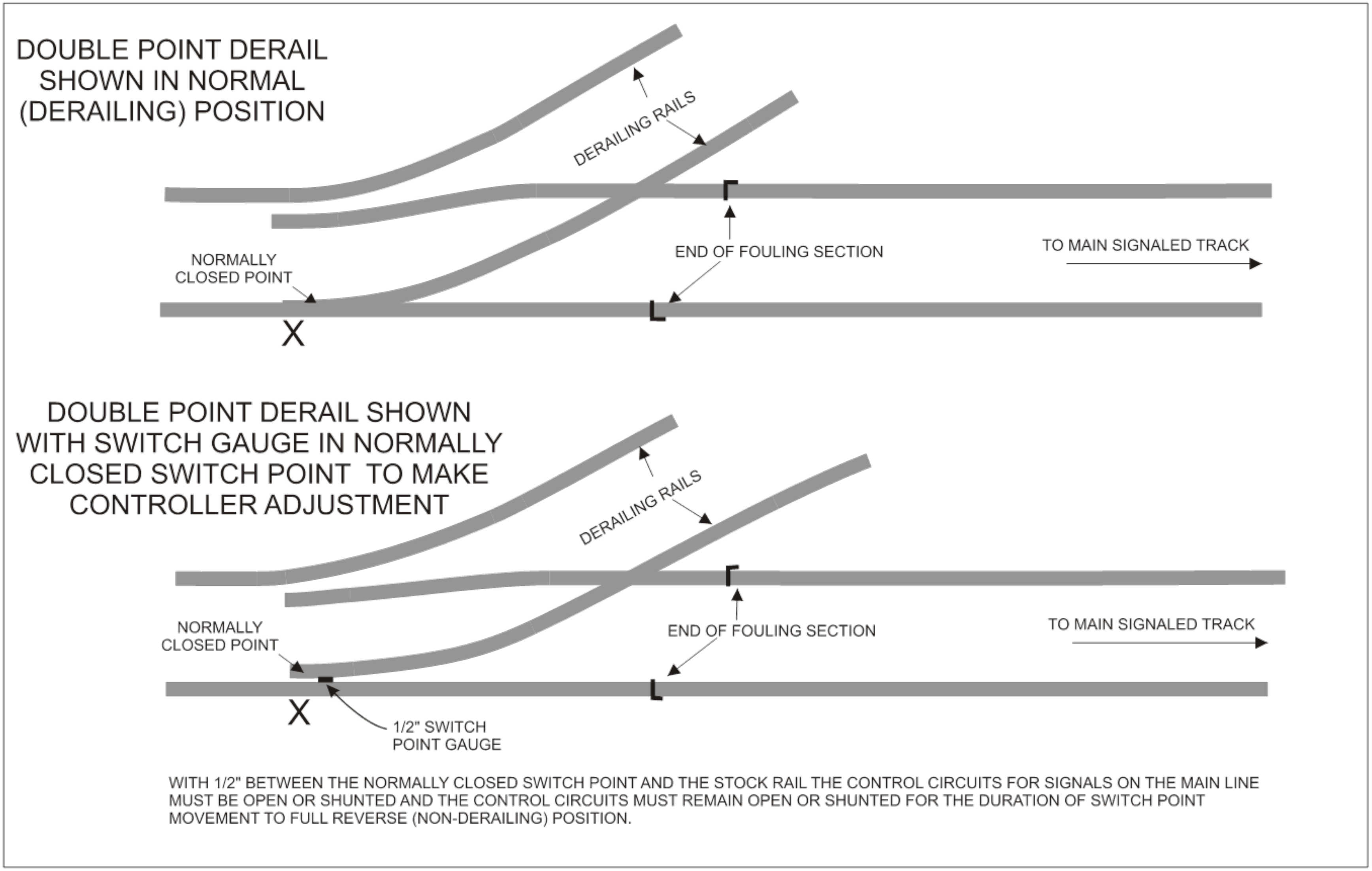

Figure 2-11
Movement Over Derail Not Governed By Signal Indication

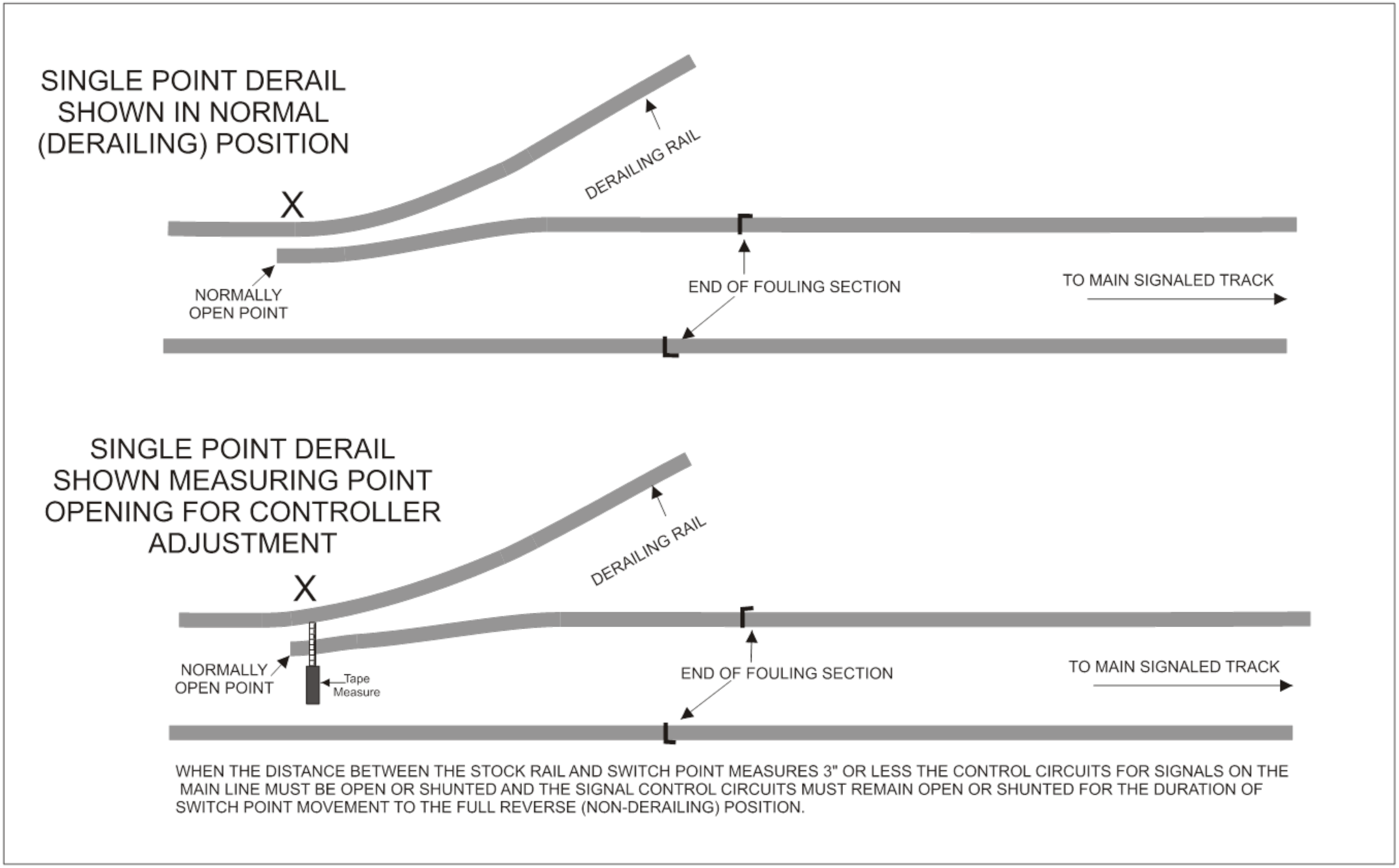

Figure 2-12
Movement Over Derail Not Governed By Signal Indication

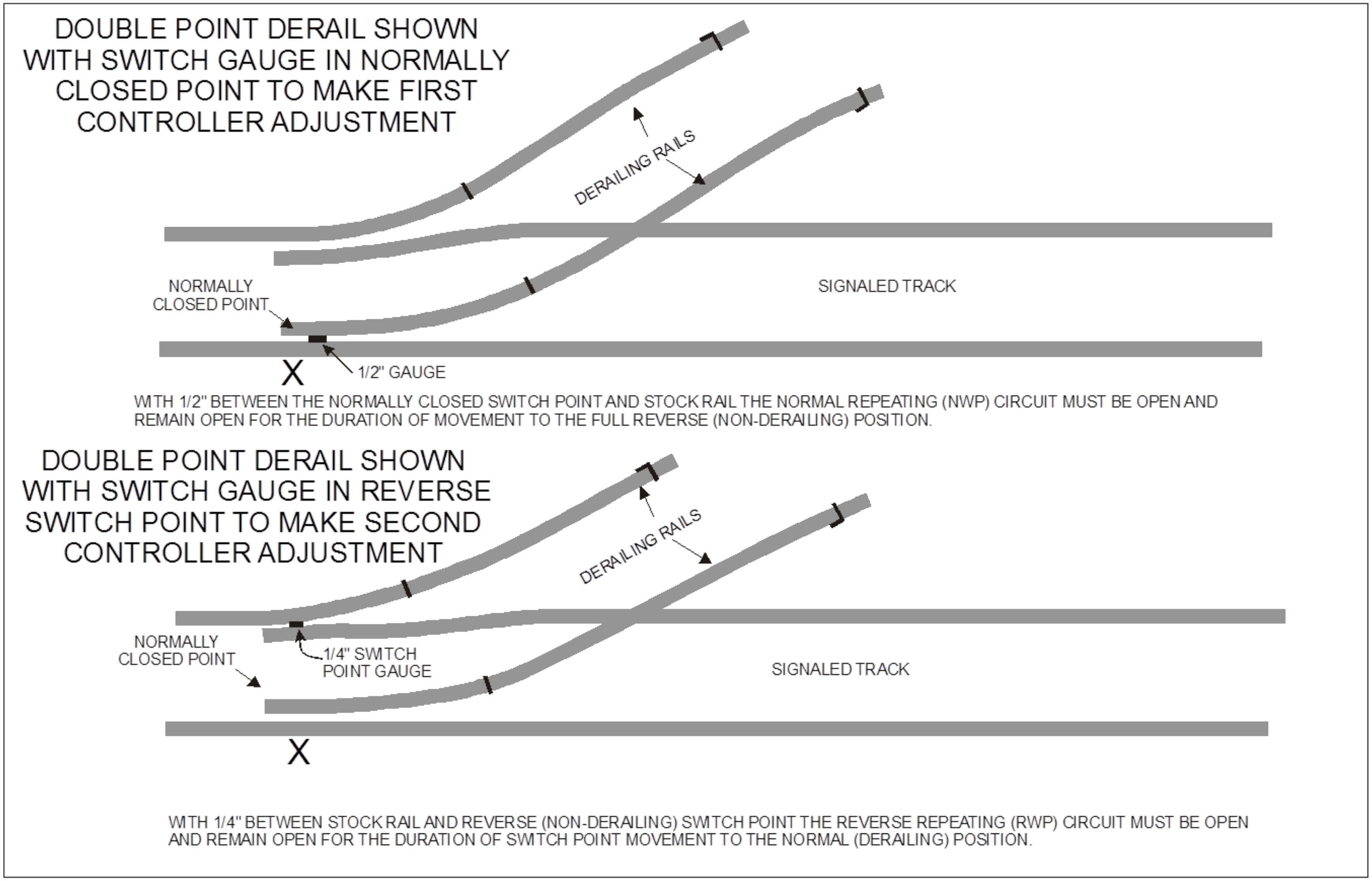

Figure 2-13
Movement Over Derail Governed By Signal Indication

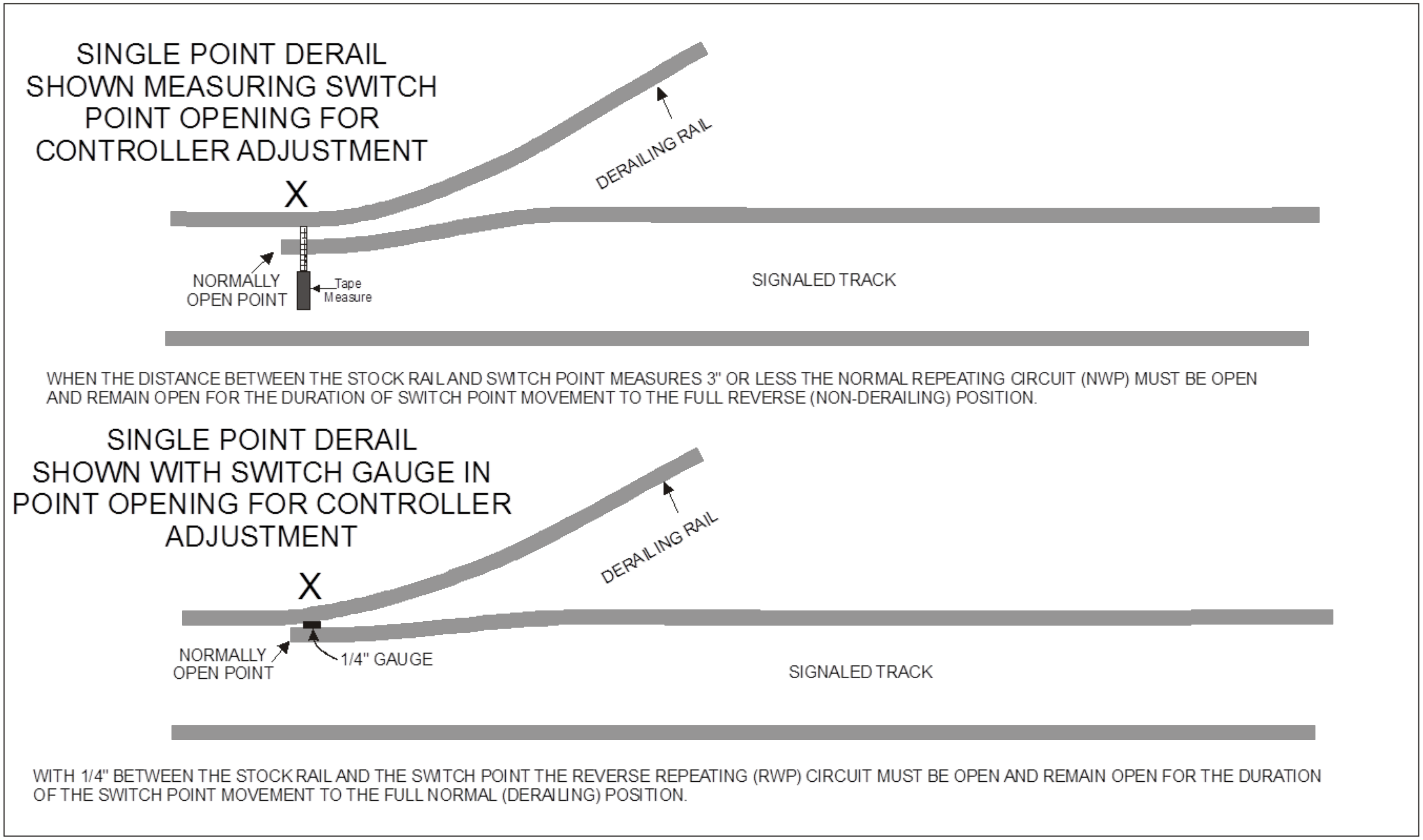

Figure 2-14
Movement Over Derail Governed By Signal Indication

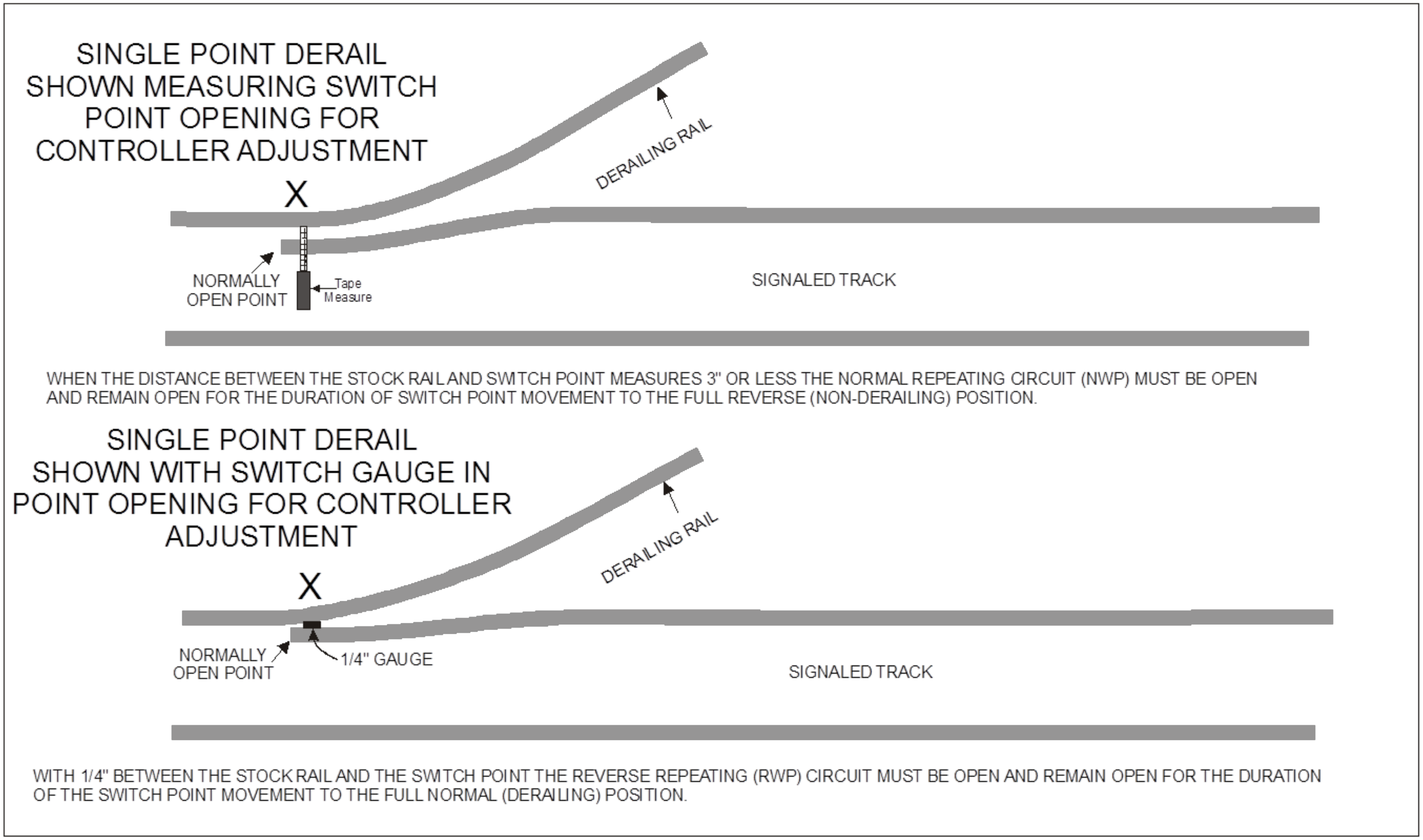

Figure 2-15
Movement Over Derail Governed By Signal Indication

2.4.1 Additional Instructions for Spring Switches Maintenance

Rev. 08/96

A. **Proper Oil Level.** Rev. 08/96

Special oil for use in spring switch cylinders is supplied and no other oil must be used. The cylinder must be kept filled to the oil level at all times and at each inspection the level must be checked. The oil level line is at the bottom of the intake plug flange and may be checked by removing the plug and screen.

B. **Clean Oil.**

Rev. 08/96

If dirt accumulates in the oil it is liable to block the valves and prevent the switch from operating properly; consequently, it is important that only clean oil be used. Before adding oil to the cylinder, check the oil strainer to ensure that it is clean, not torn and in place.

C. **Prevent Condensation.** Rev. 12/97

Care must be exercised to prevent water from getting into the cylinder; consequently, oil should not be added during snow or rain storms. The oil used in the mechanism is an all season oil and does not require thinning for winter operation. A small amount of denatured alcohol is sometimes added to absorb condensation. Do not use antifreeze.

D. **Gauge Plates.** Rev. 08/97

Gauge plates and riser plates on which the point rails slide must be kept clean of all accumulation of dirt, snow, and ice. Plates must be treated with approved lubricants as often as necessary.

E. **Piston Binding.** Rev. 08/96

The packing glands should be kept tight enough to prevent leakage of oil but not so tight as to bind on the piston rod and interfere with the free movement of the switch. The tight gland condition is often the trouble when the switch returns too slowly.

F. **Adjustment.** Rev. 12/97

Switches should be adjusted and checked at least quarterly (more often as required to prevent failures) to ensure the switch points return to their normal position between ten and twelve seconds after being trailed through.

G. **Painting.** Rev. 08/96

Paint must be applied as often as required to prevent deterioration. Paint must not be applied to the piston rods, adjusting screws or gaskets.

H. **Clean and Lubricated.** Rev. 08/96

Threads of rods, jaws and bolts, and bearings of all moveable parts must be kept clean and properly lubricated.

I. **Maintenance Responsibility.** Rev. 01/09

Unless otherwise directed by the General Director of Signal, signal forces are responsible for the maintenance, repair, and replacement of the cylinder and parts pertaining thereto.

Note: Under no circumstances should the switch cylinder be taken apart in the field. If the mechanism itself requires repair, a spare unit should be installed immediately. The Signal Manager will advise regarding the repair procedures.

2.4.2 Spring Switches Quarterly Inspection and Testing Rev. 08/96

Movement of the switch points under spring force must be tested and timed periodically in accordance with the following:

1. Place the test bracket and hydraulic jack (Hein-Warner 1.5 ton or equivalent) into position on the open point side between the second and third tie behind the point.
2. Jack the open point closed until a 4 inch opening is measured on the opposite side.
3. Release the hydraulic jack by opening the relief valve.
4. Time the reverse to normal movement of the switch points. It should take 10 - 12 seconds.
5. Repeat steps 1 through 4 with the switch points in the opposite position.
6. While the points are moving observe them to verify that:

   A. The movement is smooth throughout the stroke.

   B. There is a definite snapping action during the latter part of the stroke.

   Note: With the stroke complete, the switch point should fit firmly against the stock rail. If the closed switch point is not tight against the stock rail, adjustment should be made and tests repeated.

The spring normally exerts a force of about 1100 pounds against the piston rod. This can be checked as required with the use of a hydraulic testing device available for this purpose. If a hydraulic testing device is not readily available, the following tests should be made during regular inspection to ensure that there is adequate pressure on the piston rod.

Normal Position (mechanism on the normally closed point side)

1. Lift the handle on the switch stand relieving the pressure on the spring.

2. Place a pencil mark on the piston rod at the point where it enters the cylinder.
3. Apply pressure on the spring by placing the handle of the switch stand down in the normal position.
4. Piston rod should measure at least 1/4 inch more length under pressure in the normal position.

Reverse Position (mechanism on normal closed point side)

1. Reverse the switch manually and place the handle of the switch stand down in the reverse position.
2. Place a pencil mark on the piston rod at the point where it enters the cylinder.
3. Release pressure to the piston rod by lifting the handle on the switch stand.
4. Piston rod should measure at least 1/4 inch more length with spring pressure released in the reverse position.

Note: The mechanical switchman has a maximum stroke of 5 inches. The switch points should be installed to provide 4 3/4 inches throw at the throw rod. Measure the distance between the open point and running rail six (6) inches behind the point of switch to determine the throw. This measurement must be checked periodically after installation to ensure that 4 3/4 inches throw is maintained.

2.5 Electro-Pneumatic

Rule 236.386 - Restoring Feature

Rev. 01/09

Record	Interval	Retention
Form 24094 FSM	3 months	Until Next Record is Filed - in no case less than 1 year

Distribution

Test By	Original	Copies
Mtr.	MSM	Mtr.

Definition

An arrangement on an air switch movement by means of which air is applied to restore the switch movement to the full normal or reverse position before the driving bar creeps sufficiently to unlock the switch with control lever in the normal or reverse position.

Purpose

Test to ensure that air will be applied to restore switch movement to full position before the driving bar creeps sufficiently to unlock the switch.

Frequency

When placed in service and thereafter when modified, disarranged, or at least once every three months. Conditions or performance data may warrant more frequent inspections and tests.

Precautions

The employee(s) making the test must have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

Description of Tests

The purpose of this test is to check circuits in an air operated machine that restores the switch points if the locking plunger is displaced.

Test:

With the switch normal, displace the locking plunger and observe that the machine drives the plunger back. Repeat the test for the reverse position.

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Rule 236.383 - Valve Locks and Magnets

Rev. 01/09

Record	Interval	Retention
Form 24094 FSM	Valve Locks (3 months) Valves and Magnets (1 Year)	Until Next Record is Filed - in no case less than 1 year

Distribution

Test By	Original	Copies
Mtr.	MSM	Mtr.

Definition

A valve electrically operated which, when operated, will permit or prevent the passage of air.

Purpose

Test to ensure that valves, valve locks and valve magnets are functioning as intended.

Frequency

Test must be performed on valve locks when placed in service and thereafter when modified, disarranged, or at least once every three months. Tests must be performed on valves and valve magnets when placed in service and thereafter when modified, disarranged, or at least once every year. Conditions or performance data may warrant more frequent inspections and tests.

Precautions

The employee(s) making the test must have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

Procedure

1. On electro-pneumatic switches, with the switch in the normal position, disconnect the control wires from the lock magnet; then energize the reverse magnet. Air pressure should not be applied to the cylinder and the switch should not move.

2. Operate the switch to the reverse position and with the control wires to the lock magnet disconnected, energize the normal magnet. Air pressure should not be applied to the cylinder and the switch should not move.

2.5.1 Pneumatic Switch Spring Combination Rev. 08/96

The spring combination on electro-pneumatic and similar machines and the adjustment of the contact springs and the bands with relation to indication and electric locking must be carefully maintained as follows:

A. **Contact Springs and Bands.** Rev. 08/96

Contact springs and bands must be cleaned periodically. Approved commercial cleaning cloths or chamois, moistened with oil, must be used as necessary to clean the contacts. Oil must be used sparingly on the roller shaft bearings and must never be used on the bevel gears.

B. **Roller Surfaces.** Rev. 08/96

Roller surfaces which inadvertently become covered with oil film must be cleaned by wiping with a clean, lint free cloth with a small amount of electrical contact cleaning fluid applied. The surfaces must be rubbed carefully with a clean, dry, lint free cloth to remove all traces of cleaner and any remaining residue.

C. **Replace, Change or Adjust.** Rev. 08/96

Bands, contacts, rollers, electric lever locks, etc., on interlocking machines must not be replaced, changed or adjusted, except in an emergency or under the direction of the Manager of Signal Maintenance. When changes are made under emergency circumstances, the Manager of Signal Maintenance must be advised of such changes.

2.5.2 Pneumatic Switch Air Distribution Rev. 08/96

A. **Leakage.** Rev. 08/96

Air distribution systems shall be so maintained that leakage in any section of the plant will not exceed one pound in one minute from normal pressure with all apparatus connected and at rest.

B. **Air Strainers.** Rev. 08/96

Air strainers used between air distribution system and air apparatus shall be cleaned frequently enough to avoid air pressure reduction.

C. **Drained Frequently.** Rev. 08/96

Condensers, tanks, reservoirs and air distribution lines must be drained frequently enough to avoid overflow of condensation into branch lines and apparatus.

D. **Pressure Alarms.** Rev. 08/96

At electro-pneumatic interlocking with compressors where low air pressure alarms are provided, the alarm shall be set five pounds below the cutting-in-pressure.

E. **Removal.** Rev. 08/96

When necessary to repair switch cylinders or valves, they shall be removed from service.

2.6 Additional Switch Types

2.6.1 RCL Type Switch Including LP-3000 and TS-4500 Rev. 05/15

A. Test according to instructions 10.3.5 RCL Type Switch Including LP-3000 and TS-4500 . on page 10-5.

B. Associated RCL Zones must be tested according to instructions 10.8.4 RCL Zone. on page 10-17.

Chapter 3 Emergency Procedures

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3.1 Emergency Procedures

3.1.1 In Case of Any Train Accident, Including Those with Work Equipment or Roadway Equipment

Rev. 02/15

In case of any train accident, including those with work equipment or roadway equipment in which the normal operation of the signal system, or a portion thereof (e.g. interlockings, wayside signals, etc.) may be in question, immediate action must be taken as follows:

A. **Notification.** Rev. 01/14

The AVP of Engineering – Signal, Director of Signal Maintenance, and Manager of Signal Maintenance must be notified of the occurrence in the fastest possible manner.

B. **Immediate Action.** Rev. 05/15

The following action must be taken:

1. Ensure that protection is provided for the public and train movements in all directions. Do not shunt track circuits to provide protection.
2. Do not disturb or touch any other pieces of equipment until the AVP of Engineering - Signal, Director of Signal Maintenance or their representative arrives.
3. Immediately secure all affected signal locations by sealing instrument cases and enclosures, including approach signal locations governing movement into that portion of track or tracks, which is or may be occupied or fouled by derailed or damaged equipment. Use only approved seals.
4. Observe and record all signal aspects including the approach signals governing movement into that portion of track or tracks, which are or may be occupied.
5. The Manager of Signal Maintenance, on arrival, will ensure all signal appurtenances are sealed or locked and will not perform any tests or inspections of signal facilities until the AVP Engineering - Signal or his representative arrives.
6. The AVP Engineering - Signal may authorize the Manager of Signal Maintenance to proceed with testing and restoring the signals to service.
7. Written record must be kept at all times when any of the above items are performed.

3.1.2 Grade Crossing and Other Third-Party Incidents. Rev. 01/14

A. **Incidents.** Rev. 05/15

In case of incidents involving grade crossing warning system, immediate action must be taken as follows:

1. Ensure that protection is provided for the public and train movements in all directions.
2. Dispatcher, SOC, and Manager of Signal Maintenance must be notified of the occurrence in the fastest possible manner.
3. Inspect the crossing governed per instruction 8.1.14 found on page 8-37.
4. Field Claims representatives and/or National Claim Center will contact MSM with Signal Data requests.
5. At locations of catastrophic incidents, the Field Claims representatives will determine if tagging of evidence is necessary and contact the MSM. MSM shall inform Claims representatives if remote locations and equipment are part of the design.
6. If signal case or enclosure is damaged as a result of the incident, the signal case or enclosure must be treated as containing ACM or other hazardous materials. Be governed per instructions 3.1.8 on page 3-5 and 7.1.12 on page 7-6.
7. Written record must be kept at all times when any of the above items are performed.

B. **Alleged Failure to Provide Minimum Required Warning.** Rev. 05/15

In the event the incident involves a train and is accompanied by a report of the crossing device allegedly failing to provide minimum required warning, the AVP Engineering - Signal, Director of Signal Maintenance, and Manager of Signal Maintenance must be notified of the occurrence in the fastest possible manner. The following actions must be taken:

1. Ensure that protection is provided for the public and train movements in all directions. Do not shunt the track.
2. Do not disturb or touch any other pieces of equipment until the AVP Engineering - Signal, Director of Signal Maintenance or their representative arrives.
3. Apply approved seals as directed. Secure all affected crossing and signal locations by sealing instrument cases and enclosures, gate mechanisms, including shunt box locations. Use only approved seals.

4. Inspect and test the location per 8.1.14 on page 8-37 after receiving authorization from the AVP Engineering - Signal, Director of Signal Maintenance or their representative.
5. Field Claims representatives and/or National Claim Center will contact MSM with Signal Data requests.
6. At locations of catastrophic incidents, the Field Claims representatives will determine if tagging of evidence is necessary and contact the MSM. MSM shall inform Claims representatives if remote locations and equipment are part of the design.
7. If signal case or enclosure is damaged as a result of the incident, the signal case or enclosure must be treated as containing ACM or other hazardous materials. Be governed per instructions 3.1.8 on page 3-5 and 7.1.12 on page 7-6.
8. Written record must be kept at all times when any of the above items are performed.

3.1.3 In Case of Derailment, Secure Signals

Rev. 09/06

In case of a derailment, immediately secure all affected signals to their most restrictive aspect including the signals governing movement into that portion of track or tracks, which is or may be occupied or fouled by the derailed or damaged equipment.

1. Home signals must be arranged to indicate their most restrictive indication by disconnecting local controls.

2. Approach signals must be arranged so they cannot display an indication more favorable than approach.

3. Other than the above, do not disturb apparatus which may have been involved, except under the direction of the Manager of Signal Maintenance.

3.1.4 Reported False Proceed (Unusual Signal Occurrence - USO)

Rev. 01/14

1. Manager of Signal Maintenance or designated Employee in Charge must obtain all available information from Signal Operations to help determine:

- What signals and switches are involved,
- If signals are functioning as intended,
- What steps must be taken to duplicate the scenario,
- What tests to perform,
- Where the testing will occur,

- What must be done to accomplish the testing.

2. If the preliminary test performed by a qualified employee indicates the signals are operating as intended, signals may be kept in service, provided a qualified employee observes the signal continuously until the Director of Signal Maintenance, or his representative arrives. The employee in charge of the investigation will restore signals to regular service after all tests have been completed and any defects corrected.
3. If a signal is found to have given a false proceed indication, or if switches or others apparatus have not functioned properly through failure of mechanism or controlling devices, defective mechanism or device must be replaced under the direction of the Manager of Signal Maintenance. The device or mechanism will be held without change or repairs until inspected by the AVP of Engineering - Signal or their representative, unless otherwise directed. If the trouble is due to defective wiring or wires, they must be disconnected from the terminals, but may not be removed. After new wires are installed, evidence of the failure must be preserved until the AVP of Engineering - Signal or their representative has had the opportunity to make an inspection or test.

3.1.5 Written Report

Rev. 01/14

Written report must be made to the AVP Engineering - Signal if action is taken under sections 3.1.1 In Case of Any Train Accident, Including Those with Work Equipment or Roadway Equipment on page 3-1 or 3.1.3 In Case of Derailment, Secure Signals on page 3-3.

3.1.6 Possible Damage to Cables, Megger

Rev. 09/06

When there is a possibility that damage to underground signal cables might have occurred as a result of a wreck or derailment, regardless of the circumstances involved in the incident, cables must be meggered (See Rule 234.267 and 236.108
Insulation Resistance Tests, Wires in Trunking and Cables, ground test performed (Rule 234.249 - Ground Test, or Rule 236.2 and 107 – Quarterly Ground Test) and operations of the signals checked before restoring signals to their normal operation.

3.1.7 Emergency Procedures during Power Operated Switch Restoration After Derailment

Rev. 05/15

Precaution

The employee(s) making the test must have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

When a switch machine will have to be replaced and it is known that a window will not be available for the installation and testing of the switch machine after the track is restored for movements of trains, follow this procedure:

1. Disconnect all damaged cables in the enclosure so that circuits cannot be grounded or crossed. Ensure that all remaining cables are free of grounds.
2. If the "OS" track circuits are down and cannot be readily restored, coordinate the direction that trains will be fleeted with the train dispatcher or control operator; then, set the direction stick relays at the intermediate and approach signals so that trains will not have to flag signals unnecessarily.
3. When the track has been restored and okayed for the movement of trains by the track person in charge, ensure that all switch points are lined in their normal position, securely clamped, spiked and locked with a signal lock.
4. If a crossover is affected, both ends of the crossover must be lined, clamped, spiked and locked in the normal position. If a switch machine is still in place, depending upon circuitry, lock machine in hand operation or remove motor control battery from the affected switches.
5. Ensure that a track bulletin is issued to the effect that all applicable switches are out of service and that speed over these switches on all tracks in both directions will be restricted to the speed authorized by track person in charge, but in no case exceeding restricted speed.
6. When the "OS" track circuits are restored to normal operation to detect train movements and all the above conditions are complete, the signal person in charge may adjust the appropriate switch NWP relay to the normal position to allow the signals to be controlled by the train dispatcher or control operator.

Note: Switches must be inspected between every train movement by the signal and track person in charge, and both must remain at the location until all affected switches are properly restored and tested.

3.1.8 Damage to Signal Enclosures

Rev. 05/15

When damage to signal case or enclosure has occurred as a result of a wreck, derailment or other incident; the signal case or enclosure must be treated as containing ACM or other hazardous materials. Contact the RMCC (Response Management Communications Center) and be governed per instruction 7.1.12 Processing Signal Enclosures and Cases on page 7-6.

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Chapter 4 Locking and Interlocking Plants

4.1 General Locking Instructions

4.1.1 Precaution

Rev. 08/96

A. **Know Your Specific Signal System.** Rev. 08/96

Before testing begins, study the signal prints for the circuits you are preparing to test. A complete understanding of the locking functions and all of the associated circuits is essential.

B. **Obtain Proper Authority and Information.** Rev. 08/96

Ensure that no trains will be endangered while tests are being made, it is essential that employee(s) performing these tests have proper authority and information relative to train movements.

C. **Permits Do Not Provide Protection.** Rev. 08/96

Engineers are governed by the indication of wayside signals regardless of any Track and Time issued. Therefore, if the location under test is located at the outer limits of Track and Time, action must be taken to ensure that no train or engine will accept a signal that the dispatcher did not authorize for train movement.

D. **Proceed Signal Not Mistakenly Displayed.** Rev. 08/96

Before testing, proper steps must be taken to ensure that a proceed signal is not mistakenly displayed to any train or engine. This would include any upgrade to an approach signal to the CP under test.

E. **Intermediate Tumble Down.** Rev. 08/96

Some of the tests you will perform in this section may cause the adjacent CP and all of the intermediate signals between the CP under test and the adjacent CP to display red aspects. Precautionary steps must be taken to ensure that a proceed signal will not inadvertently display a red aspect to a train moving toward the location under test.

F. **Manipulating Field Request Relays.** Rev. 08/96

While performing locking tests it will be necessary to request and obtain proceed signals by manipulating field relays. When utilizing a control panel that is interfaced with request or function relays, verify that the control panel directly controls the request relays. If the control panel has internal checks that are effective, tests must be performed by manipulating the request relays.

G. **Organize Tests.** Rev. 08/96

Routes and equipment should be organized in a logical sequence. The use of route charts, locking charts or test check off sheets should be used to ensure proper and thorough testing of all routes, circuits and equipment.

4.1.2 Protection During Changes

Rev. 08/96

A. **Circuit Changes.** Rev. 08/96

When circuit changes are made that may interfere with the normal operation of signal and interlocking systems, the approach signals must be arranged so that they will not display an indication more favorable than approach, and the switches spiked for all train movements, until the changes are completed and checked, unless otherwise authorized by the supervisory employee in charge.

B. **Removal or Change.** Rev. 12/97

Mechanical locking must not be removed or made ineffective, nor locking caps removed, unless properly authorized. When necessary to remove or change mechanical locking, and until locking has been restored and known to be correct, unless otherwise authorized by Manager of Signal Maintenance the following must be completed:

1. Switches must be spiked or secured with a locking point clamp
2. Routes patrolled before any train or engine movement is permitted over them
3. Approach signals so arranged that an indication more favorable than approach cannot be displayed
4. All trains stopped at the home signal

If a defect develops requiring the removal of or change in mechanical locking, the Manager of Signal Maintenance must be notified at once.

C. **Inoperative or Disconnected.** Rev. 08/96

If units become inoperative or are disconnected, controlling lever or levers must be secured by an approved blocking device.

4.1.3 Locking Dogs and Trunnions

Rev. 08/96

Unless otherwise secured, the top of trunnions for swing dogs in mechanical locking of interlocking machine must be slightly center punched to prevent the dogs from springing off the trunnions.

4.1.4 Replacement of Mechanical Locking Parts

Rev. 08/96

Machine parts, connections, and devices affecting the operation of mechanical locking must be renewed as frequently as necessary to ensure reliable operation.

4.1.5 Emergency Locking Release Procedures Rev. 08/96

Electric locking of interlocking machines and locking relays on relay interlocking, including C.T.C. systems, must not be released by hand except in cases of emergency or when necessary on account of repairs. Such action must not be taken until it is known that no hazard is being introduced to rail traffic. Whenever electric locking or locking relay is released by hand, report must be made to the Manager of Signal Maintenance. When electric locking or the locking relay has been released by hand, the following precautions must be taken:

A. **Signal Indications Locks and Relays** Rev. 08/96

If a signal lever cannot be restored to its normal position on account of the signal indication lock or relay holding, the lock or relay must not be released until the Signal Maintainer knows that all signals directly controlled by the lever are in the "Stop" position, and all signals governing the approach to these signals are in their normal or a more restrictive position.

Note: Examination must be made as soon as possible to determine whether the lock or relay failed to release because a signal was positioned more favorable than its normal position, or because of a defect in the indication circuit.

B. **Switch Indication Locks or Relays** Rev. 08/96

Necessary precautions must be taken to protect rail traffic before switch indication locks or relays are released by hand.

C. **Electric Lever Locks (Detector Locks or Switch Locking Relays)** Rev. 08/96

Electric switch lever locks (Detector locks or switch locking relays on relay Interlockings, including C.T.C.) must not be released by hand until it is ascertained that there is no train, engine or other rail traffic on or approaching the switches affected. After release is made under such circumstances, necessary precautions must be taken to protect traffic.

D. **Traffic Lever Locks or Traffic Relays** Rev. 08/96

Traffic lever locks or traffic relays must not be released by hand except when specifically authorized by the Manager of Signal Maintenance and then only after necessary precautions have been taken to safeguard rail traffic in the territory affected.

4.1.6 Mechanical Stick Push Button Controller Rev. 08/96

Where a lever is equipped with a mechanical stick push-button circuit controller, this controller must be so adjusted as not to move toward the normal position enough to open the reverse contact until the lever has passed the indicating point going normal.

4.1.7 Locked or Sealed

Rev. 08/96

Interlocking machines and time releases must be kept locked or sealed.

4.2 Solid State Interlocking

4.2.1 Periodic Testing of Solid State Interlocking Standby Units

Rev. 02/01

Solid state interlocking that have standby units will be tested accordingly:

A. **Standby Units.** Rev. 02/01

Solid state interlocking can be configured with two independent sets of equipment permanently wired to a transfer switching arrangement which allows either set of equipment to operate the interlocking. At any particular time, one set of equipment forms the "on-line unit", which performs all the functions of the interlocking, and the other set of equipment forms the "standby unit", which is idle. Typically, the transfer switching arrangement has the capability to select the set of equipment currently in service as the on-line unit, and when enabled, to automatically transfer control of the interlocking from the current on-line unit to the standby unit upon failure of the on-line unit.

All required FRA locking and operational tests must be current for the set of equipment functioning as the on-line unit. In addition, if the automatic transfer capability is enabled, all required FRA locking and operational tests must be current for the set of equipment functioning as the standby unit. If for any reason the standby unit is not current with FRA regulations, the automatic transfer capability must be disabled, and the set of equipment functioning as the standby unit must be clearly marked "Do Not Enable Automatic Transfer" until all applicable tests not current are performed on the unit.

B. **Record of Tests Performed.** Rev. 02/01

When a solid state interlocking is configured with two sets of equipment permanently wired to a transfer switching arrangement as described in 4.2.1A. above, each set of equipment must be clearly identified in accordance with the nomenclature on the control switches for the transfer switching arrangement (i.e. Unit A / B, 1 / 2, etc.). Separate records of FRA tests performed on each of the two sets of equipment at the interlocking are required. Signal Inspectors, Maintenance Foremen or signal employees who perform required tests on either or both sets of equipment at a single interlocking must clearly indicate the set of equipment that was tested on the appropriate form(s) using the applicable nomenclature.

C. **Spare Chassis.** Rev. 02/01

A spare chassis does not constitute a standby unit. A spare chassis requires manual connection of cables to the spare chassis in order to place the spare chassis in service. Typically, a spare chassis is used to hold spare cards for the interlocking.

A spare chassis does not require periodic testing. If necessary to place a spare chassis in service, all required FRA locking tests and complete operational tests must be performed. The required locking and operational tests must be performed whether the cable connections are keyed or not.

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Microprocessor Based Interlocking Alternative Testing Procedure

Rev. 07/14

Record	Interval	Test By
Form MBIAT and Form BFCE, Form BFCM, or Form BCFV FSM* * **Pending FSM availability for this procedure**	4 Years	Inspector Electronic Tech. Mtce. Foreman Assisted By: Signal Maintainer

The following procedure must not be used as a form of in-service break-down or baseline testing.

After August 6, 2010, the location under test must have had one of the following prior to utilizing the alternative testing procedure:

A full in service breakdown test performed and all appropriate locking tests completed as outlined in instructions 1.2.4D. In Service Breakdown Tests on page 1-16 and Section 4 of the Signal Maintenance, Inspection, Test and Standard Instructions.

Appropriate locking tests performed utilizing the conventional method of testing as outlined in Section 4 of the Signal Maintenance, Inspection, Test and Standard Instructions.

Additionally, after December 18, 2013, the location under test must have a recorded baseline platform specific form for the Vital Application Software and Vital Configuration Verifications.

The various platform specific forms are:

- Electrologic (Form BFCE)
- Microlok (Form BFCM)
- VHLC (Form BCFV)

Purpose

Test to ensure all inputs to and outputs from the solid state interlocking device are effective and connected correctly. Verify that the application software and vital configurations have not changed and match the values recorded during the baseline tests.

Frequency

After a full in-service breakdown test and all appropriate locking tests performed, or appropriate locking tests utilizing the conventional testing method performed, and in all cases baseline testing has been recorded, alternative testing can be used thereafter at least once every four years.

Precautions

The employee(s) making the test must have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

Description of Test

1. **Solid State Interlocking chassis type.** Verify the type of interlocking system (Electrologic, Microlok, VHLC) matches the baseline testing record.
2. **Vital Application Software Verification.** Complete verification using the corresponding platform specific form for the vital application software. Verification of a program version and CRC must be performed utilizing an appropriate test device.

   Devices that may be used are:

   - EPROM Tester
   - Laptop computer
   - System display module

   Verify the following values:

   - Program Name
   - Program Version
   - CRC
   - Prom Number (as needed)

Never verify an EPROM based solely on its label identification.

3. **Vital Configuration Verification.** Complete verification on the platform specific form for the vital configuration settings.

   Verify the following for all input modules:

   - Slot number
   - Module type
   - Cable address (as needed)
   - Nomenclature and assignment of input

- Input as energized (H) or de-energized (L)

If the Vital Application Software and Vital Configuration Verification match the baseline testing recorded values, the alternative testing may be used. If the values do not match those found, the conventional method of locking test must be used.

4. **Track Verification.** List in the FSM all tracks providing input to the interlocking system. Verify each track listed is providing the designed input to the system by shunting each listed track individually.

   Use the following process for verification:

   OS Tracks

   1. Verify on the solid state interlocking system that the track to be tested indicates unoccupied.
   2. Place a shunt on the track under test.
   3. While track is shunted verify corresponding occupied indication on the solid state interlocking system.
   4. Remove the shunt.
   5. Verify loss of shunt time. Track under test must not indicate unoccupied in less than 90% of the prescribed time and in all applications must be more than five (5) seconds. (FRA Rule 236.309)
   6. Ensure the track under test indicates unoccupied.
   7. Record the test in the FSM.

   Approach Track Verification

   8. Verify on the solid state interlocking system that the track to be tested indicates unoccupied.
   9. Place a shunt on the track under test.
   10. While track is shunted verify corresponding indication on the solid state interlocking system.
   11. Remove the shunt and ensure the track under test indicates unoccupied.
   12. Record the results of test in the FSM.

5. **Power Switch Verification.** List in the FSM each power operated switch, derail, and movable point frog machine with control and indication connections to the interlocking system under test. Verify that the indication contacts in each switch machine are effective by carding or breaking each contact. Additionally, verify the control to each switch machine is effective by requesting the switch normal and reverse.

   Use the following process for verification of switches:

13. Verify the switch, derail or movable point frog is indicating in the normal position on the control panel.
14. Verify switch indicates out of correspondence on interlocking system by opening each contact in the switch machine circuit controller. Also, verify the same results using the dual selector lever and the latch out device.
15. Record the test in the FSM.
16. Using the control panel on the solid state interlocking system, request the switch, derail or movable point frog to the reverse position.
17. Verify the switch, derail or movable point frog is indicating in the reverse position on the control panel.
18. Verify switch indicates out of correspondence on Interlocking system by opening each contact in the switch machine circuit controller. Also, verify the same results using the dual selector lever and the latch out device.
19. Record the test in the FSM.

6. **Other Device Verification.** List each device providing vital indication input to the interlocking system in the FSM.

Other devices include:

- Electric lock(s)
- Hand throw switches
- Spring switches
- Slide fence(s)
- Flood detector(s)
- Any device providing vital indication input to the interlocking system

Indicate the type of device in the FSM (i/e: electric lock (EL), hand throw switch (HT), spring switch (SS), slide fence (SF), flood detector (FD)).

Verify the indication contacts in each device are effective by carding or breaking each contact. Additionally, verify the control to each electric lock is effective by requesting a switch unlock. Record the results in the FSM.

7. **Searchlight and Color light Signal Verification.** List in the FSM each color light and searchlight signal head. Each signal head controlled by the interlocking system must be verified by visually observing the signal head and ensuring the route governed by the signal corresponds with the interlocking system. Additionally, each searchlight signal mechanism providing indication input to the interlocking system must be verified by performing a rocking test on each signal head. Verify that the signal indication circuit for each signal head is effective when the signal mechanism is rocked from the center position to the left and from the center position to the right.

   Use the following process for verification of searchlight signals:

   20. Ensure the signal under test is not requested or in time.
   21. Verify the signal under test is indicating in the red position on the interlocking system.
   22. Clear the signal and verify the signal is indicating not at stop on the interlocking system.
   23. Place the signal to stop.
   24. Verify the signal under test is in time.
   25. Take the signal out of time.
   26. Where applicable, rock the signal mechanism from center to left.
   27. Verify the signal under test is indicating not at stop on the interlocking system.
   28. Allow the mechanism to return to the center or red position.
   29. Verify the signal under test is in time.
   30. Take the signal out of time.
   31. Record the test in the FSM.
   32. Verify the signal under test is indicating in the red position on the interlocking system.
   33. Rock the signal mechanism from center to right.
   34. Verify the signal under test is indicating not at stop on the interlocking system.
   35. Allow the mechanism to return to the center or red position.
   36. Verify the signal under test is in time.
   37. Take the signal out of time.
   38. Record the test in the FSM.

8. **Recording of Tests.** When recording tests in FSM indicate Alternative Testing Procedure used.

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Rule 236.307 and 236.380 - Indication Locking

Rev. 01/09

Record	Interval	Retention
Form 24094 FSM	2 Years	Until Next Record is Filed - in no case less than 1 year

Distribution

Test By	Original	Copies
Insp. Mtce. Foreman Assisted By: Signal Maintainer	MSM	Insp. Mtce. Foreman

Definition

Electric locking which prevents manipulation of levers that would result in an unsafe condition for a train movement if a signal, switch or other operative unit fails to make a movement corresponding to that of its controlling lever, or which directly prevents the operation of signal, switch or other operative unit in case another unit which should operate first fails to make the required movement.

Purpose

Test to ensure that indication locking circuits are effective.

Frequency

When placed in service and thereafter when modified, disarranged, or at least once every two years, whichever shall occur first.

Precautions

The employee(s) making the test must have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

Description of Test

At interlocking where mechanical locking between levers is in effect, indication locking must be tested as follows:

Lock on Signal Lever:

To ensure that the lever or latch cannot be placed in normal position.

1. For semaphore signals, until the corresponding home signals are within 5 degrees of the stop position and approach signals are within 5 degrees of the approach position, signal must be cleared and the lever restored to indicating position. Hold the signal arm by hand and let the arm gradually resume to the normal position; during which time the person operating the lever should be trying to restore the lever or latch to the normal position.
2. For light signals, until the corresponding home signals are in the stop position and approach signals are in the approach position, signal must be cleared and the lever then restored to the indication position, keeping the signal control relay picked up, try to restore the lever or latch to the normal position.

This operation must be repeated for each signal arm controlled by such lever on the switch or lock lever

When operated, locked and indicated by the same lever, ensure that the lever, switch(s), or other operated units are in the corresponding position, and switches are locked before the lever stroke can be completed and mechanical locking released. The lever must be operated to the indicating position and each switch or other unit separately prevented from completing their stroke; then an attempt to complete the stroke of the lever or latch must be made.

When locked and indicated by lock lever, ensure that the operating lever and switch or switches or other operated units are in corresponding position before lock lever can be operated and mechanical locking released, switch or switches or other units must be operated and each switch or other unit separately prevented from completing stroke, then attempt to unlatch lock lever.

Description of Test - Interlockings and CTC

At all interlockings and in CTC territory; indication locking at each home signal, approach signal where indication locking is in service, and at each power-operated switch, derail or movable point frog, must be tested as follows:

Switch Indication Locking

1. Each power operated switch, derail and movable point frog must be tested by first determining the switch repeater relay (WPR) correctly repeats the position of the switch, derail or movable point frog.

2. De-energize the appropriate WP relay by opening each contact in the switch machine circuit controller. Also, verify the same results using the dual selector lever. Perform this test in the normal and reverse positions.
3. In addition, if the switch is located in a crossover, arrange the crossover so that one switch is lined full normal and the opposite end of the crossover is lined full reverse. Verify that both WP relays are de-energized. This test must be made with the dual selector lever in the motor position and the motor circuit contact carded. On GRS switch machines, ensure only the motor circuit is cutout by use of the crank cutout, knife switch, or "local/remote" switch. Test with the switches in the crossover opposing each other in both the normal and reverse positions.

   Note: If an electric lock is located in an "OS" track circuit, switch indication locking will be performed. Verify that each individual contact through the electric lock will de-energize the appropriate switch lock repeater (WLP) relay.
4. Clear each signal individually and de-energize the appropriate WP relay associated with each switch that is located within the route cleared. Verify that the signal which governs movement over the switch, derail or movable point frog displays its most restrictive aspect when each individual WP relay is de-energized.

Signal Indication Locking

1. Rock each signal mechanism in both directions to verify that the appropriate Red Signal Repeater Relay (RGPR) drops.
2. Clear each signal individually and determine that the appropriate RGPR correctly repeats the position of the signal. Determine that the route cannot be changed and that no signal will display an aspect to proceed for a conflicting route at the location under test. Additionally, verify that no aspect control information is sent toward an adjacent control point which would permit any conflicting proceed signal.
3. Restore the signal to stop and take the signal out of time, de-energize the appropriate Red Signal Repeater Relay (RGPR).* Determine that the route cannot be changed and that no signal will display an aspect to proceed for a conflicting route at the location under test. Additionally, verify that no aspect control information is sent toward an adjacent control point which would permit any conflicting proceed signal.

***Note:** If a (RGPR) does not exist, disable the effective TER and then de-energize the appropriate approach stick (AS) relay.

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Rule 236.305 and 378 - Time Locking

Rev. 01/09

Record	Interval	Retention
Form 24094 FSM	2 Years	Until Next Record is Filed - in no case less than 1 year

Distribution

Test By	Original	Copies
Insp. Mtce. Foreman	MSM	Insp. Mtce. Foreman

Assisted By:
Signal Maintainer

Definition

A method of locking, either mechanical or electrical, which after a signal has been caused to display an aspect to proceed, prevents, until after the expiration of a predetermined time interval, after such signal has been caused to display its most restrictive aspect, the operation of any interlocked or electrically locked switch, movable point frog, or derail in the route governed by that signal, and which prevents an aspect to proceed from being displayed for any conflicting route.

Purpose

Test to ensure that time locking is effective and circuits are functioning properly.

Frequency

When placed in service and thereafter when modified, disarranged, or at least once every two years, whichever shall occur first.

Precautions

The employee(s) making the test must have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

Description of Test

All Systems:

Each route's effective time element or device must run the entire predetermined amount of time, ensuring that the release is effective, at least once throughout this testing procedure.

Lever Interlockings:

Time locking must be tested as follows:

1. **Lock on signal lever:** To ensure that the lever or latch cannot be restored to the normal position until the designated time interval has elapsed, the lever must be reversed and an attempt made to restore the lever or latch to the normal position while time release is operating.
2. **Combined with Switch Lever Locking:** To ensure that the lever or latch cannot be moved from the normal to reverse position until the time interval has elapsed, an attempt must be made to move the lever or latch from the normal or reverse position while time release is operating.
3. **Multiple Circuits:** Multiple circuits must be tested by opening each contact cut around the approach circuit with the multiple circuits closed, when lock is on signal lever, restore lever or latch to normal position; when combined with switch lever locking, move lever or latch from normal to reverse position. This test must be made separately for each multiple circuit.

Automatic Interlockings:

Time locking must be tested as follows:

1. Clear each home signal, one at a time, for a specific route.
2. Restore signal to the stop position.
3. While time is running, determine that no signal can be cleared for a conflicting movement until the required time period has expired.

CTC Control Points and Interlockings:

Time locking must be tested as follows:

1. Clear each home signal.
2. Restore the signal to the stop position, verify that the time relay is operating, and that the appropriate ASR is de-energized.

3. Determine that the route cannot be changed and that no signal will display an aspect to proceed for a conflicting route at the location under test while the time relay is operating. Additionally, verify that no aspect control information is sent toward an adjacent control point, which would permit any conflicting proceed signal.

Hand Operated Switches Equipped With Electric Locks Where Time Locking is Effective:

Time locking must be tested as follows:

1. If the electric lock is equipped with a releasing track circuit, simulate a train occupancy and determine that the electric lock will unlock.
2. Restore the location back to normal, place a hard wire (zero ohm) shunt at the switch points, and determine that the release will not operate. Ensure that the lock will not unlock and that the time relay is operating.
3. After the predetermined time relay operation, determine that the electric lock can be unlocked.

Note: Time locking test will be performed on SL-7 locks by attempting to move the lever to the unlock position while the mechanical timer is operating.

At all Hand Operated Switches Equipped With a Leaving Signal in Lieu of an Electric Lock Where Time Locking is Effective:

1. Determine the manner in which the leaving signal used in lieu of the electric lock is time locked.
2. Line the switch reverse and determine that leaving signal used in lieu of the electric lock does not clear, then determine that the appropriate time element relay operates.
3. After the predetermined amount of time has expired, ensure that the leaving signal clears.

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Rule 236.377 - Approach Locking

Rev. 01/09

Record	Interval	Retention
Form 24094 FSM	2 Years	Until Next Record is Filed - in no case less than 1 year

Distribution

Test By	Original	Copies
Insp. Mtce. Foreman	MSM	Insp. Mtce. Foreman

Assisted By:
Signal Maintainer

Definition

Electric locking effective while a train is approaching, within a specified distance, a signal displaying an aspect to proceed, and which prevents until after the expiration of a predetermined time interval after such signal has been caused to display its most restrictive aspect, the movement of any interlocked or electrically locked switch, movable point frog, or derail in the route governed by the signal, and which prevents an aspect to proceed from being displayed for any conflicting route.

Purpose

Test to ensure that approach locking circuits are effective and functioning properly.

Frequency

When placed in service and thereafter when modified, disarranged, or at least once every two years, whichever shall occur first.

Precaution

The employee(s) making the test must have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

Description of Test - All Systems

Each route's effective time element or device must run the entire predetermined amount of time, ensuring that the release is effective, at least once throughout this testing procedure.

Approach locking must be tested as follows:

At mechanical interlockings:

1. **Lock on Signal Lever:** To ensure the lever or latch cannot be restored to the normal position, with the proper route set, signal cleared when necessary, and the approach circuit open, each contact in the approach circuit must be opened separately (multiple circuits to be open) and an attempt made to restore the lever or latch to the normal position.
2. **Combined with Switch Lever Locking:** To ensure that the lever or latch cannot be moved from the normal or reverse position, each signal has been cleared and approach circuit open, signal levers must be restored to normal position and each contact in the approach circuit opened separately (multiple circuits to be open) and attempt made to move switch lever or latch from normal or reverse position.
3. **Multiple Circuits:** Multiple circuits must be tested by opening each contact cut around in the approach circuit with the multiple circuit closed, and when lock is on signal lever, restore lever or latch to normal position; when combined with switch lever locking, move lever or latch from normal or reverse position. This test must be made separately for each multiple circuit.

At all relay interlockings and in CTC territory:

1. Determine each track circuit within the limits of the approach circuit will de-energize the approach relay.
2. Clear each home signal individually.
3. Disable the TE Relay.
4. Open the respective approach relay, and restore the signal to the stop position.
5. Determine that the route cannot be changed for a conflicting route and that no conflicting signal will display an aspect to proceed. Additionally, verify that no aspect control information is sent toward an adjacent control point which would permit any conflicting proceed signal.
6. Re-clear the original home signal.
7. Enable the TE Relay.

8. Restore the signal to the stop position and verify that the time element is operating.
9. Determine that the route cannot be changed and that no signal will display an aspect to proceed for a conflicting route while the time element is operating. Additionally, verify that no aspect control information is sent toward an adjacent control point which would permit any conflicting proceed signal.
10. This test must be repeated for all possible routes.

At All Hand-Operated Switches Equipped With Electric Locks Where Approach Locking is Effective:

1. Determine the manner in which the electric lock is approach locked.
2. Where a separate and distinct circuit is used to check the approach, verify each track circuit in the approach will de-energize the approach relay.
3. Without a signal requested over the territory containing the electric lock and the approaches unoccupied (as determined in 1) determine the electric lock can be unlocked.
4. With a signal cleared or the approach occupied (as determined in 1) determine the electric lock cannot be unlocked until time has expired at the electric lock.
5. Repeat step 3 by clearing an opposing signal and/or opposing approach occupied.
6. Ensure by steps 3 and 4 that each approach is tested individually and are individually effective.
7. Simulate a train movement at an electric lock equipped with a releasing track circuit and determine that it will release. Place a hard wire (zero ohm) shunt at the switch points and determine that the electric lock cannot be unlocked.

At all Hand Operated Switches Equipped With a Leaving Signal in Lieu of an Electric Lock:

1. Determine the manner in which the leaving signal used in lieu of the electric lock is approach locked. Where a separate and distinct circuit is used to check the approach, verify each track circuit in the approach will de-energize the approach relay.
2. Line the switch reverse without a Control Point signal requested over the territory containing the location under test and the approaches unoccupied (as determined in 1) and determine that leaving signal used in lieu of the electric lock clears.

3. With a Control Point signal cleared or approach occupied (as determined in 1) to the location under test, line the switch reverse and determine that the leaving signal that is used in lieu of the electric lock does not clear.
4. Repeat step 3 by clearing an opposing signal and/or opposing approach occupied.
5. Ensure by steps 3 and 4 that each approach is tested individually and are individually effective.

Rule 236.379 - Route Locking

Rev. 01/09

Record	Interval	Retention
Form 24094 FSM	2 Years	Until Next Record is Filed - in no case less than 1 year

Distribution

Test By	Original	Copies
Insp. Mtce. Foreman	MSM	Insp. Mtce. Foreman

Assisted By:
Signal Maintainer

Definition

Electric locking, effective when a train passes a signal displaying an aspect for it to proceed, which prevents the movement of any switch, movable-point frog, or derail in advance of the train within the route cleared. It may be so arranged that as a train clears a track section of the route, the locking affecting that section is released.

Purpose

Test to ensure that route locking is effective.

Frequency

When placed in service and thereafter when modified, disarranged, or at least once every two years, whichever shall occur first.

Precautions

The employee(s) making the test must have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

Description of Test

All Systems

Verify correct insulated joint placement to ensure that route locking is effective at a point less than 13 feet in advance of the governing signal. The distance will be measured between the effective insulated joint and the center of the signal mast or, if there is not a mast to the center of the signal (FRA Rule 236.302).

Sectional release locking permits the release of switches, movable point frogs, derails and facing point locks in the rear of progressive shunts. Where sectional release is utilized, verify that as each section is released, a route cannot be established that would result in improper clearance between train movements.

Where a single battery feeds multiple track relays; in addition to shunting each track with a .06 ohm shunt, determine that each relay is individually effective by opening a track lead wire at the terminal board.

Where a double battery feeds multiple track relays; in addition to shunting each track with a .06 ohm shunt, determine that each relay is individually effective by opening a track lead wire at the terminal board.

At Interlocking and CTC Control Points switch locking must be tested as follows:

Switch locking must be tested by shunting each track circuit while the device is in movement. With the power operated switch, moveable point frog, or derail being operated from normal to reverse, shunt the track with a .06 ohm shunt. Device must come to a stop, then lift the shunt allowing the device to continue movement. Repeat the test for the device operating from reverse to normal.

Note: Where loss of shunt protection is provided, after the .06 ohm shunt is removed, power-operated device must not resume movement in less than 90% of the prescribed time and in all applications must be more than five (5) seconds. (FRA Rule 236.309)

At Interlocking and CTC Control Points route locking must be tested as follows:

1. Clear each home signal individually that governs movement over a route.
2. Shunt the first track circuit beyond the governing signal, and verify that the signal indicates its most restrictive aspect.
3. Determine that power operated switches, movable point frogs or derails cannot be operated within the shunted track circuit or any remaining part of the route ahead of the shunted track circuit.

4. Shunt each succeeding track circuit individually in the route to simulate a train moving through the route lined and repeat step 3. These tests are to be repeated until all track circuits in the route have been shunted in the proper sequence.
5. During this route locking test, ensure that two (2) track restoring is effective by observing the ASR operation. The ASR should not pick up until two consecutive track circuits beyond the signal are occupied simultaneously. Where a special ASR restoration circuit is provided, refer to the circuit plan and verify that the circuit is functioning as intended.

At Interlockings with mechanical locking between levers is in effect, route and switch locking must be tested as follows:

1. To ensure that the lock will hold the lever or latch, locking circuit must be opened and lever latch moved against the lock several times while no train is occupying or approaching the section of track affected.
2. To ensure that a lock will not release while the circuit is occupied, each lever must be unlatched or floor push operated (but lever must not be moved) while a train is on the circuit and the lock closely observed to see if it releases. If not practical to occupy the track circuit(s) with a train, proceed as above having each track section involved shunted successively and carefully observe the results.
3. Each track circuit must be shunted with a .06 ohm shunt giving particular attention to crossovers and turnouts; note that each track and repeating relay opens.
4. Each route should be set and the proper relays operated to determine that route locking is effective.

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Rule 236.376 - Mechanical Locking

Rev. 01/09

Record	Interval	Retention
Form 24094 FSM	2 Years	Until Next Record is Filed - in no case less than 1 year

Test By	Distribution Original	Copies
Insp. Mtce. Foreman	MSM	Insp. Mtce. Foreman

Assisted By:
Signal Maintainer

Definition

An arrangement of locking bars, dogs, tappets, cross locking and other apparatus by means of which interlocking is effected between the levers of an interlocking machine and so interconnected that their movements must succeed each other in a predetermined order.

Purpose

Test to determine that all apparatus is serviceable and will prevent signals from displaying aspects which permit conflicting movements.

Frequency

When placed in service and thereafter when modified, disarranged, or at least once every two years, whichever shall occur first.

Precautions

The employee(s) making the test must have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

Procedure

Make all inspections and tests in accordance with FRA Rules 236.335 through 236.341.

Description of Tests

Determine the amount of movement in a lever or latch when locked. If lever movement is more than indicated below, it shall be considered to have lost motion. Correct any defects detected.

A. Mechanical Machine

Latch-operated locking.

When the lever latch block can be raised to within 3/8 inch of top of the quadrant.

B. Electro-Mechanical Machine

Lever moving in a horizontal plane.

When lever can be moved more than 5/16 inch when in the normal position or 9/16 inch in the reverse position.

Lever moving in an arc.

When lever can be moved more than 5 degrees.

C. Power Machine

Latch-operated locking.

When lever latch block can be raised to within 7/32 inch of top of quadrant.

Lever moving in a horizontal plane.

When lever can be moved more than 5/16 inch when in normal position or 9/16 inch when in reverse position.

Lever moving in an arc.

When lever can be moved more than 5 degrees.

A complete test of the locking from a signal layout, check sheet, or interlocking plan must be made as follows:

1. Test locking between the switch, derail and movable point frog levers.
2. Test locking between the facing point lock and the switch, derail and movable frog levers.
3. Set up each route and endeavor to release the latch or operate each signal lever that should be locked by that route. Then, raise the latch on the signal lever, or reverse the signal lever, governing movements over the route. Endeavor to release the latch or operate each lever that should be locked by the signal lever. Then, restore the latch or lever to the normal position. Make a similar test with the lever or latch from the opposing signal.
4. Determine that the locking and the dog chart agree.

Rule 236.381 - Traffic Locking

Rev. 01/09

Record	Interval	Retention
Form 24094 FSM	2 Years	Until Next Record is Filed - in no case less than 1 year

	Distribution	
Test By	**Original**	**Copies**
Insp. Mtce. Foreman	MSM	Insp. Mtce. Foreman

Assisted By:
Signal Maintainer

Definition

Electric locking which prevents the manipulation of levers or other devices for changing the direction of traffic on a section of track while that section is occupied or while a signal displays an aspect for a movement to proceed into that section.

Purpose

Test to ensure that where traffic locking is in use that the levers cannot be manipulated to change the direction of traffic while the signal displays an aspect to proceed while any of the track section is occupied.

Frequency

When placed in service, thereafter when modified, disarranged, or at least once every two years, whichever shall occur first.

Precautions

The employee(s) making the test must have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

Description of Test

1. Place the traffic lever in position and clear a signal. Determine that the traffic cannot be changed until the signal is restored to stop and released by approach or time locking. Repeat the test for each signal governed by the traffic levers.
2. Drop each track relay in the traffic block and determine that the traffic cannot be changed.

Rule 236.384-Cross Protection

Rev. 01/09

Record	Interval	Retention
Form 24094 FSM	6 Months	Until Next Record is Filed - in no case less than 1 year

Distribution

Test By	Original	Copies
Signal Inspector Mtce. Foreman	MSM	Signal Inspector Mtce. Foreman

Assisted By:
Signal Maintainer

Definition

An arrangement to prevent the improper operation of a signal, switch, movable-point frog, or derail as the result of a cross in electrical circuits.

Purpose

Test to ensure that the cross protection system operates to prevent the movement of any switch, movable-point frog, derail or signal if current is improperly applied to its circuit.

Frequency

When placed in service, thereafter when modified, disarranged, or at least once every 6 months, whichever shall occur first.

Precaution

The employee(s) making the test must have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

Description of Test

Before beginning the tests, check the operating battery voltage. The battery must be fully charged. Operate each switch, signal, etc. before and after testing to ensure that the relay is charged.

Checking Cross Protection of a Switch

Starting with the switch machine in the normal position, adjust a variable resistance unit for maximum resistance and connect one side of the resistance unit to the normal control wire in the switch machine or in the control tower. Connect the other side of the variable resistance unit to the positive lead of a DC ammeter. Connect the negative ammeter lead to the reverse control wire in either the switch machine or the control tower. Reduce the resistance of the variable unit in small steps while watching the meter. Note and record the highest current reading on the meter which will occur just as the switch motor rotates and continue adjusting resistance unit and note reading at which the polar relay trips. Repeat this test with the switch in the reverse position.

Required Test Results for Switch Machines

The polar relay must trip before the switch machine starts to unlock. If a switch machine does not pass the test, adjust the polar relay trip setting, recharge polar by operating the switch and repeat the above test. If unlocking current is greater then normal operating current, inspect and adjust the switch machine. After adjusting the switch machine, test should be repeated prior to adjusting the polar trip setting.

Checking Cross Protection of 2A Semaphore Signal

Connect a jumper wire from H.V. battery buss to a resistance unit that has been adjusted for maximum resistance. Connect the other end of the resistance unit to the positive lead of a DC ammeter. Connect the negative lead of the ammeter to the R wire. Slowly reduce the resistance of the variable resistance unit while watching the meter. Note and record the highest current reading which will occur just as the polar relay trips.

Required Test Results for 2A Semaphore Signals

Polar relay must trip before the signal starts to clear. If signal does not pass the test, adjust the polar relay trip setting and repeat test.

Checking Plant Sectionalization

If the plant is sectionalized, one or more functions in each section should be crossed with wires taking energy from each of the other sections. In case functions in various sections are too widely separated, the temporary crosses can be made between binding posts in the terminal board of the interlocking machine.

Required Test Results for Plant Sectionalization

Crosses between sections should open section breakers.

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Field Tests of Automatic Interlocking

Rev. 02/15

Record	Interval	Retention
Form 24050 FSM	1 Year	Until Next Record is Filed - in no case less than 1 year

Distribution

Test By	Original	Copies
Insp. Mtce. Foreman	MSM	Insp. Mtce. Foreman

Assisted By:
Signal Maintainer

Purpose

Test to ensure that automatic interlockings are functioning properly.

Frequency

When placed in service, thereafter when modified, disarranged, or at least annually, whichever shall occur first.

Precaution

The employee(s) making the test must have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

Special Operating Tests at Automatic Interlocking Plants

When the track between home signals on any road is occupied, signals for all conflicting routes and for the route occupied must indicate stop.

Description of Test

1. Place a shunt on an approach to clear a signal and verify that the signal cleared.
2. Place a shunt on the approach of a conflicting signal and determine that the conflicting signal will not clear.
3. Repeat steps 1 and 2 for each route governing movement through the interlocking.
4. Ensure that signals display the proper aspects for following and opposing trains on both roads, simulating all possible train movements by use of shunt wires.
5. Ensure that the indication of approach signals is in accord with the indication of home signals.
6. On routes provided with time element release, ensure that time element devices are adjusted within 10 percent of the time designated and that they function as intended. Where automatic approach releasing circuits are used, ensure that the home signal, which has cleared by occupancy of the clearing section, goes to Stop at the expiration of the designated time (where required) and that it again clears when the re-start section (re-clearing section or "step-on") is occupied, provided no train is on the opposing route.
7. Ensure that designated time interval is effective between the time a signal on one route goes to Stop and a signal on any conflicting route can clear.
8. Ensure that each relay performs its proper function and that the plant is released as the rear of a train leaves the limits of the home signal by shunting track circuits in sequence to correspond with the passage of a train through the plant. This test must be made for each route.
9. Ensure that preference alternates from one road to the other where called for by circuits.
10. Ensure that special devices such as key circuit controllers, clockwork hand releases, push button circuits, Maintenance of Way releases, indicator lights, etc., are working as called for on the circuit plans and for all necessary routes.
11. Test for compliance on approach circuits should be made by placing a shunt on the approach circuit to establish a route. The route is established when the home signal displays an aspect authorizing movement into interlocking limits. After the route is established, remove the shunt while observing the home signal to ensure its aspect does not change until after the expiration of more than five seconds. Each track circuit in the approach circuit should be tested.
12. Test for compliance on track circuits within interlocking limits should be made by making an operating shunt test into the interlocking limits. Then, place a shunt on the approach circuit of a conflicting route. Remove the shunt from the track circuit within interlocking limits while observing the conflicting route home signal to assure it does not clear until after the

expiration of more than five seconds. Each track circuit within interlocking limits must be tested.

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Rule 236.387 / 236.312 – Movable Bridge Locking

Rev. 01/09

Record	Interval	Retention
Form 24094 FSM	1 Year	Until Next Record is Filed - in no case less than 1 year

Distribution

Test By	Original	Copies
Insp. Mtce. Foreman	MSM	Insp. Mtce. Foreman

Definition

An arrangement of electric and/or mechanical apparatus so interconnected with bridge devices that the bridge must be properly locked and track properly aligned before a proceed signal can be displayed over the bridge.

Rail Seats: Applies to both **lift and swing** bridges. Each lift / slide rail must indicate seated when it is within 3/8 inch of correct surface and alignment with the fixed rail when the bridge is aligned for rail traffic. Each rail seating device used to indicate that the rail is seated must be kept properly maintained and adjusted. Where movable rails slide into position they are required to be locked in proper alignment. Conely frogs are designed to be self aligning and are not required to be locked or electrically checked for alignment. **They are required to be checked for surface.**

Bridge Seats: Applies to **swing** bridges and some **lift** bridges. Each bridge seat must indicate seated when the bridge member is within 1inch of being in its fully seated position. Each bridge seating device used to indicate the bridge is seated must be kept properly maintained and adjusted.

Bridge Locks: Applies to **swing** bridges and some **lift** bridges. Each bridge lock must indicate locked when the locking member is within 1 inch of being in its fully driven position. Each bridge locking device used to indicate the bridge locks are fully driven must be kept properly maintained and adjusted.

Rail Locks: Applies to both **lift and swing** bridges. If rail locks are utilized on lift rails, they must indicate locked when the locking member is within 3/8 inch of being in its fully driven position. Each rail lock must properly indicate in both the normal and reverse positions relative to the bridge operation. Each rail lock device used to indicate the rails are locked must be kept properly maintained and adjusted.

Purpose

Test to ensure that bridge locking circuits and devices are effective and functioning properly.

Frequency

When placed in service and thereafter when modified, disarranged, or at least once every year, whichever shall occur first.

Precaution

The operation, mechanics and design of movable bridges are all unique. The employee(s) testing must have a complete understanding of the operation and how it relates to the signal system. They must also have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set by the application of testing equipment.

Description of Tests

At all movable bridges interlocked with signals, bridge locking tests must be performed as follows:

Lift Bridges - Tests applicable to Lift Bridges

Rail Seats

1. **Bridges utilizing Conely frogs:** Each movable rail (slide or lift) must be tested by vertically displacing them 3/8 inch from correct surface and verify that the appropriate repeater relay is de-energized.
2. **Bridges <u>not</u> utilizing Conely frogs:** Each movable rail (slide or lift) must be tested by vertically displacing them 3/8 inch from correct surface and alignment, and verify that the appropriate repeater relay is de-energized.
3. If the movable rails slide into position, they are required to be locked. Unlock each slide rail and insert a 3/8 inch obstruction between the slide rail and fixed span. Verify that the appropriate repeater relay is de-energized and that the slide rails cannot be locked.
4. With the bridge lined and locked for rail traffic, clear each signal individually and de-energize each rail seat repeater relay in the route. Verify that the signal which governs movement over the bridge displays its most restrictive aspect.

Bridge Seats

1. Each bridge seat must be tested by displacing them 1 inch from their fully seated position and verify that the appropriate repeater relay is de-energized.

2. With the bridge lined and locked for rail traffic, clear each signal individually and de-energize the appropriate **bridge seat** repeater relay. Verify that the signal which governs movement over the bridge displays its most restrictive aspect.

Bridge Locks

3. Bridge locks must be tested by withdrawing each bridge locking member 1 inch from its fully driven position and verifying that the appropriate repeater relay is de-energized.
4. With the bridge locks in the unlocked position, de-energize each **rail seat** repeater relay and verify that the bridge locks cannot be restored to the locked position.
5. With the bridge lined and locked for rail traffic, clear each signal individually and de-energize each **bridge locking** repeater relay. Verify that the signal which governs movement over the bridge displays its most restrictive aspect.

Rail Locks

1. If equipped, each rail lock must be tested in both the locked and unlocked positions to verify that the appropriate repeater relays correspond. Also, displace each rail lock 3/8 inch from its locked position and verify the appropriate repeater relay is de-energized.
2. With the rail locks in the unlocked position, de-energize each appropriate **rail seat** repeater relay and verify that the rail locks cannot be restored to the locked position. Repeat this test for each rail lock.
3. With the bridge lined and locked for rail traffic, clear each signal individually and de-energize the appropriate **rail lock** repeater relay. Verify that the signal which governs movement over the bridge displays its most restrictive aspect. Repeat this test for each rail lock.

Swing Bridges - Tests applicable to Swing Bridges

Bridge Locks

4. Bridge locks must be tested by withdrawing each bridge locking member 1 inch from its fully driven position and verifying that the appropriate repeater relay is de-energized.
5. With the bridge lined and locked for rail traffic, clear each signal individually and de-energize each **bridge locking** repeater relay. Verify that the signal which governs movement over the bridge displays its most restrictive aspect.

Bridge Seats

1. Each bridge seat must be tested by displacing them 1 inch from their fully seated position and verify that the appropriate repeater relay is de-energized.
2. With the bridge lined and locked for rail traffic, clear each signal individually and de-energize the appropriate **bridge seat** repeater relay. Verify that the signal which governs movement over the bridge displays its most restrictive aspect.

Rail Seats

1. Each movable rail (slide or lift) must be tested by vertically displacing them 3/8 inch from their correct surface and alignment and verifying that the appropriate repeater relay is de-energized.
2. If the movable rails slide into position, they are required to be locked. Unlock each slide rail and insert a 3/8 inch obstruction between the slide rail and fixed span. Verify that the appropriate repeater relay is de-energized and that the slide rail cannot be locked.
3. With the bridge lined and locked for rail traffic, clear each signal individually and de-energize the appropriate **rail seat** repeater relay. Verify that the signal which governs movement over the bridge displays its most restrictive aspect. Repeat this test for each rail seat.

Rail Locks

1. If equipped, each rail lock must be tested in both the locked and unlocked positions to verify that the appropriate repeater relays correspond. Also, displace each rail lock 3/8 inch from its locked position and verify the appropriate repeater relay is de-energized.
2. With the rail locks in the unlocked position, de-energize each appropriate **bridge seat** repeater relay and verify that the rail locks cannot be restored to the locked position. Perform this test for each rail lock.
3. With the rail locks in the unlocked position, de-energize each appropriate **rail seat** repeater relay and verify that the rail locks cannot be restored to the locked position. Perform this test for each rail lock.
4. With the bridge lined and locked for rail traffic, clear each signal individually and de-energize the appropriate rail lock repeater relay. Verify that the signal which governs movement over the bridge displays its most restrictive aspect. Repeat this test for each rail locking device.

4.3 Additional Locking Devices

4.3.1 Maintenance of Boat Detectors, Bridge Indication, and Water Traffic Warning Devices.

Rev. 01/09

A. **Bridge Indication Devices.** Rev. 01/09

Devices used for indication in the bridge locking process may be, but are not limited to, switch circuit controllers, bridge circuit controllers, limit switches or proximity switches. These devices must be maintained in accordance with these instructions and any other special instructions applicable to the bridge they are installed on.

B. **Water Traffic Detection Devices.** Rev. 01/09

Devices used to detect water traffic such as boat detectors, are considered interlocking appliances and must operate in their proper sequence and perform their intended function.

C. **Water Traffic Warning Devices.** Rev. 01/09

Audible warning devices and visual warning devices used to govern movement of water traffic are considered interlocking appliances and must operate in their proper sequence and perform their intended function.

D. **Emergency Bypass Switches.** Rev. 01/09

Emergency bypass switches or devices must be locked or sealed and must not circumvent time or approach locking when operated.

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Chapter 5 Batteries

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5.1 Battery Instructions

5.1.1 General Battery Instructions Rev. 01/09

A. **Clean.** Rev. 08/96

Batteries, trays and supports must be kept clean, dry and in such condition as to prevent surface leakage of current.

B. **Covered With Proper Lubricant.** Rev. 08/96

All connections must be kept clean and tight. Exposed brass or copper battery connections must be kept covered with the proper lubricant.

C. **Proper Ventilation.** Rev. 05/15

Batteries shall be kept in suitable enclosures with proper ventilation. Do not block floor or wall vents. Ventilating fill plugs must be maintained and properly secured in each cell.

D. **Level For Inspection.** Rev. 09/06

Cells shall be set level on shelves, racks or in trays, and be arranged to permit ready inspection of any cell or element.

E. **Proper Solution Level.** Rev. 08/96

After tests and readings have been completed, water must be added, if necessary, to maintain proper solution level. When water is added in cold weather, the solution must be agitated by the use of a syringe to prevent freezing. Proper height of electrolyte must be maintained.

F. **Visual Inspection.** Rev. 08/96

Careful visual inspection must be made to detect broken, cracked or buckled plates, misplaced separators, excessive sulphation (the lead plates turn a grayish white), or an undue accumulation of sediment (the sediment level reaches approximately 75% of the sediment holding area).

G. **Open Flames.** Rev. 08/96

During the charging process of batteries, explosive gas is created. Keep open flames and electric sparks away from batteries and battery compartments.

H. **Exhausted Batteries.** Rev. 01/09

Exhausted cell type batteries shall be brought to a specified collection site for disposal. Prior to transporting batteries, ensure all cells are sealed, caps are attached and tight. Any cells missing caps must be sealed with foam or duct tape. To prevent shorting of cells containing a residual charge, remove all wires, eyelets, straps and cover posts with an insulating material. Different types of batteries will not be disposed or shipped in the same containers. Refer to the battery disposal policy for additional instructions.

I. **Verify Connection.** Rev. 01/09

Test to verify the battery banks are not connected to each other unless so designed. All battery connections should be torqued to 100 in/lbs.

J. **Temperature Compensation Probes.** Rev. 02/01

Do not use temperature compensation probes on GNB batteries.

K. **Batteries in Storage.** Rev. 02/01

All lead acid batteries in storage must be kept charged by use of a trickle charge or a freshening charge applied at 3-6 month intervals.

5.1.2 Additional Instructions for GNB Batteries Rev. 09/06

A. **Installation of New Batteries.** Rev. 02/01

Request shipment of GNB batteries after new location has been prepared for installation of new batteries.

B. **Equalization Charge.** Rev. 01/09

An equalization charge must be applied to GNB batteries upon receipt. An equalization charge must be applied at 6 month intervals from manufactured date or last equalization charge until installed and maintained with proper float charge. An equalization charge for GNB Absolyte batteries is defined as charging each cell at 2.3 volts per cell for 24 hours or 2.35 volts per cell for 12 hours.

C. **Restoration Charge.** Rev. 02/01

A Restoration Charge is required to be applied to GNB batteries left unequalized more than 9 months. Contact GNB at 1-800-GNB-Rail for information concerning restoring batteries.

D. **Float Charge.** Rev. 01/09

Batteries must be maintained to the proper float voltage of 2.23 to 2.27 volts per cell. Optimum voltage is 2.25 volts per cell.

E. **Battery Chargers.** Rev. 02/01

Battery chargers must be Automatic Constant Voltage chargers capable of maintaining the proper float voltage and providing an equalizing charge. The Manager of Signal Maintenance and/or the Manager of Signal Construction are responsible to ensure the correct charger is installed and maintained per current standards.

F. **Solar Applications** Rev. 01/09

GNB Absolye batteries in solar applications should have the Charge Regulator/Converter set as recommended in the I/O Manual for appropriate “depth of discharge.” The default setting should be 2.35 volts per cell.

G. **Battery Records.**

Rev. 01/09

Battery records must include an equalizing history.

5.1.3 Tests and Inspections

Rev. 01/09

A. **Record Kept.** Rev. 01/09

A complete battery record card will be maintained.

B. **AC Power.** Rev. 10/14

Check AC power voltage and record. AC voltage should be within 5% of nominal voltage. (i.e. 120 VAC should not be less than 114 VAC) but in no case should be more than 20% below nominal voltage. AC voltage more than 20% below nominal may cause equipment issues.

Ensure the expected and actual AC voltage and current power company information is entered in SMP/FSM on an annual basis.

The review of power company information will consist of:

- Power company name
- Power company phone number
- Power meter number

Power company information must be kept current to provide restoration assistance during power outages.

C. **Check Voltage.** Rev. 01/09

Battery voltage should be checked with the charging current removed and the voltage stabilized.

D. **Fully Charged.** Rev. 02/01

Each bank of batteries will be charged to a voltage that is in accordance with tables Table 5-2, Table 5-3, Table 5-4, and Table 5-5, and a record kept at the location.

E. **Test Individual Cells.** Rev. 02/01

Individual cells will be tested once every three months to ensure proper cell voltage.

F. **Load Test.** Rev. 01/09

Once a year, or more often if required, perform a load test on all battery sets.

1. Disconnect the AC to the rectifier for the battery to be tested, thereby placing the normal load on the battery.
2. If the battery to be tested supplies standby energy for any lighting circuits, such as highway crossing signals, or wayside signals, then the operation of these lights is a required part of the load test.

3. The load test must be conducted for a minimum of three minutes.
4. At the end of the three minutes, with the battery under full load and the AC power still off, measure each cell's voltage. Table 5-1 Load Test on page 5-4 can be used as a reference to help determine the integrity of cells during testing.

Table 5-1 Load Test	
Nickel Cadmium @ 70 Degrees F.	
1.35V - 1.45V	Good
1.30V – 1.34V	Check Rectifier
Below – 1.30V	Mark Cell for Possible Replacement
Sealed Lead Acid @ 70 Degrees F.	
Above 2.27	Investigate Reason for High Voltage
2.05V – 2.25V	Good
1.80V – 2.04V	Investigate Reason for Low Voltage
Below - 1.8V	Mark Cell for Possible Replacement

Table 5-2
GNB Absolyte Maintenance Free
Lead Acid Battery Voltage Table

Cells	Minimum	Best	Maximum
1	2.23	2.25	2.27
2	4.46	4.5	4.54
3	6.69	6.75	6.81
4	8.92	9.0	9.08
5	11.15	11.25	11.35
6	13.38	13.50	13.62
7	15.61	15.75	15.89
8	17.84	18.00	18.16
9	20.07	20.25	20.43
10	22.3	22.5	22.7
11	24.53	24.75	24.97
12	26.76	27.0	27.24
15	33.45	33.75	34.05
20	44.6	45.0	45.4

Table 5-3 Flooded Lead Acid Battery Voltage Table			
Temperature in Degrees Fahrenheit			
Cells	**Below 32**	**60 Degrees**	**Above 80**
1	2.30	2.19	2.12
2	4.60	4.38	4.24
3	6.90	6.57	6.36
4	9.20	8.76	8.48
5	11.50	10.95	10.60
6	13.80	13.14	12.72
7	16.10	15.33	14.84
8	18.40	17.52	16.92
9	20.70	19.71	19.08
10	23.00	21.90	21.20
11	25.30	24.09	23.32
12	27.60	26.28	25.44
13	29.90	28.47	27.56
14	32.20	30.66	29.68
15	34.50	32.85	31.80
16	36.80	35.04	33.92
17	39.10	37.23	36.04
18	41.40	39.42	38.16
19	43.70	41.61	40.28
20	46.00	43.80	42.40

Table 5-4 Nickel Iron Battery Voltage Table			
Number of Cells	Temperature in Degrees Fahrenheit		
	Below 32	60	Above 80
1	1.6	1.52	1.48
2	3.2	3.04	2.96
3	4.8	4.56	4.44
4	6.4	6.08	5.92
5	8.0	7.6	7.4
6	9.6	9.12	8.88
7	11.2	10.64	10.36
8	12.8	12.16	11.84
9	14.4	13.68	13.32
10	16	15.2	14.8
11	17.6	16.72	16.28
12	19.2	18.24	17.76

Table 5-5 Nickel Cadmium Battery Voltage Table			
Number of Cells	Temperature in Degrees Fahrenheit		
	Below 32	60	Above 80
1	1.55	1.49	1.45
2	3.1	2.98	2.9
3	4.65	4.47	4.35
4	6.2	5.96	5.8
5	7.75	7.45	7.25
6	9.3	8.94	8.7
7	10.85	10.43	10.15
8	12.4	11.92	11.6
9	13.95	13.41	13.05
10	15.5	14.9	14.5
11	17.05	16.39	15.95
12	18.6	17.88	17.4

5.1.4 Specific Gravity Tables

Specific gravity readings should be taken in the fall of the year and adjusted according to the following Tables.

Table 5-A **Nickel Iron and Nickel Cadmium**	
Actual Solution Level Below the Full Line	**Actual Hydrometer Reading (Specific Gravity)**
1/2”	1.230 or higher
1”	1.240 or higher
1 1/2”	1.250 or higher
2”	1.260 or higher
2 1/2”	1.270 or higher

Note: If the Specific Gravity is found to be equal to or greater than the figures in Table 5-A, add water.

Table 5-B	
Actual Solution Level Below the Full Line	**Actual Hydrometer Reading (Specific Gravity)**
1/2”	1.190 to 1.225
1”	1.200 to 1.235
1 1/2”	1.210 to 1.245
2”	1.220 to 1.265
2 1/2”	1.230 to 1.275

Note: If the Specific Gravity is found to be within the range of Table 5-B, SAB NIFE Renewal Electrolyte should be used to fill the battery.

Table 5-A and Table 5-B are recommended for cold weather areas where zero degrees F (or colder) is common during the winter. Milder climates would use Table 5-A and Table 5-B but reduce all Specific Gravity figures by .020.

Table 5-C **Flooded Lead Acid**	
Specific Gravity (Corrected for Temperature & Level)	**State of Charge**
Above 1220	Indicates Overcharged
1205 – 1220	Indicates Full Charge
1160 – 1205	Indicates Low Charge
Below 1160	Potential Bad Cell

Table 5-D **Electrolyte Level Compensation**	
Actual Solution Level	**Specific Gravity Points**
1/2” Above Full Mark	Add 15
1” Above Full Mark	Add 30
Between Full & Low Marks	No Correction
1/2” Below Low Mark	Subtract 15
1” Below Low Mark	Subtract 30

Table 5-E **Temperature Compensation**	
Temperature	**Specific Gravity Points**
105F	Add 10
90F	Add 5
77F	No Correction
65F	Subtract 5
50F	Subtract 10
35F	Subtract 15
20F	Subtract 20
5F	Subtract 25
-10F	Subtract 30

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Chapter 6 Defect Detector

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6.1 Hot Box Detectors General Instructions

6.1.1 Precaution

Rev. 01/09

Before making any tests, on all central reporting Hotbox Detectors, notify the dispatcher and Signal Operations of the testing. Verify that no trains are on or near the approach to the location under test. Tests made with a train on or near the approach will cause CAD to be out of sync and assign the approaching train's symbol to the test train. When the actual data for the approaching train is transmitted, an improper train symbol will be attached. This will affect train meets planned by CAD and will cause undue train delay. Once testing is complete, contact Signal Operations Center (SOC) to verify test train data was received properly.

6.1.2 Out of Service

Rev. 09/09

The following procedure will be followed by the Manager of Signal Maintenance, or his representative, when taking a defect detector out of service:

1. Notify Signal Operations of the reason the train defect detector is to be removed from service.
2. Provide Signal Operations with the name and contact number of persons other than the local Signal Maintainer that will be performing the work.
3. Provide Signal Operations with the estimated time frame the detector will be removed from service.
4. Notify the dispatcher that the train defect detector is removed from service.

6.1.3 Back in Service

Rev. 09/09

The following procedure will be followed by the Manager of Signal Maintenance, or his representative, when placing a defect detector back in service.

1. Verify that train direction is correct. This must be done following the procedure outlined in step 13 of 6.2.3 Hot Box Detector Semi-Annual Tests and Inspections.
2. Perform heat alarm tests per the specific instructions in 6.2.2 Heat Alarm Tests. Verify that the correct rail is indicated for the side alarmed.
3. Notify Signal Operations that the train defect detector is ready to be placed back in service.
4. View the train summary and verify the correct site orientation with Signal Operations. This will be either north/south or east/west.

5. Upon completion of these criteria, Signal Operations must verify receipt of the alarm matching the correct rail of the alarm test.
6. Notify the dispatcher that the train defect detector is back in service.

6.1.4 Schedule, Parts and Instructions Rev. 09/09

A. **Precaution.** Rev. 09/09

Always determine the location of approaching trains and provide the proper protection before beginning any tests.

B. **Schedule Inspection Early.** Rev. 09/09

Arrange schedule to allow for inspection to occur early in the day and the work week. Report any problems found immediately.

C. **Order Parts.** Rev. 09/09

Signal Maintainers are responsible for ensuring all necessary maintenance items for hotbox detectors on the assigned district are ordered through the supervisor. It is the Electronic Technician's or the assigned employee's responsibility to ensure that the latest software revision is ordered and installed.

D. **Post Current Instructions.** Rev. 05/15

Ensure individual maintenance instructions, appropriate manufacturer's instruction manuals, FCC Radio License, current alarm level/parameters, and signal circuit plans for hotbox detector systems are current and posted in each hotbox detector enclosure.

6.1.5 Routine Inspections and Maintenance of All Hotbox and Dragging Equipment Detectors. Rev. 09/09

Note: When rail gangs are working in the vicinity of a detector, all rail-side equipment will be removed to allow mechanical surfacing and tamping.

A. **Cables.** Rev. 05/15

Transducer cables and dragger cables must be secured to ties and/or rails. To prevent possible pinching or smashing, cables should be arranged to clear all spikes and anchors. Cables must be properly sealed. Verify that all cables are properly tagged in junction boxes and enclosures.

B. **Scanner Assemblies.** Rev. 05/15

Ballast should be cleared from beneath mounts and track-side assemblies to provide sufficient clearance and drainage. Inside of scanner assemblies must be cleaned as often as necessary to prevent accumulation of sand, and dirt, dust, etc.

C. **Transducers.** Rev. 05/15

Transducers must be kept clean and tight, per Hot Box Detector Bi-Weekly Test and Inspections Step 5. Spikes and anchors that may strike the bottom or side of the transducer must be removed and/or plugged. When transducers are installed or replaced, mount with approved nuts, bolts and hardware (Stage 8). Rail must be free of lettering. Remove excess rubber/sleeve from both sides of transducer. For Servo/Trip transducers, silicone will be applied between the rail and transducer, and torque plates installed. and Torque to manufacturer's specifications.

D. **Rail Anchors and Gauge Rods.** Rev. 05/15

Work with the track forces to ensure that the rail is 100% solid box anchored 250 feet in each direction from the scanner heads (Engineering Track Maintenance Handbook 4.17.5). At locations with wood ties, install gauge rods or gauge plates to ensure proper gauge.

E. **Junction Boxes.** Rev. 09/09

Junction boxes must be inspected for condensation and water.

F. **Dragging Equipment Detectors.** Rev. 05/15

Paddle type detectors should have ballast removed below the bottom of the mechanism assembly and mounting brackets to ensure proper drainage, and any paddle that is out of line should be repaired or replaced (6.5.5C.). Install DED according to Standard Drawings.

Note: Other DED types can be found under 6.5.5Dragging Equipment Detectors Test on page 6-30.

G. **Train Summary.** Rev. 05/15

Review train summary to verify that transducer counts are equal. Review average bearing temperatures of East/North compared to West/South. Temperatures should be within approximately 5 degrees Fahrenheit or 0.6 millimeters. Review detector voltages if available. Review accuracy of ambient temperature (+/- 5 degrees Fahrenheit). If necessary, replace probe. Review summary of system warning, defects, and integrity failures. Ascertain, if possible, the cause of failures. Review integrity heat values for maximum readings and consistency.

H. **Records.** Rev. 09/09

Fill out the hotbox detector bi-weekly (every two weeks), semi-annual (every six months) on on page) after completing tests. In addition to the periodic forms that are required, all non-routine calls will be recorded at the location. Information will include: reason for the call, time and complete date (day, month and year), action taken and the initials of the person called. A remedy trouble ticket must be created with SOC to track all non-routine calls.

I. **Alarm Levels.** Rev. 05/15

Prior to performing routine inspections and maintenance, current alarm level information and parameter settings should be verified. Current alarm level information and parameter settings can be found in:

- Signal Business Area
- Signal Bulletin Board
- Defect Detectors

J. **Power Down and Power Up for the STC 2058.** Rev. 05/15

If it becomes necessary to reset or power down the STC 2058 Sentry System detector (Central Reporting or Stand-Alone with Com Board)

1. Power Down
   - **a.** Remove the battery fuse.
   - **b.** Remove the 3 or 5 amp AC fuse on the power supply module. (Left Fuse)
   - **c.** Remove the 6 amp DC fuse on the power supply module. (Right Fuse)
2. Power Up
   - **a.** Install the 6 amp DC fuse on the power supply module. (Right Fuse)
   - **b.** Install the 3 or 5 amp AC fuse on the power supply module. (Left Fuse)
   - **c.** Install the battery fuse.

6.2 Hot Box Detector Tests

6.2.1 Hot Box Detector Bi-Weekly Test and Inspections Rev. 05/15

Tests to be completed by the Signal Maintainer. Conditions or performance data may warrant more frequent tests and inspections (e.g. heavy coal and grain traffic). Review central reporting data to ensure proper operation. Perform appropriate tests to ensure proper operation anytime repairs, replacement or software upgrades are done.

1. Recorders/Printers

   A. Review train summary and defect summary. Verify detector is operating properly.

   B. Record rail 1 and 2's average temperature of the last train.

   C. Check for correct time and date. (Correct if necessary).

2. Clean mirrors and lenses bi-weekly, or more frequently as conditions warrant.

   A. The STC lens cleaning wand **will not be used** and must be removed from all locations.

   B. Specific instructions and the required supplies for proper mirror and lens cleaning procedures are found on the website in the Signal Business Area (link) and must be followed.

   C. Check the Signal Business Area periodically for updates. Use this link or search under:

   Union Pacific Home Page

   - Departments
   - Engineering
   - Signal

   Signal Business Area

   - Signal Bulletin Board tab
   - Defect Detectors

3. Check scanners, gauge rods, gauge plates, deflectors, and DED's for damage and make sure all the hardware is tight. Torque as follows:

   A. Torque Servo rail mount scanner bolts at 60 foot pounds.

   B. Torque STC rail mount scanner bolts at 50 foot pounds.

4. Verify scanner heaters are operating properly.

   A. Check scanner heaters by touch.

   i. Harmon Model 32/75 scanner heaters must be installed through an isolation transformer to ensure safety. The DC-AC inverter must not provide the heater power.

   ii. STC - Check the status panel for N-E and S-W heater LEDs. Verify the heaters are working.

Note: Scanner heaters are not to be disconnected in the summer. All scanners have thermostatically controlled heaters and will only operate when the temperature warrants. Heaters also prevent condensation build-up on mirrors and lenses. The Servo ACS scanners are designed to operate at an elevated temperature.

5. Inspect and test transducers.

   A. Check transducer height from the top of the rail.

   - Harmon = 1 3/4 inches to 2 inches
   - Servo = As high as the design allows. Transducer modification may be required on 141# rail.
   - STC = 1 9/16 inches.

   B. Check tightness of bolts or clamps.

   - Harmon = 35 foot pounds.
   - Servo = 25 foot pounds without torque plate or 35 foot pounds with torque plate.
   - STC = 30-35 foot pounds mounting plate and 5-10 foot pounds transducer bolts.

   C. Strike each transducer with a non-metallic object. If system turns on, correct the defect. (Exclude Southern Tech.)

   D. Clean any metal filings from the transducers.

   E. Check all transducers, cables and hoses for damage. Replace or repair as needed.

6. Perform heat alarm test on both rails and the DED alarm test for both directions.

   A. For Central Reporting systems, call Harriman and notify them that you will be testing.

   B. All HBD systems must have the North or East rail designated as rail #1.

   C. Perform heat alarm test per the specific instructions in this section.

   D. Test associated defect detectors (e.g. dragging equipment, shifted load, wind speed, etc.)

   i. Test paddle type DED in both directions.

   ii. Test split DED for sections in both directions.

   iii. Test impact DED alarm test for all sections.

   iv. High and Wide load test, break all circuits.

E. Verify with the detector download, alarms are received and indicating on the correct rail.

F. Verify spikes are removed from under all transducers.

Note: Detector should activate on any test with an audible alarm.

7. Record the results of the test and inspection on Form 24240 Hotbox Detector Tests on page 1-67.

Note: Anytime repairs are made to the system, or software upgrades are done, appropriate tests should be performed to ensure proper operation.

6.2.2 Heat Alarm Tests

Rev. 09/09

A barbecue briquette electric heating iron is the recommended heat source. Keep the heat source (200 degrees above ambient) moving to prevent multiple alarms. Heat alarm tests must be verified with SOC to be received and indicating on the correct rail.

A. Harmon 32/75 Heat Test

Rev. 09/09

1. Turn the dial to mode position "E".
2. Press the data advance, either direction. (toggle once for West, toggle twice for East.)
3. Pass a heat source by the scanner on each rail and function test the dragger in both directions, if equipped.
4. Press the data advance again to stop the gating.
5. Listen for the alarm and check the print out for results.

B. Micro HBD

Rev. 02/15

1. To simulate a train crossing the detector, use the Display Mode ‘T’ command.
2. Designate axle count and train direction.
3. Pass a heat source by the scanner on each rail and function test the dragger in both directions, if equipped.
4. Listen for the alarm and check the computer “last train” summary for results.

C. STC Model 2058

Rev. 02/15

This procedure applies to central reporting and stand-alone systems with com boards.

1. Press the SYS button located on the analyzer keypad
2. Verify that the gate test is on the display

3. Press "yes" twice. When the gating starts you will have three minutes to perform the tests, the system will simulate 256 axles
4. Pass the heat source by each scanner and function test the dragger, if equipped
5. Listen to the detector message and print out a report

This procedure applies to stand-alone systems without com boards.

1. Shunt track circuit
2. Manually gate transducers
3. While gating transducers, apply heat to both scanners and activate dragger/High Wide in both directions
4. Stop manual gating and remove shunt
5. Listen to the detector message and print out a report

D. **STC Model 2300** Rev. 02/15

1. From main menu, select option “I” setup menu
2. From setup menu select “H” system function
3. From the system function menu select “C” gate test
4. To start gate test type “Y”
5. Apply the heat source to each scanner and function test the dragger/High Wide, if equipped. It is not necessary to alarm the hot wheel detector, if equipped.
6. Listen to the detector message, press [Esc] to return to main menu and review the last train summary

E. **Servo 9000** Rev. 09/09

Note: Do not leave the function simulator plugged into the system when not being used.

1. Plug the function simulator front panel connector cable into connector J3 on the back of the system power supply.
2. Press the CPU reset pushbutton located on the edge of the CPU card, slot number 9 in the DPU. Press “F” on keyboard to check ambient temperature.
3. Ground TB1-2, located on the back of the DPU, to the chassis. The function simulator is used as a gate source only, the heat should be adjusted to a minimum value.
4. Turn the function simulator "power" switch to the "on" position. Refer to alarm table for temperature setting.

5. Turn the function simulator "gate" switch to the "on" position.
6. Pass the heat source by each scanner and function test the dragger in both directions, if equipped. Turn the function simulator's "gate" switch off. Listen to the detector message. Upon completion of the test, turn the function simulator "power" switch off; and unplug the function simulator.
7. Remove the ground wire from TB1-2. If the ground wire is not removed, the system will remain in an idle state. This wire must be removed in order for the system to be operational.
8. Print out a report and after all the data has been extracted, press the reset pushbutton on the CPU card.

When software versions CPU "I" and PCON "I" are used, trains generated with the "enhanced function simulator" will send information to the SOC technician desk and not to the train dispatcher.

F. UP HBD 250

Rev. 09/09

1. Connect the Servo function simulator heat source to the blue box.
2. Turn on the function simulator power switch and gating switch to simulate gating, pass the heat source by each scanner and function test the dragger in both directions, if equipped.

   Note: leave the heat set at minimum. The simulator should not be used as the heat source.
3. Turn off and unplug the heat source and function simulator. Listen to detector message.
4. Print out a report.

G. Cyberscan 2000

Rev. 09/09

1. Activate the MENU on the hand held remote terminal by pressing any key on the keypad
2. Push < enter> at the prompt
3. Press < 0> (zero) to scroll through the menu until the test menu appears.
4. From the test menu Press<3>
5. The SIM TRAINS menu will appear. Press <4> (EFS)
6. Connect function simulator to the Cyberscan unit and power on.
7. To start the test, turn the function simulator gate switch to on.
8. Pass the heat source over both scanners and activate the dragger in both directions. Listen for alarm tones.

9. Turn the function simulator gate switch to off to end test. Listen to the end of train report for the proper alarm sequence.
10. Turn the power off on the function simulator, and remove the plug.
11. Review train data.

6.2.3 Hot Box Detector Semi-Annual Tests and Inspections Rev. 05/15

Semi-annual inspections and tests are to be completed by the Signal Maintainer and/or other qualified employee.

1. Review printout of train data.
2. Check scanner height and alignment using the alignment procedures for each individual detector type.
3. Clean the mirrors and lenses as outlined in 6.2.1 Hot Box Detector Bi-Weekly Test and Inspections on page 6-4.
4. Calibrate the system using the appropriate instructions and calibration chart.
5. Perform remaining 6.2.1 Hot Box Detector Bi-Weekly Test and Inspections on page 6-4.
6. Check carrier levels, if applicable.
7. Check and record voltages on appropriate form.
8. Check all wiring connections for tightness and cleanliness. Ensure that all relays, boards, and plugs are properly seated. Verify that all cables are properly tagged in junction boxes and enclosures.
9. Verify that the location has a current radio license. Notify Communications Technician when license has expired.
10. Where chart recorders are used, check for proper operation, calibration and pen settings.
11. Perform board self-test. UPRR (Blue Box) switch to AUX.3 - test all cards; and press the "execute" or the center button to run the test. Harmon Model 32/75 systems, place in the self test mode and push the "data advance" switch to run the test. Servo 9000, press the “S” to execute the self test. This does not apply to the STC detectors, Cyberscan, or Micro HBDs.
12. If the detector is equipped with a radio, determine that the radio is operating properly by listening to the message with a separate radio. Verify that the message is correct and understandable. Key the system on and stroke the gating transducers. Message should be understandable at approximately 2 miles, or verify detector’s exit message with train crew when possible. Test with wattmeter if available.

13. Confirm that the detector indicates the proper train direction. This cannot be done by generating a test train. If no trains are expected at the location use the following procedure.
    - If advance transducer equipped, strike advance start transducer with a metallic object. Strike the north or east advance transducer to simulate a south or westbound train.
    - If short range track circuit equipped, shunt short range track circuit.
    - Activate the gating transducers manually by striking the north or east transducer first to simulate a south or west bound train with at least 24 axles. Review train summary and verify the direction shown is the same as the simulated train.
14. Verify that the prints, manuals and instructions are current and correct.
15. Inspect the lightning protection, ground rods, ground connections and aerial cables. Resistance to ground must be measured from ground buss and documented. Refer to 1.1.5 Proper Grounding on page 1-4.
16. Check track gauge 100 feet in each direction from the scanner. Gauge in this area should be maintained to 56 1/2 inches. Inspect the insulation in gauge plates and gauge rods. The track should be 100% solid box anchored 250 feet in each direction from the scanner heads. Track surface should not deviate or pump.
17. On paddle type draggers, check for proper contact adjustment by performing the 8-degree deflection test. Move the paddles 1 1/2 inches in each direction and verify that the contacts open. Apply grease to the fittings while depressing the paddle in both directions.
18. Inspect all enclosures to verify that gaskets are properly placed and enclosures are rodent free.
19. Lubricate all hinges and doors.
20. Record results of the test and inspection on Form 24240 Hotbox Detector Tests on page 1-67

Note: Perform Servo lens focusing procedures only if needed.

6.3 Alignment Procedures

6.3.1 Triangulate Scanner Heads

Rev. 01/09

Before performing the alignment procedure for any of the various scanners, verify that the scanner located closest to the gating transducers is properly located relative to the gating transducers.

Then follow the triangulation procedure to ensure that the other scanner head is located directly across from the scanner head closest to the gating transducers. The triangulation should be done from the reference mark on the tie, to the scanner centerline mark on rail, or a common point on both scanners.

1. Select a tie approximately 15 feet in either direction from the scanners. Measure from the inside base of both rails to find the tie's center and anchor a length of insulated wire long enough to reach the center of both scanners.
2. Keeping the wire taut, bring it to the common reference point on the scanner head closest to the gating transducers and mark the wire.
3. Then, keeping the wire taut, move the wire to the other scanner head. Position the scanner where the mark on the wire is aligned with the common reference point.

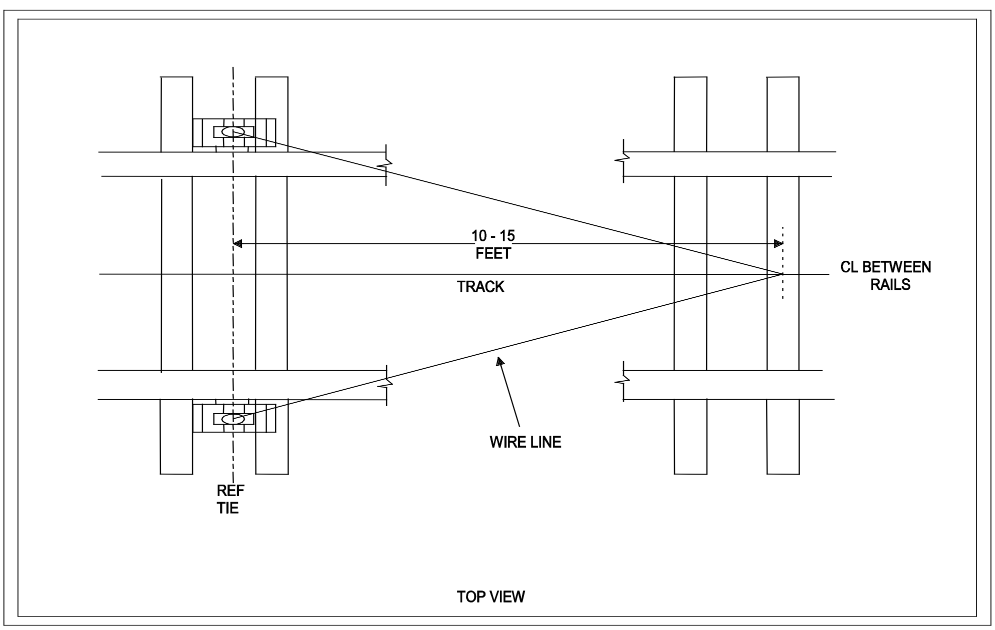

Figure 6-1

6.3.2 Alignment Procedure for Harmon Tie-mount Scanners

Rev. 01/09

1. Triangulate scanner heads.

2. Square and level the scanners. Adjust and square the ties as necessary. The top of the scanner should be 1 inch below the top of the rail. (See Drawing 250H_SV.DGN)
3. Place the alignment fixture 26 inches from the center of the scanner, between the transducers.
4. **Do not look directly into the laser, it will cause permanent eye damage.**
5. Power down, remove scanner cover and replace the preamp with the laser unit; then power up.
6. Adjust the scanner mirror so the laser beam strikes the center of the target. To verify proper alignment, replace the scanner cover and insert the white plastic alignment fixture in the shutter opening. If the laser beam does not light up the post, the alignment is not correct and must be adjusted. If laser beam does not light up the post, and are unable to adjust, contact the Electronic Technician for assistance. Repeat procedures numbers 2-4 for opposite scanner.
7. After scanners are properly aligned, power down and replace the laser unit with the preamp, replace scanner cover(s) and remove the alignment fixture. Power up and verify that the detector is operating properly.
8. Calibrate only after alignment procedures are complete.

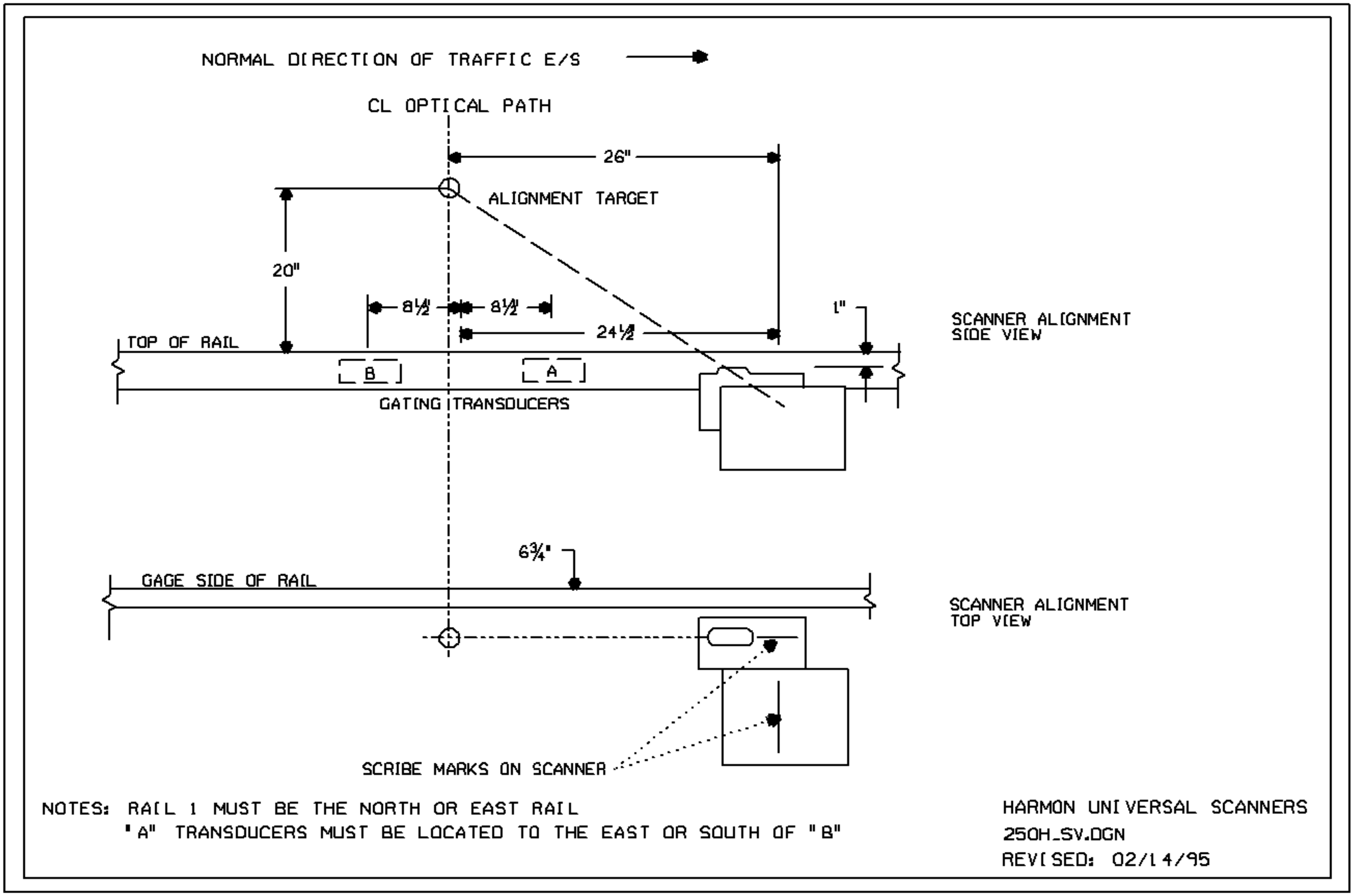
NORMAL DIRECTION OF TRAFFIC E/S
CL OPTICAL PATH
26"
ALIGNMENT TARGET
20"
8½
8½
24½
1"
SCANNER ALIGNMENT
SIDE VIEW
TOP OF RAIL
B
A
GATING TRANSDUCERS
6¾"
GAGE SIDE OF RAIL
SCANNER ALIGNMENT
TOP VIEW
SCRIBE MARKS ON SCANNER
NOTES: RAIL 1 MUST BE THE NORTH OR EAST RAIL
"A" TRANSDUCERS MUST BE LOCATED TO THE EAST OR SOUTH OF "B"
HARMON UNIVERSAL SCANNERS
250H_SV.DGN
REVISED: 02/14/95

Figure 6-2

6.3.3 Alignment Procedures for Servo Scanners 9000, 8808, 8909, ACS

Rev. 01/09

1. Triangulate scanner heads.
2. Mark a reference mark on the rail at the centerline of scanner opening. Measure from this mark 20 inches to a point between “A” and “B” transducers and make another mark on each rail. This is the alignment mark. (See Figure 6-3 on page 6-16)
3. Check the measurement between the “A” & “B” transducers. The centerline of each transducer should be 12 inches from the alignment mark.
4. Center the Universal Alignment Fixture Bar (UAFB) over the alignment mark on each rail.
5. Turn off the AC power to scanner covers.
6. Remove the cover from each scanner and place the alignment mirror over the lens.
7. Put the target bar on the 7 1/4 (+/-1/4) inch mark of the UAFB. Sight through the hole in the target; you should see a red dot in the center of a black circle if the scanner is correctly aligned.

   Note: Both right and left scanners should align to the same relative point.
8. Remove the mirror from the scanner lens, reinstall the scanner covers and remove UAFB from the rail. Restore AC power to the cover heaters.
9. Perform a heat test and recalibrate if necessary.
10. Check transducer “C”, it should be 40 feet (+/- 6 inches) from transducer “A”. Transducer “D” should be 40 feet (+/- 6 inches) from transducer “B”. Perform an activation test.

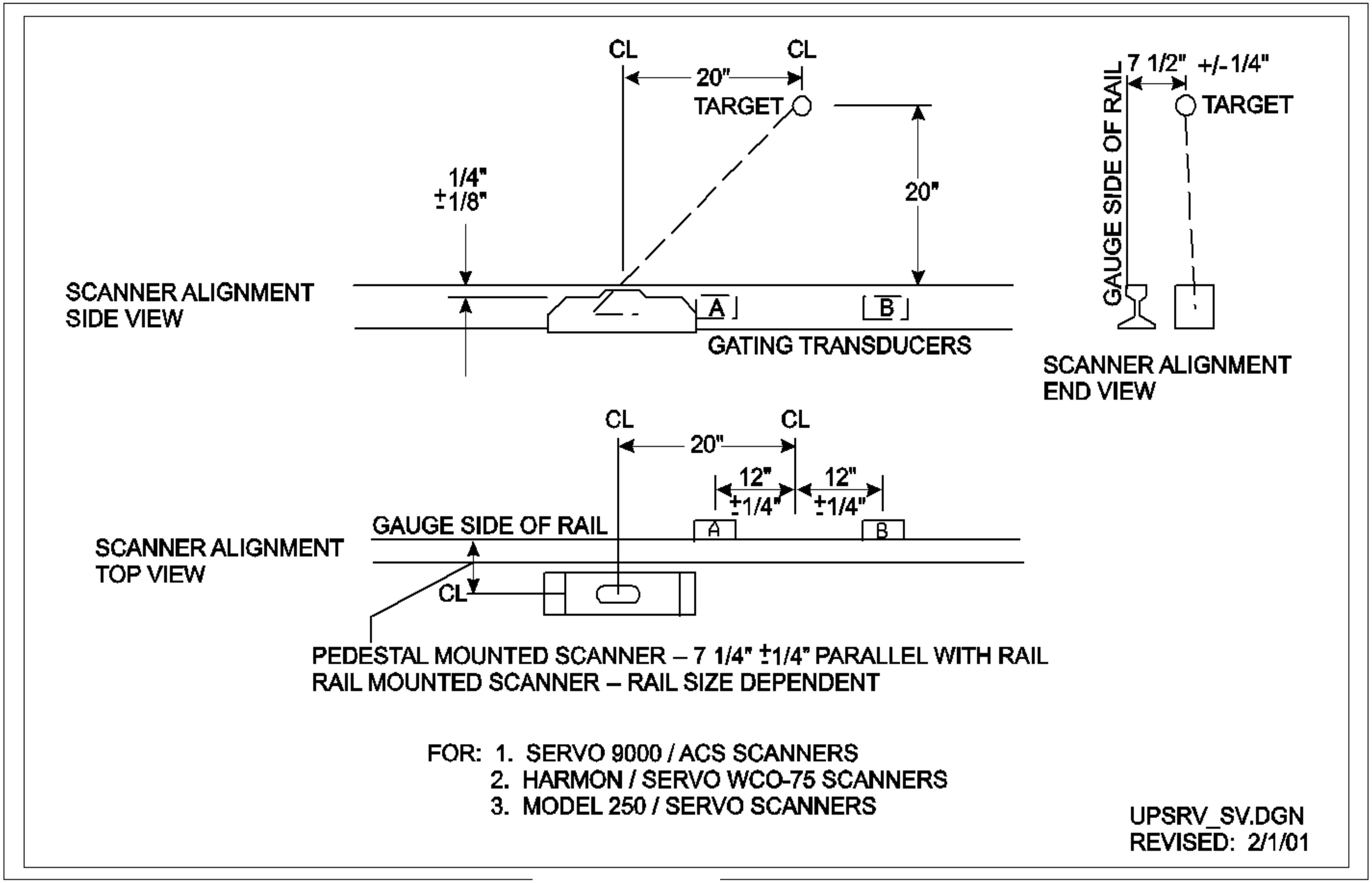
CL
CL
20"
TARGET
20"
1/4"
±1/8"
SCANNER ALIGNMENT
SIDE VIEW
A
B
GATING TRANSDUCERS
7 1/2" +/- 1/4"
GAUGE SIDE OF RAIL
TARGET
SCANNER ALIGNMENT
END VIEW
CL
CL
20"
12"
±1/4"
12"
±1/4"
GAUGE SIDE OF RAIL
A
B
SCANNER ALIGNMENT
TOP VIEW
CL
PEDESTAL MOUNTED SCANNER – 7 1/4" ±1/4" PARALLEL WITH RAIL
RAIL MOUNTED SCANNER – RAIL SIZE DEPENDENT
FOR: 1. SERVO 9000 / ACS SCANNERS
2. HARMON / SERVO WCO-75 SCANNERS
3. MODEL 250 / SERVO SCANNERS
UPSRV_SV.DGN
REVISED: 2/1/01

Figure 6-3

6.3.4 Servo Lens Focusing

Rev. 02/01

1. Check scanner alignment.
2. Mount function simulator on upright post of alignment fixture using mounting plate.
3. Set function simulator to:
   - **a.** Coarse 225
   - **b.** Fine 25
   - **c.** Power on
   - **d.** Gate on
4. Allow 2-3 minutes to stabilize
5. Loosen the set screws to allow the lens to move, then slide the lens back and forward to obtain a peak reading. Tighten the set screws and calibrate.

   Note: New scanner lenses are focused at the factory.

6.3.5 Alignment Procedure for GE Scanners

Rev. 02/01

1. Triangulate scanner heads.
2. Remove scanner covers.
3. Forward stud should be 21 1/2 inches from gage side of rail and at least 14 1/2 inches below top of rail.
4. From the reference marks (step 3) measure 28 1/16 inches to a point between the “A” and “B” transducers and make another mark on each rail. These are alignment marks. (Refer to Figure 6-4)
5. Center the Servo Universal Alignment Fixture Bar (UAFB) over the alignment marks on each rail. Set target on bar 14 inches from gage side of rail.
6. Turn off power to preamp and remove preamp from scanner mount. Install laser in preamp cradle and connect to appropriate power source, energize. If alignment is correct the laser dot will be in the center hole of the UAFB target. Repeat for each scanner.

   Note: Do not look directly into the laser, it will cause permanent eye damage.
7. Make any necessary adjustments to the scanner base and mounts to obtain proper alignment.
8. Turn off power, remove laser and the UAFB. Reinstall preamp and replace scanner covers.

9. Restore power and check for proper heat setting and calibrate if necessary.
10. Check measurements between “A” and “B” transducers. Center line of transducer “A” should be 14 inches from alignment mark. Center line of transducer “B” should be 10 inches from alignment mark.
11. Check “C” and “D” transducer measurements. Transducer center line should be 150 feet from the alignment mark on the rail.

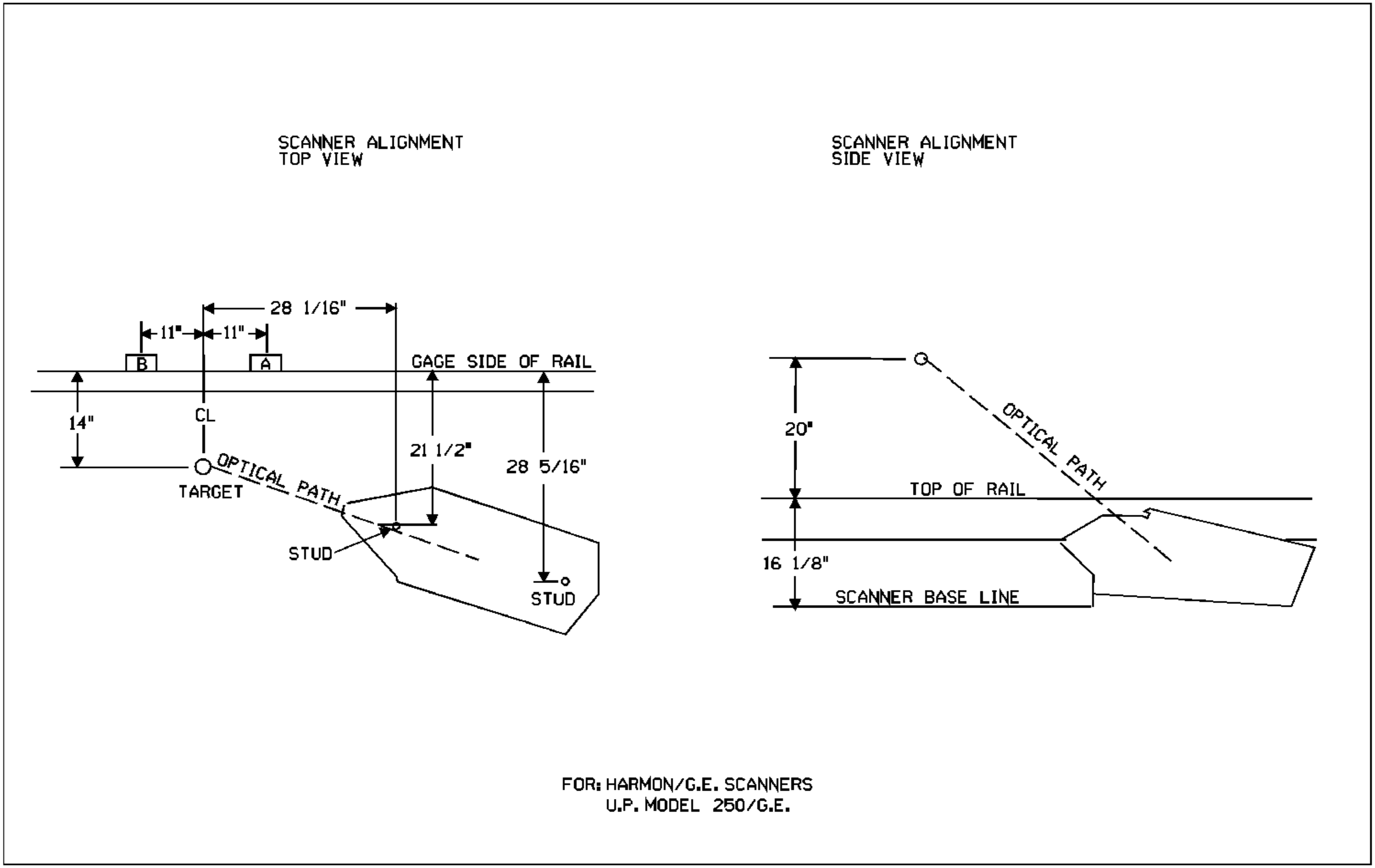
SCANNER ALIGNMENT
TOP VIEW
28 1/16"
11"
11"
B
A
GAGE SIDE OF RAIL
14"
CL
21 1/2"
28 5/16"
OPTICAL PATH
TARGET
STUD
STUD
SCANNER ALIGNMENT
SIDE VIEW
20"
OPTICAL PATH
TOP OF RAIL
16 1/8"
SCANNER BASE LINE
FOR: HARMON/G.E. SCANNERS
U.P. MODEL 250/G.E.

Figure 6-4

6.3.6 Alignment Procedure for STC Scanners

Rev. 01/09

1. Triangulate scanner heads.
2. Place the Alignment fixture across both rails at the alignment marks Remove covers and install the reflector block in the top of the scanner module.
3. Check the scanner alignment for horizontal 7 1/4 inch and vertical of 18 inch.
4. Remove reflector block. Remove bar. Replace covers

   Note: If scanner adjustment is necessary, refer to STC Manual.

6.4 Calibration Procedures

6.4.1 Calibration Devices

Rev. 01/09

A. **Servotherm Function Generator (Silver with Black writing)** Rev. 01/09

1. Device used in conjunction with: Servo 8808 Scanners, Servo 8909 Scanners, and Servo ACS.
2. Gating switch used when calibrating: Servo 9000 and Blue Box.
3. Device must be allowed time to achieve ambient temperature; recommend 20 minutes in shady area. If possible, reference the chopper blade temperature as ambient with a non contact thermometer.
4. Set temperature according to the detector instructions, turn power on, and allow 20 minutes for generator to stabilize at calibration temperature.
5. As the sensor cycles calibrate at highest end of heat cycle (peak).
6. Always ensure Heat Generator is turned off when not in use.
7. If Function Generator fails to achieve appropriate temperature return for repair.

   Note: Do not open device, asbestos is present.

B. **Servotherm Function Simulator (Silver and Red)** Rev. 01/09

1. Device used in conjunction with: Servo 8808 Scanners, Servo 8909 Scanners, and Servo ACS.
2. Gating switch used when calibrating: Servo 9000 and Blue Box.
3. Device must be allowed time to achieve ambient temperature; recommend 20 minutes in shady area. If possible, reference the chopper blade temperature as ambient with a non contact thermometer.

4. Set temperature according to the detector instructions, turn power on, allow no more than 5 minutes for generator to stabilize at calibration temperature.
5. As the sensor cycles calibrate at lowest end of heat cycle (valley).
6. Always ensure Function Simulator is turned off when not in use, set to lowest heat settings.
7. If Function Simulator fails to achieve appropriate temperature return for repair.

6.4.2 STC Calibrated Heat Sources

Rev. 01/09

A. **Models 2067 and 2100-810**

Rev. 01/09

1. Device used in conjunction with the Sentry System 2058 with Type 1 Scanners.
2. Plug in device, place in shady area, allow 30 minutes for generator to stabilize at calibration temperature, LED on front panel of heat sources will cycle on and off.
3. Subzero switch must be in the off position at ambient temperatures above 32 degrees F.
4. As the sensor cycles calibrate at highest end of heat cycle (peak).
5. Always ensure Calibrated Heat Source is unplugged when not in use.
6. If Calibrated Heat Source fails to achieve appropriate temperature return for repair.

B. **STC Adjustable Heat Source Generation 1**
(Two Digital Displays, Model 2100-810XX)

Rev. 01/09

1. Device may be used in conjunction with all Scanners when proper adapters are provided.
2. Plug in device, ensure all switches are off, place in shady area, allow 30 minutes for Heat Source Ambient Temperature (left digital display) to stabilize.
3. When left digital display (Heat Source Ambient Temperature) stabilizes use the three buttons on right display to set calibrating temperature.
4. Push left button on the right display twice, display will read SP (Set Point).
5. Display will show calibrating temperature (e.g. 240.6).
6. Push Right or Center button on the right display to set the calibrating temperature (Set Point).
7. Push the left button on the right display twice (display will read PROC).

8. Turn on heat switch; heat source will begin to heat toward set point.
9. Allow Heat Source to reach set point (right display), review ambient temperature (left display) for any change.
10. If ambient temperature has changed, adjustment must be made to the Set Point temperature, as necessary repeat step 3.
11. When calibration is complete turn off all switches unplug heat source.

C. **STC Adjustable Heat Source Generation 2 (One Rotating Switch, One Meter, Model 2100-810NG)** Rev. 01/09

1. Device may be used in conjunction with all Scanners when proper adapters are provided. Use only when outside temperature is between 0 and 90 degrees Fahrenheit.
2. The function connector which is not being used has live AC present, keep covered when not in use.
3. Set Gating switch as necessary for equipment to be tested. OFF for all equipment except Servo 9000, Cyberscan 2000, and UP HBD Model 250.
4. Use rotary switch to select desired calibrating temperature for equipment to be tested.
5. Plug in Heat source, allow approximately eight (8) minutes in a shady area for heat source to stabilize.
6. When meter needle centers, begin calibration.
7. When calibration is complete, unplug heat source.

D. **STC Sentry System 2058 Scanner** Rev. 01/09

Note: If ambient temperature is above 90 degrees F or below 32 degrees F, do not calibrate.

1. Plug in the heat source for 30 minutes. (Remove covers and clean lenses while waiting for heat source to stabilize).
2. Put the heat source firmly on Rail 1 (North or East) scanner
3. Press <CAL> on the keypad
4. Press <YES>
5. Press <NO>
6. Adjust the pot under the cursor to 180 degrees peak.
7. Press <YES>
8. Move heat source to Rail 2 (South or West) scanner.
9. Press <NO>

10. Adjust the pot under the cursor to 180 degrees peak.
11. Press <YES>
12. Remove heat source from scanners and unplug.
13. Put the covers back on scanners.
14. Perform a heat alarm test.

    Note: If the unit times out while performing calibration, go to step 3 and repeat the process. (If on Rail 2, change step 5 to Yes.)

E. **Cyberscan 2000** Rev. 01/09

Note: To activate the MENU on the hand held remote terminal, press any key on the keypad. Then push < enter > at the prompt. Press < 0 > (zero) to scroll through the menu until the TEST Menu appears. Press < 2 >. Proceed to step number 1.

1. Clean mirrors and lenses.
2. Verify current ambient temperature.
3. From the calibrate menu Press < 2 > (calibrate HBD)
4. Ambient < Y, N > IF temperature is correct press < Y >. If no temperature probe has been installed, then enter the current ambient temperature, press < enter >, then press < Y >.
5. Plug the function simulator into the D board and set dial on the function simulator to the displayed pyro-bolo temperature.
6. Turn the function simulator power ON. Let stabilize for approximately 2 to 3 minutes.
7. Press < enter >.
8. Put the simulator on Rail 1 scanner.
9. Turn function simulator gate switch on. The system will respond with (calibration under way).
10. When the gating has finished, the system will display gain for Rail 1. Enter < Y >.
11. Move the function simulator to Rail 2 and push < Y > to calibrate.
12. When the gating has finished, the system will display gain for Rail 2. Enter < Y >.
13. Remove the simulator from the scanner.
14. Turn off the simulator, gate off and disconnect the simulator from Board D.

15. Perform heat alarm test.

F. **STC 2300 Smartscan** Rev. 01/09

Note: STC recommends that the calibrated heat source (2100-810NG) be used only when the outside (ambient) temperature is above 0°F (-18°C) and below 90°F (32°C).

1. Plug in the heat source and turn off gating switch (if equipped).
2. Remove hot wheel apertures (if equipped) and clean lenses while waiting for heat source to stabilize.
3. Put the heat source firmly on Rail 1 (North or East) scanner.
4. From Main Menu press < I > for the Setup Menu.
5. From the Setup Menu press < H > for the Systems Functions Menu.
6. From Systems Functions Menu press < E > to Auto-Calibrate.
7. When Auto-Calibration Disengaged is displayed move heat source to Rail 2 and repeat step 6.
8. When Auto-Calibration Disengaged is displayed move heat source to Rail 3 and repeat step 6.
9. When Auto-Calibration Disengaged is displayed move heat source to Rail 4 and repeat step 6.
10. Replace hot wheel apertures; marker dot must be facing rail.
11. Perform a heat alarm test on bearing scanners only.

G. **Harmon WCO/75 (Bolometer)** Rev. 01/09

NOTE: Do not allow Servo simulator to remain on for more than five minutes before beginning calibration.

1. Clean lenses.
2. If necessary, power down and position interface board in test slot.
3. Restore power.
4. Plug in the heat source. adjust to temperature setting on calibration chart.
5. Place function switch in B position (CHOP mode) and toggle the Data Advance switch.
6. Put the heat source firmly on Rail 1 (North or East) scanner.
7. Adjust Channel 1 to 10MM using R68.
8. Move the heat source to Rail 2 (South or West) scanner.
9. Adjust Channel 2 to 10MM using R85.
10. When complete, power down and replace interface board in chassis.

11. Restore power.
12. Place function switch in E position.
13. Perform a heat alarm test.

H. **Harmon WCO/75 (Pyrometer)** Rev. 01/09

NOTE: Do not allow Servo simulator to remain on for more than five minutes before beginning calibration.

1. Clean lenses.
2. Plug in the heat source.
3. Adjust temperature setting to 130 degrees over ambient temperature.
4. Place function switch in B position (CHOP mode) and toggle the Data Advance switch.
5. Put the heat source firmly on Rail 1 (North or East) scanner.
6. Adjust Channel 1 to 10MM using variable resistor R12.
7. Stop rotation of Chopper wheel on heat source, measure "Channel 1 IN" test point for DC voltage and record voltage.
8. Measure "Offset Channel 1" test point.
9. Adjust "Offset Channel 1" pot R14 0.2 volts more negative than the voltage recorded in step 8.
10. Move the heat source to Rail 2 (South or West) scanner.
11. Adjust Channel 2 to 10MM using pot R28.
12. Stop rotation of Chopper wheel on heat source.
13. Measure "Channel 2 IN" test point for DC voltage and record voltage.
14. Measure "Offset Channel 2" test point.
15. Adjust "Offset Channel 2" pot R30 0.2 volts more negative than the voltage recorded in step 14.
16. Place function switch in E position.
17. Perform a heat alarm test.

I. **Harmon WCO/32 (Model 38 preamp shutterless system)** Rev. 01/09

1. Clean lenses.
2. Plug in the heat source and adjust temperature setting to 126 degrees over ambient temperature.
3. Place heat source on Rail 1 (North/East) scanner.

4. Place the switch in position B (CHOP mode), measure “Channel 1 IN” test point for DC voltage and record voltage.
5. Adjust DC BAL CH 1 (R77) for 0 volts DC +/- 0.2.
6. Adjust CH1 gain pot (R76) for 12MM.
7. Toggle reset switch to close shutters.
8. Measure “Channel 1 IN” test point again for DC voltage and record voltage.
9. Adjust DC BAL CH 1 (R77) for 0 volts DC +/- 0.2.
10. Toggle data advance switch to open shutters, recheck detector for 12MM.
11. Adjust pot (R76) if necessary.
12. If adjusted, recheck DC balance. Continue until no change is required.
13. Toggle reset switch to close shutters.
14. Measure “Offset Channel 1” test point.
15. Adjust “Offset Channel 1” pot (R14) for 0.2 volts more negative than the DC voltage measured at the “Channel 1 IN” test point.
16. Move heat source to Rail 2 (South/West) scanner.
17. Toggle date advance to display Channel 2.
18. Adjust DC BAL CH 2 (R82) for 0 volts DC +/- 0.2.
19. Adjust CH2 gain pot (R81) for 12MM.
20. Toggle reset switch to close shutters.
21. Measure “Channel 2 IN” test point again for DC voltage and record voltage.
22. Adjust DC BAL CH 2 (R82) for 0 volts DC +/- 0.2.
23. Toggle data advance switch to open shutters, recheck detector for 12MM.
24. Adjust pot (R81) if necessary.
25. If adjusted, recheck DC balance. Continue until no change is required.
26. Toggle reset switch to close shutters.
27. Measure “Offset Channel 2” test point.
28. Adjust “Offset Channel 2” pot (R30) for 0.2 volts more negative than the DC voltage measured at the “Channel 2 IN” test point.
29. Place function switch in E position.
30. Perform a heat alarm test.

J. **Micro HBD** Rev. 01/09

Note: To perform calibration process computer must be connected.

1. Remove covers, clean lenses.
2. Plug in the Function Simulator, adjust temperature setting to 100 degrees over ambient temperature (allow five minutes for simulator to heat up), place heat source on Rail 1 (North/East) scanner.
3. From the display menu, access maintenance mode by typing < MM > <Enter> if necessary use the factory default password (Bumblebee).
4. From the maintenance menu type < C > < Enter > to begin calibration process.
5. Choose option 1 to calibrate Channel 1, detector will display ambient temperature, verify ambient is correct.
6. If ambient temperature is correct, type < Y >. If ambient is not correct type < N > and enter ambient temperature (the value must be between –40 and 120 degrees F.
7. Cover the Rail 1 (North/East) Scanner opening so that no heat is injected into the system by the simulator.
8. Press any key to continue.
9. Remove object covering scanner.
10. Press any key to start calibration.
11. If calibration is successful the Micro HBD will display new calibration value, type < Y > to accept the new value.
12. The Micro HBD will then recalibrate to new value. Type < Y > to accept new value.
13. Move Function Simulator to Rail 2 (South/West) scanner and repeat steps 5 through 7 for Rail 2
14. Perform a heat alarm test.

K. **Servo 9000 (Bolometer)** Rev. 01/09

1. Remove covers and clean lenses
2. Replace covers
3. Power down unit in the following sequence:
4. CPU
5. HBD
6. Remove analog card

7. Insert card extender
8. Place analog card in extender
9. Power up unit in the following sequence:
10. HBD
11. CPU
12. Measure voltage at TP1 on the analog board
13. Set voltage (R4) to -0.10 volts DC
14. Measure voltage at TP9 on the analog board
15. Set voltage (R8) to -0.10 volts DC
16. Measure voltage at TP18 on the analog board
17. Set voltage (R25) to 0.40 volts DC.
18. Measure voltage at TP19 on the analog board
19. Set voltage (R73) to 0.40 volts DC.
20. Measure voltage at TP3 on the analog board
21. Set voltage (R38) to 2.50 volts DC.
22. Type < F > to check ambient temperature and refer to calibration chart for simulator setting.
23. Place Function Simulator on Rail 1 (North/East) Scanner.
24. Turn on simulator, allow to heat.

    Note: Simulator has reached temperature when the red light turns off.
25. Turn on gating switch.
26. Detector will count down towards 10MM.
27. Adjust gain pot (R31) until cycle bottoms at 10MM.
28. Move Function simulator to Rail 2 (South/West) Scanner
29. Turn on gating switch.
30. Detector will count down towards 10MM.
31. Adjust gain pot (R81) until cycle bottoms at 10MM.
32. Turn off gating switch
33. Turn off Function Simulator
34. Set heat setting switches to lowest value.
35. Power down unit in the following sequence:

36. CPU
37. HBD
38. Remove analog card from extender card
39. Remove card extender
40. Replace analog card in chassis
41. Power up unit in the following sequence:
42. HBD
43. CPU
44. Perform a heat alarm test.

6.5 Hazard Detectors

6.5.1 Hazard Detectors-Identification

Rev. 01/09

Hazard detectors typically provide detection by opening or shunting control circuits. Determine which method of detection is used and obtain the appropriate information and instruction from the Manager of Signal Maintenance. Add instructions and information to this section.

Examples of hazard detectors include, but are not limited to: Bridge, Fire, Slip, Rock, Mud, Flood, Barricade, Collision, Earthquake, High-Wide Load, Wind Speed, etc.

6.5.2 Hazard Detectors-Inspection and Test

Rev. 02/01

A. Hazard detector control devices will be kept clean, free of debris, properly adjusted and in good working condition. Repair as damage occurs.

B. Detectors must be tested when placed in service and thereafter when modified, disarranged, or at least once each designated time period. Conditions or performance data may warrant more frequent inspections and tests.

C. Detectors will be visually inspected monthly for the following:

Structural damage to vertical posts and overhead arms

Condition of wire insulators and supporting mounts

Side and overhead wires properly strung and tight

Proper shape (wire clearance) of detector wire

Fence plugs properly lubricated and seated in receptacle

Bell cord slack maintained as per current standard drawing

Exposed splicing sleeves or un-insulated wire that could cause a ground or short circuit

Condition of seals/gaskets, contacts, holders/clips

6.5.3 Hazard Detectors-Restoration

Rev. 01/09

When a hazard detector is tripped, inspection of the area affected will be made. It must be known that track is clear of any obstruction and safe for train operation before the signals governing movement into the track section are restored to normal operation. Damage preventing normal functioning of detector requires proper action be taken to protect train movements.

6.5.4 Testing Radios

Rev. 02/01

A. "Talk on defect only" radios associated with detectors not interconnected with the signal system must be tested monthly for proper operation.

B. Radios associated with detectors interconnected with the signal system must be tested annually for proper operation.

6.5.5 Dragging Equipment Detectors Test

Rev. 02/15

Record on Form 24039 Hazard Detectors on page 1-69 or FSM with retention until next record is filed, but in no case less than 1 year.

Purpose of testing is to determine that the DED, and radio when equipped, is functioning properly.

Frequency of test is when placed in service and thereafter when modified, disarranged, or at least once each month. Conditions or performance data may warrant more frequent tests and inspections.

The employee(s) making the test must have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

A. **Inspection and Test Procedures for Board-type DED**

Rev. 02/15

1. Inspect to ensure that the DED boards are in good condition and the wires woven through the boards are tight.
2. Verify that all connections are tight and that the bondstrand is properly fastened to the tie.
3. Verify that the brackets (chair braces) are securely fastened to the tie and that the tie is in good condition.
4. Simulate a dragging equipment condition by performing the following:

   C. Activate the system as applicable by design (shunt the track circuit, simulate presence detection, etc.);

   D. Open the test switch to de-energize the DED relay and, where applicable, verify that the warning strobe light flashes;

E. Using a separate radio, listen to verify that the radio voice alarm announces the appropriate message and that the message is legible;

F. Correct any defects noted.

5. Restore the detector location to normal operation.

B. Inspection and Test Procedures for Cast Iron Rod-type DED Rev. 02/15

1. Inspect to ensure that the DED cast iron rod and wooden support is in good condition.

2. Verify that the bondstrand is properly fastened to the tie and all connections are tight.

3. Verify that the wooden support is securely fastened to the tie and that the tie is in good condition.

4. Simulate a dragging equipment condition by performing the following:

A. Activate the system as applicable by design (shunt the track circuit, simulate presence detection, etc.);

B. Open the test switch to de-energize the DED relay and, where applicable, verify that the warning strobe light flashes;

C. Using a separate radio, listen to verify that the radio voice alarm announces the appropriate message and that the message is legible;

D. Correct any defects noted.

5. Restore the detector location to normal operation.

C. Inspection and Test Procedures for Paddle-type DED Rev. 02/15

1. Verify paddles are free of obstruction, ballast is maintained to provide a minimum of 2 to 3 inches clearance below the bottom of the mechanism assembly to provide proper drainage, and ensure that snow accumulation does not impair operation.

2. Inspect paddles and any paddle that is bent and out-of-line more than one and one-half (1 1/2) inch should be repaired or replaced.

3. Verify that the detector tie mounting brackets are securely fastened to the ties and that the ties are in good condition.

4. Lubricate/grease as needed.

5. Simulate a dragging equipment condition by performing the following:

A. Activate the system as applicable by design (shunt the track circuit, simulate presence detection, etc.);

B. Depress the paddle and, where applicable, verify that the warning strobe light flashes;

C. Using a separate radio, listen to verify that the radio voice alarm announces the appropriate message and that the message is legible;

D. Correct any defects noted.

6. Repeat step 5 by depressing the paddle in the opposite direction.

7. On paddle-type draggers, check for proper contact adjustment by performing the 8-degree deflection test. Open junction box, inspect for moisture or foreign material, and apply meter leads to dragger terminals. Move the paddles 1 1/2 inches in each direction and verify that the contacts open. Apply grease to the fittings while depressing the paddle in both directions.

8. Restore the detector location to normal operation.

D. **Inspection and Test Procedures for Static or Impact DED** Rev. 02/15

1. Inspect panels for damage and verify that the detector tie mounting brackets are securely fastened to the ties and that the ties are in good condition.

2. Simulate a dragging equipment condition by performing the following:

A. Activate the system as applicable by design (shunt the track circuit, simulate presence detection, etc.);

B. Strike each panel individually with a 3 pound hammer and verify proper operation.

C. Using a separate radio, listen to verify that the radio voice alarm announces the appropriate message and that the message is legible;

D. Correct any defects noted.

3. Restore the detector location to normal operation.

6.5.6 High Water Detectors Test Rev. 02/15

Record on Form 24039 Hazard Detectors on page 1-69 or FSM with retention until next record is filed, but in no case less than 1 year.

Definition of high water detector (HWD) is equipment so installed to detect a condition, which may pose erosion, washout or other high water related hazard to bridges, trestles or other track structures. This is a device so interconnected with the block signal system and when a hazard condition is detected, will cause signals governing movement into the affected area to display its most restrictive condition. Additionally, this device may be equipped with a radio to verbally announce the hazard.

Purpose of testing is to determine that the HWD and associated apparatus are functioning properly.

Frequency of test is when placed in service and thereafter when modified, disarranged, or at least once each year. Conditions or performance data may warrant more frequent inspections and tests.

The employee(s) making the test must have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

A. **Inspection and Test Procedure for High Water Detector** Rev. 02/15

1. Verify the HWD assembly and associated apparatus are securely mounted and in an appropriate location to detect a hazard condition.

2. Inspect to ensure that the HWD enclosure holes and slots are clear of debris or other foreign material. When a high water condition exists, it will be necessary to inspect and clean the mechanism and associated apparatus.

3. Verify that all connections are tight and the assembly, float or grids are clean and in good working condition.

4. Operate the float by lining the inside of the float assembly and fill the enclosure with water causing the float device to raise, or bridge the grids and:

  A. Where applicable, listen to verify that the radio voice alarm announces the appropriate message and that the message is legible.

  B. Verify the following:

  - The detector relay is de-energized
  - No aspect control information is sent to signals governing movement through the affected area and /or track relay is de-energized
  - Signals governing movement through the affected area are displaying their most restrictive aspect

  C. Depending on design, verify with the Dispatcher or Signal Operations that a high water indication is received.

  D. Correct any defects found.

5. Restore the detector location to normal operation.

Note: Upon installation it will be necessary to place the grids in approximately one inch of “dirty” water to test the operation.

Where water is used to short detector relay current, verify that the detector relay’s normal operating current or voltage is adjusted between the drop-away and pick-up value.

6.5.7 High/Wide – Shifted Load Detector Test

Rev. 10/15

Record on Form 24039 Hazard Detectors on page 1-69 or FSM with retention until next record is filed, but in no case less than 1 year.

Definition of a high/wide shifted load detector is a vertical and/or overhead device so installed to detect a shifted or high/wide load condition on a train which could strike a close clearance structure in advance of the detector location. This device may be equipped with a radio to verbally announce the hazard condition. Additionally, this device may be so interconnected with the block signal system that when a hazardous condition is detected, will cause the governing signal in advance of the train (prior to the close clearance) to display its most restrictive condition.

Purpose of testing is to determine that the high/wide shifted load detector, radio and other associated apparatus are functioning properly.

Frequency of test is when placed in service and thereafter when modified, disarranged, or at least annually. Conditions or performance data may warrant more frequent inspections and tests.

The employee(s) making the test must have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

A. Inspection Procedure

Rev. 10/15

1. Visually inspect and correct any defects for the following:

A. Vertical and overhead supports for signs of structural damage

B. Condition of wire insulators or lasers and supporting mounts

C. Ensure that all measurements are set up to follow the recommended measurement chart for the location. These charts can be obtained by contacting the Clearance Engineer (Clearance Engineer contact information can be found in the Engineering Track Maintenance Handbook 2.4.1)

B. Alignment Procedure

Rev. 10/15

A. Wire Detector

1. **For Wide Load Detectors.** Mark the centerline of track, then, measure from centerline of track to wide load wires. From the top of the structure, lower a plumb bob down to the center line of the track and place a mark on the structure to indicate the center line of track. Measure from the center line mark out to the wide load wires. Verify all side clearance wires are the appropriate distance away from the centerline according to the locations clearance chart.

2. **For High Load Detectors.** Using a string stretched tightly from both sides of the high / wide structure, lower the string across the top of both rails to determine the height of the rail on the high wide structure itself and place a mark. From the mark on the structure, measure up to the high load wire and verify the height from the top of rail is the correct height according to the location clearance chart.
3. **For Top Side Clearance Detectors.** Using the center of track, measure out to the top side clearance wires and verify the wire is attached to the structure at the appropriate place according to the location clearance chart. Using the marks for rail height, measure up to the lower connection on the structure for the top side clearance wire and verify the wire is in the appropriate place according to the location clearance chart.

B. Laser Detector

1. **Wide Load Laser.** Obtain center line of track. Using a plumb bob from the over head structure to the center of track, mark this point as a reference mark on the structure. Measure from the reference mark to the center line of each wide laser transmitter and adjust to measurement for wide cars using the chart. For the lower measurement, measure from center line of track to center line of laser receiver and adjust to measurement for wide cars. Do this step for both sides.
2. **High Load Laser.** Using a string stretched tight from both sides of the High Wide cantilever structure lower the string until it just touches the top of both rails. Mark both sides of the cantilever mast to obtain a measurement for rail height on the cantilever structure. Measure up from the mark to the center line of the laser used for high alarm to the height used on the chart. Do this step for both sides.
3. **Top Side Clearance Laser.** Using the top of rail mark, measure to the centerline of the laser receiver used to measure the top side clearances and set the height to match the clearance chart. Then using the center of track mark on the structure measure to the centerline of the laser transmitter for the top side clearance laser and set it to match the clearance chart. Do this for both sides.
4. Attach a string from each laser transmitter to its adjacent receiver and align the lasers to the string.

C. **Test Procedure** Rev. 10/15

1. Simulate a high/wide load condition by performing the following:

A. If so designed, to activate the system:

- Gate the transducer, or shunt the overlay track circuit 150 feet ahead of the detector
- Using a separate radio, listen to verify the proper greeting message

B. Activate the appropriate test switch, wire break, laser interruption and while doing so:

- Verify that the open in each clearance circuit or laser interruption will activate an alarm and verify the correct alarm announces
- Verify that if the detector is equipped with a radio that it is operating properly by listening to the message with a separate radio
- Verify that the message is correct and understandable up to approximately two miles away
- Verify the exit message with a train crew when possible
- Test radio with a watt meter if available
- If applicable, verify that the control circuit is de-energized which will cause the governing signal in advance of the train (prior to the close clearance structure) to display its most restrictive condition
- If applicable, verify that the warning strobe light flashes
- This test will be repeated for each applicable detector circuit to verify that each circuit is individually effective
- Correct any defects noted

2. If a dragging equipment detector (DED) is installed at this location, perform the appropriate inspections and tests as outlined in the DED test instruction.

3. After testing, verify all connections are tight.

4. Verify that prints, manuals, instructions and radio license for the location are correct and up to date.

5. Restore the detector location to normal operation and record tests and inspections in the FSM.

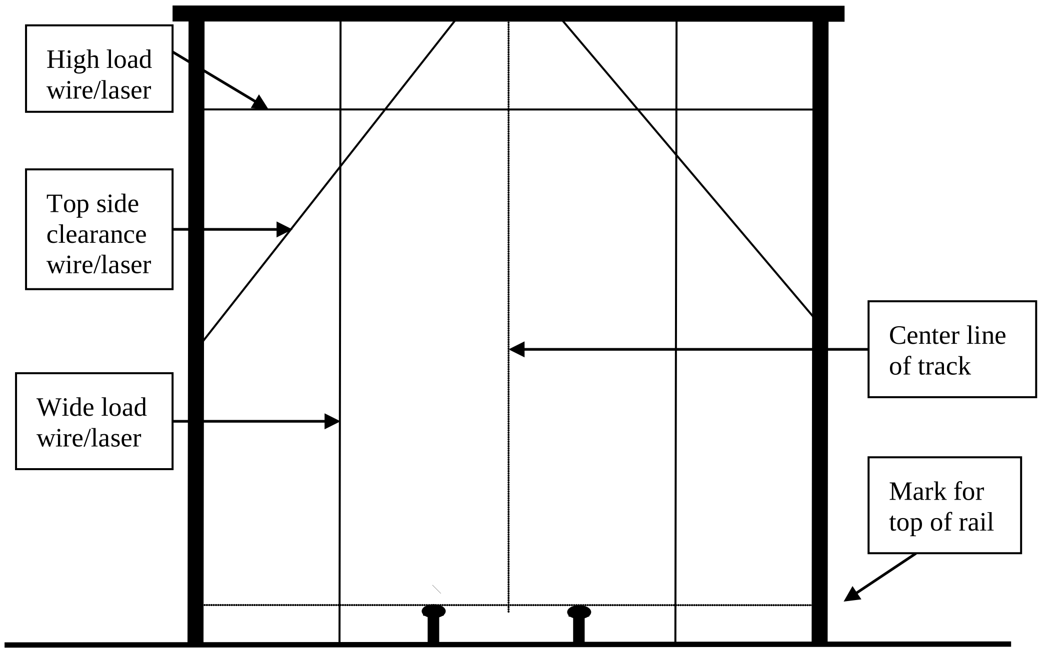

Figure 6-5

6.5.8 Rock Slide Fence Detector Test

Rev. 02/15

Record on Form 24039 Hazard Detectors on page 1-69 or FSM with retention until next record is filed, but in no case less than 1 year.

Definition of a rock slide fence detector is a lateral and/or overhead wires or, a hog wire mesh type fence so installed to detect a rockslide, which could foul the track or pose a derailment hazard to trains. This is a device so interconnected with the block signal system that when a hazard condition is detected, will cause signals governing movement into the affected area to display its most restrictive condition.

Purpose of testing is to determine that the rock slide detector and associated apparatus are functioning properly.

Frequency of testing is when placed in service and thereafter when modified, disarranged, or at least once each year. Conditions or performance data may warrant more frequent inspections and tests.

The employee(s) making the test must have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

A. Inspection and Test Procedure

Rev. 02/15

1. Visually inspect the following and correct any defects noted:

A. Vertical posts and overhead arms for signs of structural damage;

B. Side and/or overhead wires and fence tight and properly fastened to the supporting posts and/or arms;

C. Slide fence plugs properly lubricated and seated in the receptacle;

D. Bell cord slack maintained as per current standard drawing;

E. Exposed splicing sleeves or un-insulated wire that could cause a ground or short circuit.

2. Verify all connections in the fence are tight.

3. Simulate a rock slide condition by performing the following:

A. Unplug each plug or device that is designed to open the circuit (one at a time) and while doing so, verify the following:

- The detector relay is de-energized
- No aspect control information is sent to signals governing movement through the affected area and /or track relay is de-energized
- Signals governing movement through the affected area are displaying their most restrictive aspect
- Depending on design, verify with the dispatcher or Signal Operations that a rock slider indication is received.

4. Correct any defects noted.

5. Restore the detector location to normal operation.

6.5.9 Slip/Land Slide Detector

Rev. 02/15

Record on Form 24039 Hazard Detectors on page 1-69 or FSM with retention until next record is filed, but in no case less than 1 year.

Definition of slip/land slide detector is vertical posts buried in the ground with mercury wetted contacts mounted in a enclosure located on the top of the posts - so installed to open the contact(s) when a slip or land slide condition is detected which could result in the track structure becoming unsafe for train passage. This is a device so interconnected with the block signal system that when a hazard condition is detected, will cause signals governing movement into the affected area to display its most restrictive condition.

Purpose of testing is to determine that the slip/land slide detector and other associated apparatus are functioning properly.

Frequency of testing is when placed in service and thereafter when modified, disarranged, or at least once each year. Conditions or performance data may warrant more frequent inspections and tests.

The employee(s) making the test must have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

A. **Inspection and Test Procedure** Rev. 02/15

1. Visually inspect the following:
   - **A.** Vertical posts and junction boxes for signs of damage, cleanliness and alignment;
   - **B.** Condition of seals/gaskets, mercury wetted contacts and contact holders/clips.
2. Verify that all connections in the detector are tight.
3. Simulate a slip/land slide condition by, opening the appropriate test switch(es) and while doing so, verify the following:
   - The detector relay is de-energized
   - No aspect control information is sent to signals governing movement through the affected area and /or track relay is de-energized
   - Signals governing movement through the affected area are displaying their most restrictive aspect
   - Depending on design, verify with the dispatcher or Signal Operations that a slip/land slide indication is received.
4. This test will be repeated for each applicable detector circuit to verify that each circuit is individually effective.
5. Correct any defects noted.
6. Restore the detector location to normal operation.

6.5.10 Wind Speed Detector Test Rev. 02/15

Record on Form 24039 Hazard Detectors on page 1-69 or FSM with retention until next record is filed, but in no case less than 1 year.

Definition of a wind speed detector (WSD) is equipment used to feed data to a wind forecasting model and report wind speeds exceeding 50mph to the train dispatcher. A wind monitor is not interconnected with the signal system, and does not use a radio to announce high winds.

Purpose of testing is to determine that the WSD and associated apparatus are functioning properly.

Frequency is testing is when placed in service and thereafter when modified, disarranged, or at least once each year. Conditions or performance data may warrant more frequent inspections and tests.

The employee(s) making the test must have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

A. Inspection and Test Procedure for RM-Young Wind Monitor Rev. 02/15

1. Access the wind monitor by tilting the mast to ground level or by using a ladder.

2. Visually inspect the wind monitor to ensure the propeller and wind vane are balanced and rotating freely. Spin the propeller shaft and wind vane manually to check for any apparent signs of sticking or binding in their rotation. The propeller and wind vane should have no deformities or defects.

3. Verify that the wind monitor mounting structural braces and fasteners are secure and in good condition.

4. Remove the electronics cover from the wind monitor. Check for corrosion on the circuit board, and ensure all wires and connections are secure and tight.

5. Check wind speed calibration using the following steps:

A. Set up a computer to read live wind speed data from the wind monitor.

B. Remove the propeller from the shaft and mount the RM-Young Anemometer Drive instrument per RM-Young instructions as follows:

- Mount clamp and bar fixture on wind monitor and gently tighten clamp
- Attach motor to fixture
- Align wind monitor and motor coupling and gently tighten motor clamp
- Turn the anemometer drive instrument ON, and use the UP-DOWN keys to set an RPM of 1825 (20MPH)
- Ensure ACTUAL RPM is within 1RPM of TARGET RPM
- Adjust alignment of the Anemometer Drive Instrument per RM young instructions if necessary
- Check the reported wind speed by viewing the live wind data from the HBD or by calling SOC
- If wind speed is not 18-22MPH, the wind monitor requires repair

6. Check wind direction using the following steps:

A. With wind monitor erected, use a compass or known reference to observe the cardinal direction the wind monitor is pointing.

B. Check the reported wind direction by connecting to the HBD or by calling SOC

C. Use Table 6-A to convert direction (in degrees) to cardinal direction

D. If wind direction varies by more than 45 degrees, adjust the wind monitor base per RM Young instructions.

Table 6-A
Conversion of Wind Direction in Degrees to Cardinal Direction

Direction in Degrees	Cardinal Direction
0	North
45	North East
90	East
135	South East
180	South
225	South West
270	West
315	North West
360	North

6.5.11 Various Other Hazard Detectors

Rev. 05/15

Record on Form 24039 Hazard Detectors on page 1-69 or FSM with retention until next record is filed, but in no case less than 1 year.

Purpose of testing is to determine that the associated apparatus are functioning properly. Each individual device used to provide an indication of a possible hazard shall be so maintained that failure of any essential part, will so far as possible, cause any associated signals to display their most restrictive indications. Rules and instructions applicable should be observed in the inspections, maintenance and repair of these and other similar devices. If the detector is equipped with a radio, use a separate radio to verify the voice alarm announces the appropriate message and that the message is legible.

Frequency of testing is when placed in service and thereafter when modified, disarranged, or at least once each year. Conditions or performance data may warrant more frequent inspections and tests.

The employee(s) making the test must have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

Chapter 7 Signal and Enclosure

Rule 236.2 and 107 – Quarterly Ground Test

Rev. 4/14

Record	Interval	Retention
Form 24094 FSM (SMP)	3 Months	Until Next Record is Filed - in no case less than 1 year

Distribution

Test By	Original	Copies
Mtr.	MSM	Mtr.

Purpose

Test to determine whether grounds exist on energy busses furnishing power to circuits, the functioning of which affects the safety of train operation, shall be made when placed in service, and shall be made at least once every three months thereafter. The provisions of this rule shall not apply to track circuit wires, common return wires of grounded common single break circuits, or AC power distribution circuits in the interest of safety.

Frequency

When placed in service, thereafter when modified, disarranged, or at least once every three months. Conditions or performance data may warrant more frequent inspections or tests.

Precautions

The employee(s) making the test must have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

Description of Test	Results Expected
A preliminary test shall be made with a voltmeter and a radio "B" battery (i.e. Store Stock# 020-4061 Exell 412A Alkaline 22.5V Battery, or Store Stock#20054500 Power Supply Tester, DB22.5 VDC*)* in series with one meter lead to a ground bus and the other lead to a track wire.	If a reading on the meter is observed, this will prove the meter is operating and the integrity of the ground circuit. If no meter reading is observed, check the ground rod and connections.
Connect a voltmeter (TS111 or equivalent) lead with the test battery in series with the ground bus, and proceed with the other lead checking each energy bus, all aerial, and all underground wires on the terminal board(s).	If the voltmeter reads voltage on any circuit. Scale the meter down to verify the presence of a ground. A ground is not present if the meter needle deflection does not significantly increase as the meter is scaled down.*

Note: If meter deflection is significant, remove the test battery and energize the circuit with normal operating voltage and determine the amount of current leakage to ground.

Note: Clear the grounds from all circuits with a current equal to or in excess of 75% of the release value of any relay or electromagnetic device in the circuit. Wayside and crossing solid state equipment will be cleared of any leakage current to ground.

Inspect lightning protection for physical damage and replace where needed.

7.1 Instructions for Signals and Enclosures

7.1.1 Signals Must Not Be Falsely Cleared

Rev. 08/96

Signals must not be falsely cleared for the movement of trains.

7.1.2 Lenses and Roundels

Rev. 12/97

Lenses, roundels, and lamps shall be cleaned as often as necessary to ensure good aspects. The correct roundels and lenses must be placed in the proper position to display the appropriate aspect.

7.1.3 Ladders, Railings Secure

Rev. 08/96

Ladders, hand railings, and platforms shall be maintained in good condition and securely fastened.

7.1.4 Proper Light Unit Voltage, Replacement and Storage

Rev. 01/09

A. **Proper Voltage.**

Rev. 04/14

Proper light units must be used in all wayside signals. Incandescent bulbs should be rated for 25 watts. Conditions or performance data may warrant the use of 18 watt bulbs. Voltage at the light unit terminals shall not be less than 85% nor more than 95% of the rated voltage unless specific instructions are received to the contrary. Preferred voltage is 90% – 95% of the rated voltage. Double filament bulbs must not be used.

B. **Bulb Replacement Schedule.**

Rev. 12/97

Replace bulbs according to the chart below:

Table 7-1 Bulb Replacement Schedule

Signal Application	Replacement Schedule	
	5,000 hr Bulb	20,000 hr Bulb
Constantly lit	6 Month	2 Years
Approach lit with heavy train traffic (25 trains or more daily)	2 Years	6 Years
Approach lit with light train traffic (fewer than 25 trains daily)	3 Years	10 Years
Electro Code IV (soft turn on)	4 Years	14 Years

Note: The 20,000 hr bulb is preferred. When changing bulbs, visually inspect bulb sockets for defects. Sockets must be clean and free of corrosion. Verify sufficient spring tension to ensure proper contact with the bulb. When replaced, the bulb voltage and date changed will be recorded at the location. Use of No-OX-ID grease on the base of the bulb to prevent corrosion is permissible.

C. **Light Unit Storage and Handling.** Rev. 05/15

Utilize extreme care when storing, transporting and handling light units. Rough handling can cause damage to the bulb filament and decrease bulb life. Light units may be stored in signal enclosures provided there is no chance of coming in contact with electrical terminals and connections. Do not store signal bulbs in vehicles or signal light units. Every effort must be made to minimize excessive handling of bulbs.

7.1.5 Focusing, Alignment and View of Signals Rev. 08/96

A. **Prevent Phantom Aspects.** Rev. 01/09

Action shall be taken, or signal shields/visors installed as necessary, to prevent phantom aspects from reflected external light sources. Signal shields/visors shall be maintained on all new D, G, R2 and P5 light signal units placed in service.

B. **Spread the Light.** Rev. 08/96

Deflecting prisms or spread lenses shall be assembled and maintained to spread the light in the proper direction. When replacements are made, identical lenses or roundels must be used.

C. **Changes In Light Receptacles.** Rev. 08/96

In light type signals, changes in the lamp receptacle shall not be made from their original settings except where provision has been made for refocusing.

D. **Obstruction of View.** Rev. 08/96

Objects such as material, tools, machinery, etc., must not be placed where they may obstruct the view of signals.

E. **Focus and Adjustment.** Rev. 05/15

Signal units shall be focused and adjustment maintained to provide the best possible view of the signal aspect. A visual inspection shall also be performed to determine if any LED retrofitting has occurred that may create a line of sight issue with existing incandescent signal locations.

F. **Wayside Signal Flash Rate.** Rev. 02/01

Flash rate for wayside signals should be set not less than 45 nor more than 65 flashes per minute.

7.1.6 Maintained in Good Condition Rev. 04/14

All signals, enclosures and other associated signal apparatus must be maintained in good condition and kept clean as outlined in 1.1.9.Equipment Kept in Good Condition on page 1-6. Number plates must be properly installed and legible. Relays must be properly seated. All doors must fit and work freely. Door gaskets must be in place and in good condition. Enclosure must be water tight and rodent free.

7.1.7 Recorder Operation

Rev. 01/09

A. **Signal Maintainer Quarterly Inspection.** Rev. 07/14

At wayside signal locations equipped with recording devices capable of displaying date and time or recorder battery status, visually determine the recorders are operational, ensure the date and time are set correctly to standard time (1.1.2I. Standard Time. on page 1-3), and check backup battery status. Recorders found to be non-operational or operating incorrectly must be corrected, repaired, or replaced. If corrections, repairs, or replacements cannot be made, notify the Manager of Signal Maintenance.

B. **Two Year Recorder Inspection.** Rev. 05/15

All event recorders must be downloaded and proper operation verified. Recorder backup battery must be checked per manufacturers' instructions. Recorders found to be non-operational or operating incorrectly must be corrected, repaired, or replaced. If corrections, repairs, or replacements cannot be made, notify the Manager of Signal Maintenance.

Employee responsible for performing two year FRA tests will be required to perform the inspections in 7.1.7 B.

7.1.8 Phone, Carrier and Inverter Power

Rev. 08/96

Check the phone to verify it is operational and noise free. Carrier and inverter power levels must be recorded.

7.1.9 Protection from Elements

Rev. 05/15

When it is necessary to have doors of enclosures open during inclement weather conditions, employees must take precautions to protect the instruments and wiring from the elements. In the event moisture inadvertently enters the signal enclosures, instruments and wiring must be wiped dry before leaving the location.

7.1.10 Grounding and Lightning Protection Outside of Enclosures and Cases

Rev. 05/15

A. **Present Standards.** Rev. 08/96

Grounding and lightning protection systems will be maintained to present standards.

B. **Ground Wires.** Rev. 05/15

All ground wires on the outside of houses and cases shall be #6 or larger copper. Ground wires shall be buried six to eight inches deep. Ground wires must not be connected to the outside of enclosures or cases. Bends in the ground wires shall have a radius of eight inches or more.

C. **Ground Rod and Connections.** Rev. 05/15

All connections to ground rods shall be welded. No other ground wires shall be connected to the ground rods. Grounding must be installed per Standard Drawings, except data radio ground wires and any other ground wires shown on the circuit plans for the specific location. The top of each ground rod shall protrude up from the ground no more than three inches.

D. **Ground System Resistance.** Rev. 05/15

Ground system resistance shall be maintained in compliance with 1.1.5B. Grounding & Lightning Arrestors. on page 1-4.

7.1.11 Grounding and Lightning Protection Inside of Enclosures and Cases Rev. 05/15

A. **Present Standards.** Rev. 08/96

Grounding and lightning protection systems will be maintained to present standards.

B. **Ground Wires.** Rev. 05/15

All ground wires on the inside of enclosures and cases between the prime ground plate and arrestors, surge protectors, and equipment ground terminals, shall be #6 insulated, stranded, case wire. Bond strand must not be used for ground wires.

C. **Ground Plate.** Rev. 05/15

Ground wires shall be routed as directly as possible between the equipment and the prime ground plate, avoiding sharp bends. Each prime ground plate shall be connected to the enclosure with one #6 ground wire.

D. **Ground terminals.** Rev. 08/96

Ground terminals on code system chassis, carrier chassis, and code rack arrestors shall be combined on the code system terminal board and connected to the prime ground with one ground wire.

E. **Carrier Tone Pairs.** Rev. 08/96

All carrier tone pairs shall be run in #22 twisted pair from the terminal board to the carrier equipment.

7.1.12 Processing Signal Enclosures and Cases Rev. 05/15

All signal equipment enclosures removed from service must be processed for Asbestos Containing Material (ACM) inspection using the Processing Signal Enclosures and Cases procedure. (Refer to flow chart in Figure 7-1 on page 7-9.)

A. **Scheduled Signal Projects (Construction or Maintenance).** Rev. 05/15

When processing signal equipment enclosures for scheduled signal construction or maintenance projects, use the following procedure:

1. Inventory will be taken to determine the quantity, type, and location of the equipment enclosure.
2. Determine if the enclosure is accessible to the contractor for ACM inspection. If the enclosure is accessible, go to step 4.
3. Equipment enclosure located in an area not accessible to the licensed contractor will be brought to a centralized staging area located on Union Pacific property whenever possible for ACM inspection. Signal enclosures and cases need to be arranged in a manner that will provide the contractor easy access to the enclosure.
4. Environmental Management Group (EMG)/CTS will notify the licensed contractor of the equipment enclosures for inspection. The contractor will sample the equipment, notify EMG/CTS of the results, determine a schedule for abatement, and provide all required supporting documentation to the EMG.
5. EMG/CTS will notify the MSM of the results. The MSM will determine the quantity of equipment enclosure(s) to be retained or scrapped. If the enclosure(s) will be scrapped go to step 7.
6. MSM will notify and provide the enclosure identifier number to the Signal Information Systems (SIS) group of equipment enclosure to be retained. Go to step 9
7. Determine if the equipment is in an enclosure or a case. If the enclosure is a case go to step 9.
8. For scrapped enclosure(s) the contractor will generate the demolition notices to the local jurisdictions where required.
9. EMG and SIS will ensure required supporting documentation is entered into the UPRR database.
10. Following the waiting period required by the local jurisdiction, the contractor will scrap the material and enclosure.
11. Invoice will be processed to the Engineering Cost Center.

B. **Casualties or Derailments.** Rev. 05/15

When processing signal equipment enclosures involved in casualty or derailment, use the following procedure:

1. If there is any possibility the equipment enclosure contains asbestos containing material (ACM), contact the Response Management Communications Center (RMCC). RMCC will notify the EMG / CTS contractor who will test for ACM. Go to step 3.
2. Equipment enclosure(s) will be brought to a centralized staging area located on Union Pacific property for ACM inspection. Signal enclosures and cases need to be arranged in a manner that will provide the contractor easy access to the enclosure.
3. The contractor will sample the equipment, notify EMG/CTS of the results, determine a schedule for abatement, and provide all required supporting documentation to the EMG.
4. EMG/CTS will notify the MSM of the results. The MSM will determine the quantity of equipment enclosure(s) to be retained or scrapped. If the enclosure(s) will be scrapped go to step 6.
5. MSM will notify and provide the enclosure identifier number to the Signal Information Systems (SIS) group of equipment enclosure to be retained. Go to step 8.
6. Determine if the equipment is in an enclosure or a case. If the enclosure is a case go to step 8.
7. For scrapped enclosure(s), the contractor will provide demolition notices for all enclosures to the UPRR EMG and submit a duplicate notice to the local jurisdiction(s), where required.
8. EMG and SIS will ensure required supporting documentation is entered into the UPRR database.
9. Following the waiting period required by the local jurisdiction the contractor will scrap the material and / or enclosure.
10. EMG will approve invoicing. Invoice will be processed to the casualty.

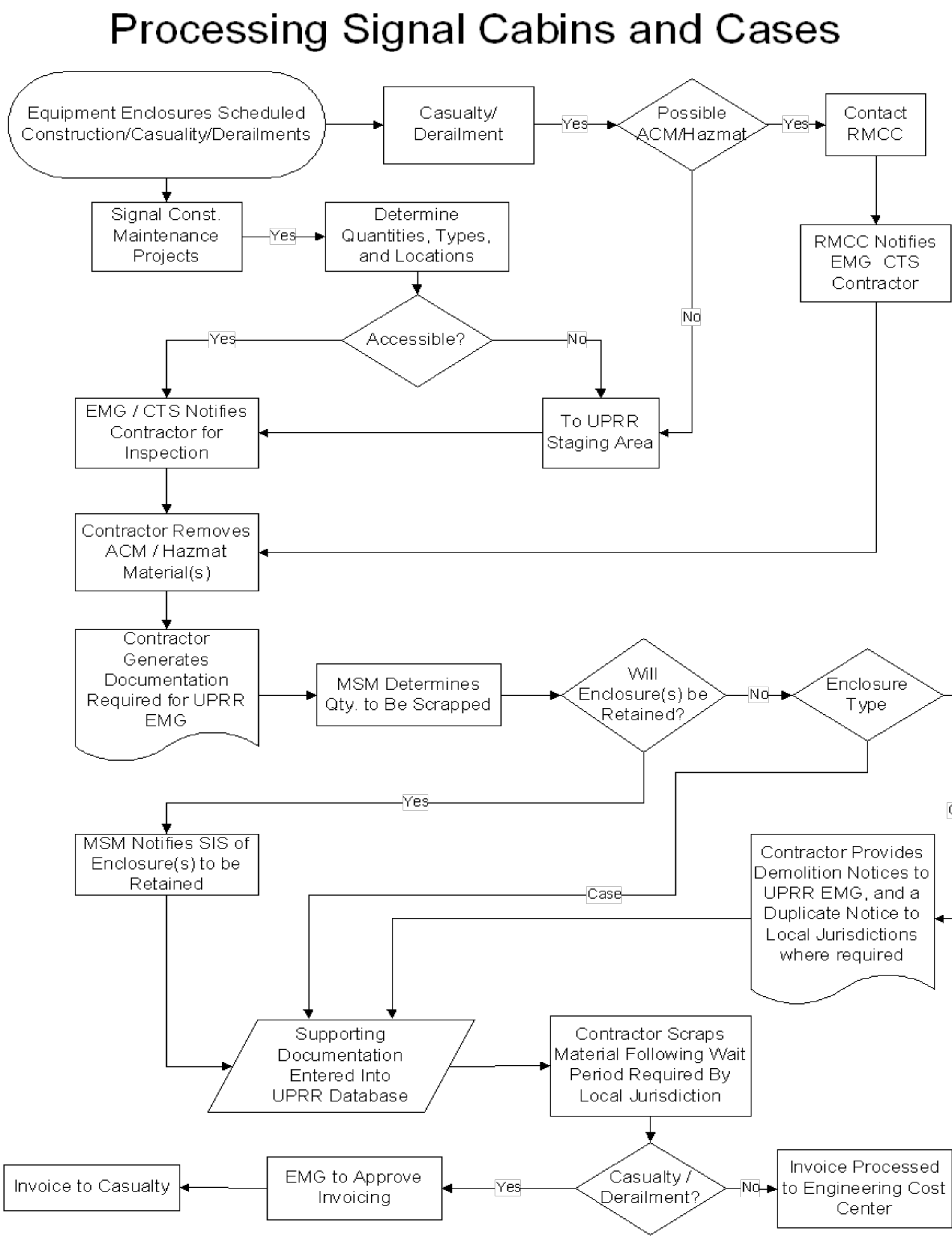

Figure 7-1
Processing Signal Enclosuress and Cases

7.1.13 LED Wayside Signals

Rev. 12/10

A. **Approved Light Units.** Rev. 12/10

Only approved LED wayside signal light units that have assigned store stock numbers will be used. Approved LED wayside signal units have been tested to ensure compatibility with the various types of lighting and light-out circuitry employed on Union Pacific Railroad.

B. **LED Compatibility.** Rev. 12/10

The following LED light unit compatibility issues must be observed:

1. Ansaldo (US&S) LED units ONLY work with the Microlok chassis equipped with a LED12 module, a Driver Protection Board per lamp, and a CCR module per signal head. Additionally, Ansaldo LED units are compatible with P5 (Safetran) signal heads, utilizing the standard incandescent light unit collar.
2. Gelcor light units may be used on Microlok chassis utilizing a Lamp 16 module.
3. Gelcor light units must not be used with an electro mechanical flasher relay.

C. **LED Light Unit Replacement.** Rev. 12/10

LED light units must be replaced with the same manufacturer and model type. Gelcor and Ansaldo LED light units are not a direct replacement for each other.

D. **Proper Polarity and Voltage.** Rev. 12/10

LED wayside signal light units must be connected to the appropriate DC voltage with the proper polarity. Reversing the polarity may damage the light unit.

E. **Retrofitting.** Rev. 05/15

During construction or maintenance activities that require retrofitting LED wayside signal light units into signal heads that utilize incandescent lighting, all signal light units and all signals for both directions at the location must be retrofitted.

Care must be taken when retrofitting LED wayside signals at locations that are within line of sight to locations that utilize incandescent lighting. If there is a line of sight incandescent downstream or adjacent track signal, action must be taken by retrofitting the downstream or adjacent track signal location or implementing CAD changes.

Note: CAD changes are only an option when a line of sight issue exists involving two absolute signal locations.

F. **External Light Deflecting Devices.** Rev. 12/10

All external deflecting and outer lenses used with incandescent light units must be removed when retrofitting with LED light units. Snow-shields and Eyebrows must remain in place.

G. **Limiting Resistors.** Rev. 12/10

LED wayside signal light units do not require limiting resistors. Limiting resistors should be removed unless the equipment driving the LED light unit requires a limiting resistor in order to function properly.

H. **Grounding.** Rev. 12/10

Signal mast must be grounded. LED light units containing a ground terminal must be connected to ground.

I. **Proper Testing.** Rev. 05/15

Replacing or retrofitting incandescent signal units with LED wayside signal light units is considered a **disarrangement**. All the proper tests and requirements as outlined in these instructions apply.

Testing shall include a visual inspection to insure downstream signal locations utilizing incandescent bulbs are not within the line of sight to the location being retrofitted. (See Retrofitting. on page 7-10)

Additionally, no test is complete until the appropriate forms have been properly completed and represent the actual tests performed.

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Chapter 8 Crossings

Rule 234.249 - Ground Test

Rev. 04/14

Record	Interval	Retention
Form 24239 FSM	1 month	Until Next Record is Filed - in no case less than 1 year

Distribution

Test By	Original	Copies
Mtr.	MSM	Mtr.

Purpose

Test to determine whether grounds exist on energy busses furnishing power to circuits, the functioning of which affects the safety of public and train operation, shall be made when placed in service, and shall be made at least once every month thereafter. The provisions of this rule shall not apply to track circuit wires, common return wires of grounded common single break circuits, or AC power distribution circuits in the interest of safety.

Frequency

When placed in service and thereafter when modified, disarranged, or at least once every month. Conditions or performance data may warrant more frequent inspections or tests.

Precautions

The employee(s) making the test must have information relative to train movements to ensure that the public, and train traffic will not be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

Description of Test	Results Expected
A preliminary test shall be made with a voltmeter and a radio “B” battery (i.e. Store Stock# 020-4061 Exell 412A Alkaline 22.5V Battery, or Store Stock#20054500 Power Supply Tester, DB22.5 VDC) in series with one meter lead to a ground bus and the other lead to a track wire.	If a reading on the meter is observed, this will prove the meter is operating and the integrity of the ground circuit. If no meter reading is observed, check the ground rod and connections.
Connect a voltmeter (TS111 or equivalent) lead with the test battery in series with the ground bus, and proceed with the other lead checking each energy bus, all aerial and all underground wires on the terminal board(s).	If the voltmeter reads voltage on any circuit. Scale the meter down to verify the presence of a ground. A ground is not present if the meter needle deflection does not significantly increase as the meter is scaled down.*

***Note:** If meter deflection is significant, remove the test battery and energize the circuit with normal operating voltage and determine the amount of current leakage to ground.

***Note:** Clear the grounds from all circuits with a current equal to or in excess of 75% of the release value of any relay or electromagnetic device in the circuit. Wayside and crossing solid state equipment will be cleared of any leakage current to ground.

Inspect lightning protection for physical damage and replace where needed.

FRA Rules 234.251, 253c, 255a&b, 257a&b and 261
Crossing Warning Monthly Procedure

Rev. 05/15

Record	Interval	Retention
Form 24239 FSM	Monthly	Until Next Record is Filed - in no case less than 1 year

Distribution

Test By	Original	Copies
Mtr	MSM	Mtr.

Purpose

Test to determine that crossing warning devices operate properly.

Frequency

When placed in service and thereafter when modified, disarranged, or at least once every month. Conditions or performance data may warrant more frequent inspections or tests.

Precaution

The employee(s) making the test must have information relative to train movements to ensure that the public and train traffic will not be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

Description of Test

1. Inspect the crossing signal location for damage (i.e. gate mechanism turned, wind bracket turned, cracked bases or brackets, light position, etc.)
2. Visually inspect the inside of the enclosure.
3. Perform a thorough inspection of the flasher, power-off and XC relays for burned or pitted contacts; as well as any other contacts of relays that are in the light circuit as outlined in 8.1.1E. steps 5 and 6 on page 8-25.
4. Check the crossing control equipment (ED voltage, phase angle, transferred unit, etc.) Investigate exceptions and clear error codes.
5. If crossing system is equipped with recording devices capable of displaying date and time or recorder battery status, visually determine the recorders are operational, ensure the date and time are set correctly for standard time (1.1.2I. Standard Time. on page 1-3), and check backup battery status. Recorders found to be non-operational or operating incorrectly must be corrected, repaired, or replaced. If corrections, repairs, or replacements cannot be made, notify the Manager of Signal Maintenance
6. Check voltage on all crossing warning system battery bank(s) with the power on.
7. **A. DC Lit Crossings. (Crossings without Lighting Circuit Power Transfer Relays)** Open the test switch to activate the crossing and determine that the crossing equipment that is visible and audible to the public operates properly. (FRA Rule 234.257a, b) Proceed to step 8A.

   C. AC Lit Crossings. (Crossings with Lighting Circuit Power Transfer Relays) Open the test switch to activate the crossing lights and determine that the crossing equipment that is visible and audible to the public operates properly. (FRA Rule 234.257a, b) Close the test switch and restore the crossing to normal. Proceed to step 8B.
8. **A. Remove AC power** (FRA Rule 234.251)**.** Verify power-off indications, i.e. strobes, flashing LEDs, etc., are operating as intended.

   D. Remove AC power (FRA Rule 234.251). Open the test switch to activate the crossing and determine that the crossing equipment that is visible and audible to the public operates properly. (FRA Rule 234.257a, b) Verify power-off indications, i.e. strobes, flashing LEDs, etc., are operating as intended.
9. If applicable, inspect and observe the gate arms for proper operation as outlined in 8.1.10 on page 8-33. (FRA Rules 234.223 and 234.255a, b)
10. Visually inspect the flashing light units for proper visibility, dirt, and damage to roundels and reflectors (FRA Rule 234.253c and 234.217-c).

11. Test the traffic light preempt if applicable (FRA Rule 234.261). Preemption should be tested by:
    1. Verifying that the circuit or relay designed to provide preemption to interconnected system(s) is de-energizing according to the circuit plans.
    2. Visually observe interconnected system operation.

    If preemption does not appear to be functioning properly:

    - Immediately notify Signal Operations to request appropriate X order
    - Notify the Manager of Signal Maintenance
12. Restore the crossing to normal and ensure all battery bank voltages are consistent with the information found in Table 5-1 Load Test on page 5-4 shown below.

Table 5-1 Load Test	
Nickel Cadmium @ 70 Degrees F.	
1.35V - 1.45V	Good
1.30V – 1.34V	Check Rectifier
Below – 1.30V	Mark Cell for Possible Replacement
Sealed Lead Acid @ 70 Degrees F.	
Above 2.27	Investigate Reason for High Voltage
2.05V – 2.25V	Good
1.80V – 2.04V	Investigate Reason for Low Voltage
Below - 1.8V	Mark Cell for Possible Replacement

13. **Restore AC power** and ensure power-off indications, i.e. strobes, flashing LEDs, etc., are operating as intended.
14. Record the inspections and FRA required tests results monthly on Form 24239 on page 1-37, or in FSM.
15. Inspect the track connections at the crossing.
16. Observe a train movement if possible and investigate improper operation.
17. Correct and/or repair all defects found.

    Note: If location has a Harmon 1141B motion detector in service it must be tested per the current instructions.

Note: If the location has a GCP 300, perform a shunt test 50 feet from the edge of the pavement to determine minimum distance. Then move the shunt 20 feet further from the pavement and observe that the crossing warning activates and then recovers.

8.0 Additional Instructions for Inspections

8.0.1 Modifications

Rev. 05/15

All modifications to circuits and circuit drawings must be approved by designated Signal Design Crossing Group before any circuit change can be made.

8.0.2 Additional Instructions for Monthly Warning Inspections

Rev. 05/15

A. Monthly Recorded Warning Time Review.

Rev. 02/15

The following instruction applies to highway grade crossings equipped with a constant warning device utilizing a recording device.

Review the recorded warning times of the last 10 normal through train moves, where train movement was at a constant speed through the entire approach of the crossing.

Exception: If constant warning device is HXP-1, review last 9 normal through train moves.

If a warning time:

- Of less than 20 seconds is discovered or
- Is found to be 10% or more, lower than program warning time for 3 or more through train moves (Refer to Table 8-1 Warning Time Tolerance Table on page 8-8)

The Manager must be notified immediately and if determined to be necessary, a speed restriction applied to the crossing. The Director of Signal Maintenance, Director, Manager or Signal Design Crossing Group must also be notified immediately.

If a warning time:

- Is found to be 50% or more, higher than program warning time for three or more through train moves (Refer to Table 8-1 Warning Time Tolerance Table on page 8-8)

Investigate for proper operation. If necessary, make proper repairs or contact the Manager of Signal Maintenance or designated representative for assistance. The Manager must be notified immediately and if determined to be necessary, a speed restriction applied to the crossing.

Note: If equipped with a standby unit, the programmed warning time must be the same.

Table 8-1 Warning Time Tolerance Table			
Designed Warning Time	Minimum Acceptable Value @ 10%	Where 2 Seconds Subtracted For Advance Preemption with Internal Timers	Maximum Acceptable Value @ 50%
23	23	23	37
25	23	25	37
26	23	26	39
27	25	27	40
28	26	27	42
29	27	28	43
30	27	29	45
31	28	29	46
32	29	31	48
33	29	32	49
34	31	33	51
35	32	34	52
36	33	35	54
37	34	36	55
38	35	36	57
39	36	37	58
40	36	38	60
41	37	39	61
42	38	40	63
43	39	41	64
44	40	42	66
45	41	43	67
46	42	44	69
47	43	45	70
48	44	46	72
49	45	47	73
50	45	47	75

Rule 234.269-Cut Out Circuits
(Switch Overrides)

Rev. 01/09

Record	Interval	Retention
Form 24239 FSM	3 months	Until Next Record is Filed - in no case less than 1 year

Distribution

Tested By	Original	Copies
Mtr.	MSM	Mtr.

Purpose

Test to determine that cut out circuit functions properly.

Frequency

When placed in service and thereafter when modified, disarranged, or at least quarterly. Conditions or performance data may warrant more frequent inspections or tests.

Precaution

The employee(s) making the test must have information relative to train movements to ensure that the public, and train traffic will not be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

Description of Test

Switches –

On switches equipped with a switch circuit controller which is interconnected with crossing warning system circuitry, throw the switch full reverse and determine the cut out circuit is effective. Insert a 1/2 inch gage in the reverse point and determine the cut out circuit is not effective. Throw the switch to the normal position observing that the cut out circuit remains non-effective from 1/2 inch from full reverse to full normal. Repeat the test for every switch interconnected with crossing warning system circuitry.

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Rule 234.271-Insulated Joints, Bonds, Track Connections

Rev. 01/09

Record	Interval	Retention
Form 24239 FSM	3 Months	Until Next Record is Filed - in no case less than 1 year

Distribution

Tested By	Original	Copies
Mtr.	MSM	Mtr.

Purpose

To ensure all insulated joints, track bonds, and track connections are sufficient to maintain the integrity of associated track circuits.

Frequency

When placed in service and thereafter when modified, disarranged, or at least quarterly. Conditions or performance data may warrant more frequent inspections or tests.

Precautions

The employee(s) making the test must have information relative to train movements to ensure that the public and train traffic will not be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

Description of Inspection

A. All rail joints will be properly bonded.

B. Inspect each bond visually and apply pressure with a long screwdriver or similar tool to ensure that each end of the bond is secure in the rail. Replace loose or defective bonds.

C. All bonding, bootlegs, rail taps, insulated joints, gauge plates, gauge rods and insulation therein should be given a thorough inspection. Particular attention should be given to the bonds that have been struck by dragging equipment. All bonding, including fouling wires between the clearance point and main line on all turnouts and crossovers, must be carefully inspected. Replace defective items.

D. During insulated joint inspections, verify that the joint is properly supported and abrasion plate properly installed. Ensure that spikes are properly installed and not across the end post. Inspect the joint for loose or broken insulation, cracked bars, broken or loose bolts, evidence of separation from the rail, and overall condition of the joint and surrounding track structure, including ties and plates. Ensure proper painting of fouling joints. If annual testing is due, follow instructions in 9.1.3.

All bonding of switch points, heel block joints and rail connections must be made in accordance with the Standard Drawings.

Rule 234.253-(a) Alignment & Flash Rate

Rev. 01/14

Record	Interval	Retention
Form 24239 FSM	Yearly	Until Next Record is Filed - in no case less than 1 year

Distribution

Tested By	Original	Copies
Mtr.	MSM	Mtr.

Purpose

To determine that lights are properly aligned and flash at the proper rate.

Frequency

When placed in service and thereafter when modified, disarranged, or at least annually. Conditions or performance data may warrant more frequent inspections or tests.

Precautions

The employee(s) making the test must have information relative to train movements to ensure that the public and train traffic will not be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

Description of Test

Light alignment will be tested to the standards outlined in 8.1.8A. on page 8-31. The flashing light units will be tested to the standards outlined in 8.1.8 on page 8-31.

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Rule 234.253(b) Lamp Voltage

Rev. 04/14

Record	Interval	Retention
Form 24239 FSM	Yearly	Until Next Record is Filed - in no case less than 1 year

Distribution

Tested By	Original	Copies
Mtr.	MSM	Mtr.

Purpose

To determine that the lamp voltage is within tolerance.

Frequency

When placed in service and thereafter when modified, disarranged, or at least annually. Conditions or performance data may warrant more frequent inspections or tests.

Precautions

The employee(s) making the test must have information relative to train movements to ensure that the public, and train traffic will not be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

Description of Test

Lamp voltage tested at each light unit must not be less than 85 percent of the prescribed rating for the lamp as outlined in 8.1.7 on page 8-30.

1. Test lamp voltage with the primary power on.
2. Test lamp voltage with the primary power off and lights operating for not less than two (2) nor more than five (5) minutes.

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Rule 234.255(c) Hold Clear Devices

Rev. 01/09

Record	Interval	Retention
Form 24239 FSM	Yearly	Until Next Record is Filed - in no case less than 1 year

Distribution

Tested By	Original	Copies
Mtr.	MSM	Mtr.

Purpose

Test to determine that hold clear devices function as intended.

Frequency

When placed in service and thereafter when modified, disarranged, or at least annually. Conditions or performance data may warrant more frequent inspections or tests.

Precautions

The employee(s) making the test must have information relative to train movements to ensure that the public, and train traffic will not be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

Description of Test

Pawl and Ratchet Wheel Equipped Devices

1. Operate the gate to fully lowered position by opening the test nut or test switch if provided; if a test nut or test switch is not provided, remove the positive hold coil wire at the terminal board.
   - **a.** Visually inspect the hold clear device as you are performing step (1) to verify the armature releases from the pole faces and that the pawl disengages from the ratchet wheel. The ratchet wheel must remain disengaged when the gate is in the fully lowered position.
2. While the gate is in fully lowered position inspect that:
   - **a.** The hold clear armature and pole faces are free from oil, grease, rust or other foreign matter.
   - **b.** There is no appreciable play in the movement of the armature assembly and any associated linkage assemblies.
   - **c.** Moving parts are not restricted in any manner and do not have any tendency to bind.
3. Operate the gate to the fully raised position by closing the test nut or by reattaching the hold coil wire to its associated terminal and fully tighten the nuts.
   - **a.** Visually inspect the hold clear devices as you are performing step (3) to verify the armature is energized, and that the pawl engages the ratchet wheel when gate is in its fully raised position.

   Note: On Griswold mechanisms, when the Hold Clear is engaged, check that the spring tension of the pawl is not too great by ratcheting the ratchet wheel and check that the holding armature does not breakaway.
4. While the gate is in the fully raised position:
   - **a.** Determine that all mounting bolts are tight and that the hold clear assembly is securely mounted and properly positioned.
   - **b.** Determine that all cotter keys are in place, properly spread and do not interfere with the movement of the armature assembly.
   - **c.** Determine that the retaining rings, if equipped, are in the proper place and securely set.
   - **d.** Inspect all wires closely for bad insulation, proper tagging, and that wires do not interfere with the proper operation of the hold clear device.

e. Inspect the ratchet pawl and wheel for signs of wear, (i.e. metal filings in enclosure, rounded or turned edges, and loose or worn bearings in ratchet wheel.)

f. Inspect pivot pins for excessive wear.

g. Inspect set screws in the armature plate, if equipped, to ensure they are in place and secured with jam nut; edges of pins must be square and not beveled.

h. Check that the armature and pole faces are aligned and parallel with each other and that the air gap is uniformly spaced between the two components, if applicable.

Note: Should replacements or adjustments be necessary, refer to the manufacturer's maintenance and instruction manual that applies to each gate mechanism.

Electric brake equipped devices
(i/e: Harmon gate mechanisms, Safetran S-60)

Refer to the manufacturer's maintenance and instruction manual for recommended testing and inspection procedures for this type of hold clear device.

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Rule 234.259 - Warning Time

Rev. 05/15

Record	Interval	Retention
Form 24239 FSM	Yearly	Until Next Record is Filed - in no case less than 1 year

Distribution

Tested By	Original	Copies
Mtr.	MSM	Mtr.

Purpose

Ensure highway-rail grade crossing system activates in accordance with the design of the warning system and in no event provides less than 20 seconds warning time.

Frequency

When placed in service and thereafter when modified, disarranged, change in Timetable speed or at least annually. Conditions or performance data may warrant more frequent inspections or tests.

Precautions

The employee(s) making the test must have information relative to train movements to ensure that the public, and train traffic will not be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

Definition

Prescribed warning time is the designed warning time less any associated additional time for equipment response, speed variance and ballast impedance. In other words, prescribed warning time is the length of time from the moment that properly operating warning devices begin to provide their intended warning (e.g., the flashing lights begin to flash) until an approaching train operating at maximum authorized speed enters the crossing (i.e., reaches the edge of the crossing surface).

Description of test

A warning system location is not considered fully tested for the prescribed warning time until the crossing activation is proven for the required distance on all available approaches at the crossing (i.e., all routes and in each direction), including while operating on standby units, if so equipped.

Examples of this include:

At a basic single-track location, the entire approach circuit in each direction (two tests); if equipped with standby units (four tests)

At a double-track location, the entire approach circuit in each direction on each track (four tests); if equipped with standby units (eight tests)

At a location where a turnout or crossover is within an approach circuit, the straight route approach and the diverging route approach must both be tested for each track, including on standby units

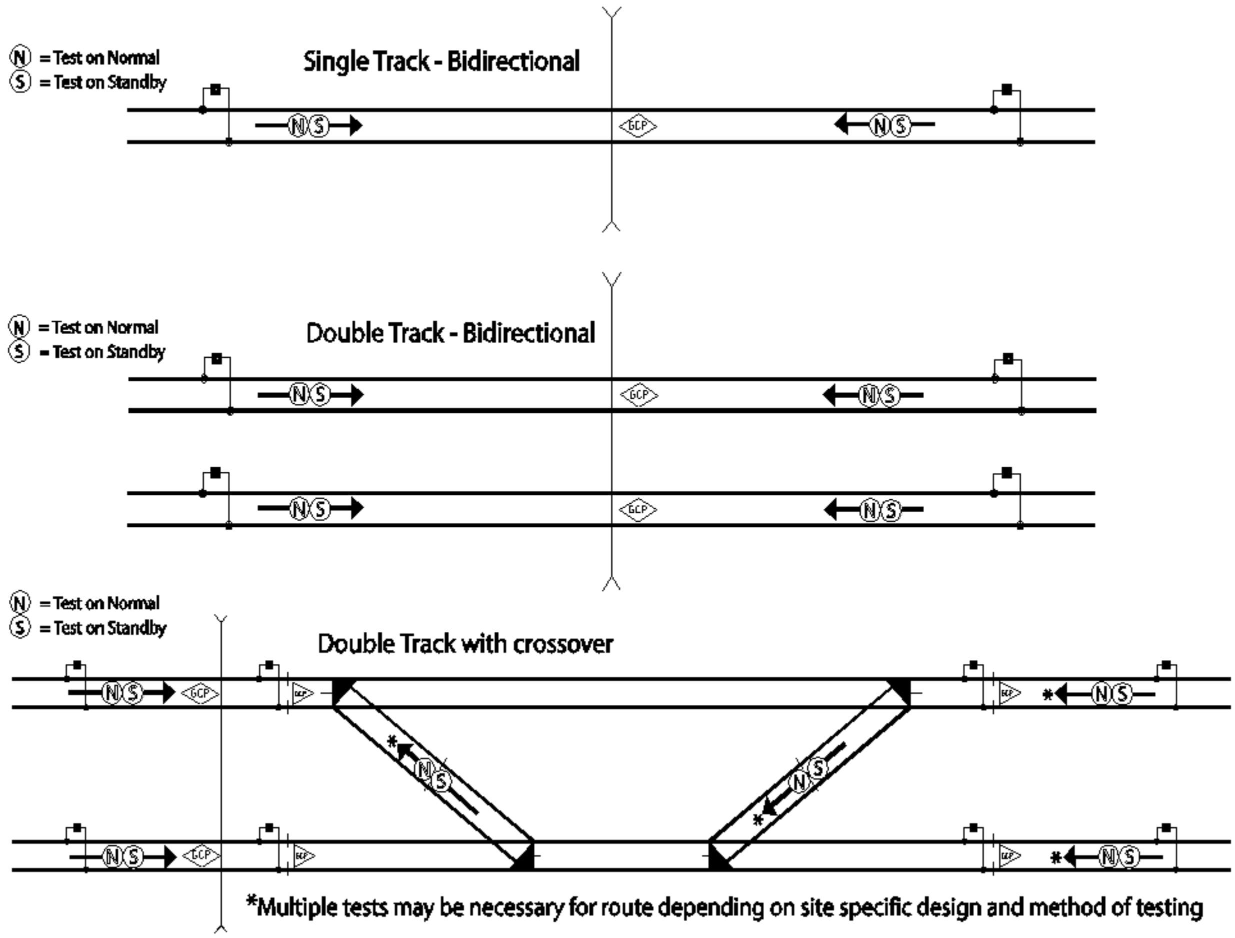


Figure 8-1

Test Procedures

DC and Overlay Circuits.

1. Shunt each end of every track circuit in the approach to the crossing warning system with 0.06 ohm shunt and verify proper operation.

2. Where crossing is equipped with an island circuit only, shunt island circuit with 0.06 ohm shunt and verify proper operation.
3. Timing overlay circuits that are utilized to indicate the speed of an approaching train must be tested for proper operation.

Note: All modifications to circuits and circuit drawings are to be approved by designated Signal Design personnel before any circuit change can be made.

Motion and Constant Warning Devices.

Repeat methods as needed to test all routes for normal and standby units. Testing may be accomplished by one of the following three methods:

Observation.

If the method used is by observation of a train movement, the actual speed, or at least a close approximate speed of the movement must be known and it must be at, or very near the maximum authorized speed for the route approaching and through the crossing.

In the great majority of instances, at or very near the maximum authorized speed will be within the lesser of 20 percent or 5 mph of the maximum authorized speed (i.e., within 5 mph of any maximum authorized speed of 25 mph or more, or within 2 mph of a maximum authorized speed of 10 mph).

If the speed of the movement were less than the maximum authorized speed by a margin beyond those parameters, the full extent of the intended approach circuit would not be proven to be effective by this method.

Calculation.

1. Place a hardwire shunt at 100% of each approach as determined from the plan, and note the distance voltage shunt value.
2. Place a hardwire shunt at 90% of each approach and verify that the distance voltage drops by 10% from the 100% distance voltage shunt value as determined in Step 1.
3. If the distance voltage does not drop by 10% with a shunt at 90% of the approach, or the crossing does not activate, the full extent of the intended approach circuit would not be proven to be effective by this method.

Note: Step 1 is not required if the 90% shunt value of Step 2 is 10% less than the 100% shunt value listed on the history card for that approach.

Note: At crossings equipped with remote starts, when hardwire shunts are used to verify warning time, the shunts must be applied in all approaches.

Recorded.

Review the recorded warning times of the last 10 normal through train moves, where train movement was at the actual speed, or at least a close approximate speed of the movement known to be at or very near the maximum authorized speed for the route approaching and through the crossing.

In the great majority of instances, at or very near the maximum authorized speed will be within the lesser of 20 percent or 5 mph of the maximum authorized speed.

If the speed of the movement were less than the maximum authorized speed by a margin beyond those parameters, the full extent of the intended approach circuit would not be proven to be effective by this method.

The shortest warning time provided must be used as the actual recorded warning time of the test.

If a warning time:

- Of less than 20 seconds is discovered or
- Is found to be 10% or more, lower than program warning time for 3 or more through train moves (Refer to Table 8-1 Warning Time Tolerance Table on page 8-8)

The Manager must be notified immediately and if determined to be necessary, a speed restriction applied to the crossing. The Director of Signal Maintenance, Director, Manager or Signal Design Crossing Group must also be notified immediately.

If a warning time:

- Is found to be 50% or more, higher than program warning time for three or more through train moves (Refer to Table 8-1 Warning Time Tolerance Table on page 8-8)

Investigate for proper operation. If necessary, make proper repairs or contact the Manager of Signal Maintenance or designated representative for assistance. The Manager must be notified immediately and if determined to be necessary, a speed restriction applied to the crossing.

Note: If equipped with a standby unit, the programmed warning time must be the same.

8.1 General Instructions and Standards for Highway Grade Crossing Warning System

8.1.1 Additional Instructions for Relays

Rev. 12/97

A. **Replacement Parts.** Rev. 12/97

When a component is changed out, the replacement will be an exact or equivalent replacement part. After replacement is made, an operating test shall be made to determine that all affected circuits that were disarranged are functioning properly. Tests must be performed as outlined in instruction 1.2.3 Testing on page 1-12.

B. **Disarrangement.** Rev. 12/97

A disarrangement has occurred when a relay is replaced with another and all required tests must be performed.

C. **Changing Out a Relay.** Rev. 12/97

Person changing out a relay will determine that the proper relay is used according to the print. The Signal Inspector, Maintenance Foreman or Signal Technician must be notified immediately, and the Manager of Signal Maintenance informed. Test of circuits affected must be made in accordance with test instructions **before** returning the system to service, and the proper form(s) must be completed for the applicable tests. A calibration test of the relay will be made by the Signal Inspector or Maintenance Foreman within 30 days.

D. **Spare Relays.** Rev. 12/97

Maintainers' spare relays will be tested so they will be current with relays in service.

E. **Visual Inspection.** Rev. 02/01

Closely observe the action of relays during actual operation and verify the following:

1. When energy is reduced in the process of obtaining the drop-away value, closely observe the action of the neutral armature as it leaves the stop pin. It will usually move slowly at this point. A sudden movement of the armature as it leaves the stop pin may indicate that a sticky substance is on the stop surfaces.
2. Determine that the relay has a positive drop-away action when the circuit is opened and that the relay contacts open without retardation of movement due to friction or any other cause. Verify that the front, back, and polar contact openings are adequate.

3. Determine that adequate clearance exists between the cover and moving parts, and between all visible fixed and moving parts. Inspect seals and gaskets for wear and proper position.
4. Determine that parts inside the relay have a clean appearance and are free from rust and corrosion. Ensure that there is not any loose or foreign matter inside the relay. Look through the relay parallel to the armature and determine there is no visible foreign matter on the armature or pole pieces.
5. Inspect relay for pitted or burnt contacts, broken or cracked glass, broken terminals, burnt heel ribbons, and moisture on or inside the relay.
6. Ensure that relay is positioned to prevent other objects from possibly bridging relay contacts.
7. With the control wires disconnected or relay otherwise de-energized, rock the relays from side to side to determine there is a small amount of endplay. The armature should slide freely on its trunnion within the limits of the play.

F. **Securely Fastened.** Rev. 12/97

Inspect all screws, nuts and binding posts to determine that they are securely fastened and lock washers are effective. All terminals will have double nuts, and relays will be properly seated

G. **Field Requirements.** Rev. 02/01

Relays not meeting field requirements, or found to be defective through visual inspection, must be repaired or removed from service as soon as practicable.

H. **Records.** Rev. 01/09

Relays will be recorded in FSM and on the proper form, one relay on each form. All records will be filed in accordance with company and FRA requirements.

8.1.2 Grade Crossing Systems Placed In Service Rev. 10/14

1. When placing grade crossing warning systems in service, all detection devices (e.g. track circuits, motion sensors) must be tested before installing cross arms, gate arms and lights. When lights are being aligned, a flagman dressed in an orange vest and equipped with a flag must be positioned at the crossing to direct vehicular and pedestrian traffic. After the lights are aligned, the gate arms and lights may be installed and adjusted continuing the use of a flagman to direct vehicle traffic until the work is complete.
2. Print or complete a history card and leave at the location.

3. Testing and all records of tests will be completed in accordance with company and FRA requirements as outlined in 1.2.3 Testing on page 1-12.
4. Ensure the completed original (white) pages from the Crossing Cutover Procedures Forms (PB-24137A) remain in the cabin and retain the copy (yellow) as record of testing.

8.1.3 Activation, Inspection and Testing of Warning System Rev. 01/14

A. **Warning Time.** Rev. 09/06

Crossing warning system must be maintained to activate in accordance with the design of the system. In no event shall a crossing warning system provide less than twenty seconds of warning time before the grade crossing is occupied by rail traffic. (FRA Standard 234.225)

B. **Annual Recorder Test.** Rev. 01/09

All crossing event recorders must be downloaded and proper operation verified. Recorder backup battery must be checked per manufacturers' instructions. Recorders found to be non-operational or operating incorrectly must be corrected, repaired, or replaced. If corrections, repairs, or replacements cannot be made, notify the Manager of Signal Maintenance.

C. **Annual Interconnection Inspection.** Rev. 04/14

Crossings equipped with simultaneous preemption or advance preemption interconnection circuits will be tested annually with the State Agency or Road Authority governing the traffic equipment. The joint test will include an activation of the crossing circuitry to ensure the interconnection circuitry between the railroad and traffic equipment is operating per design.

Verify a completed Form 24412 (see Form 24412 Interconnect Warning Example on page 1-86) is located in the crossing enclosure. If advance preemption is used, verify program time matches the design on circuit plans and the time listed on Form 24412.

Simultaneous and advance preemption will be tested by observing a through train movement, or placing a shunt across the rails to activate the crossing and ensure that the traffic interconnect relay (TIR) de-energizes as designed.

Verify with the state agency or road authority representative that traffic equipment operated correctly per design. Upon completing test, ensure Form 24412 is signed by the EIC and that the state agency or road authority representatives' name is recorded.

If preemption does not appear to be functioning properly:

- Immediately notify Signal Operations to request appropriate X order

- Notify the Manager of Signal Maintenance

Note: For assistance in completing Form 24412 for the state agency or road authority in your area, contact your local MIPP.

D. **Annual Crossing Circuit Plan Review.** Rev. 05/15

Plans must be verified to meet the requirements outlined in 1.1.7 Layouts and Wires located on page 1-5. Review crossing and remote location plans to ensure installed equipment matches the circuit plans.

Review will include, but is not limited to:

- Crossing control unit
- Programmed warning time (Normal & Standby)
- Programmed preemption time (Normal & Standby)
- Programmed approach distance (Normal & Standby)
- Programmed frequencies (Normal & Standby)
- Number, type and capacity of batteries
- Number and amperage of rectifiers
- Number and configuration of lights units
- Number of bells
- Number and type of gate mechanisms, if equipped
- Verification to the plans in EDM

Any exceptions should be noted and contact made to the Signal Design Crossings Group for approval.

8.1.4 Train Detection Apparatus Rev. 08/96

A. **Train Detection.** Rev. 01/09

Train detection apparatus must be maintained to detect a train or railcar in any part of a train detection circuit in accordance with the design of the specific warning system. (FRA Standard 234.227) Additionally, train detection circuits must detect the application of a .06 ohm shunt connected across the rails in any part of the circuit. (FRA Standard 234.229)

B. **Island Set-up.** Rev. 01/09

Island circuits must be set-up and adjusted according to Manufacturer's instructions.

C. **Island Circuits.** Rev. 04/14

Island circuits must be shunt tested when placed in service, modified, disarranged, or at least quarterly to verify proper island activation. Test island circuits as follows:

1. Verify that the island circuit is energized by viewing the visual indicator or relay inside the signal enclosure.
2. Apply a .06 ohm shunt across the rails at the transmitter wires for a minimum of thirty seconds. Verify that the island circuit is de-energized by viewing the visual indicator or relay inside the signal enclosure.
3. Remove the shunt and verify that the island circuit is energized.

Note: The above test must be performed and recorded for all tracks on main and standby if equipped.

D. **Alternate Warning.** Rev. 08/96

When automatic highway crossing warning fails to operate properly or is damaged, alternative means of warning highway users must be provided promptly and maintained until necessary repairs are made. (FRA Standard 234.105 and 234.107)

8.1.5 Fouling, Bond Wires and Shunting Relays Rev. 08/96

A. **Rail Joints.** Rev. 04/14

Rail joints located within the limits of a highway crossing detection circuit must be bonded. (FRA Standard 234.233) All crossing circuits located in non-signaled track must be double bonded. See the bonding instructions in the standard drawing 756100UP for the correct application.

B. **Fouling Wires.** Rev. 08/96

Fouling wires must be two independent bond strands; wires should be placed as close as possible to the insulated joints in the turnout (FRA Standard 234.231) Wires will be stapled to separate ties to minimize the possibility of both conductors being broken during tie replacement.

C. **Track Circuit Shunting Relays.** Rev. 01/09

Relay contacts that are designed to shunt track circuits (e.g. stick lockout relays) must be tested when placed in service and thereafter when modified, disarranged, or at least once every three months. Test must be made to determine that each individual contact effectively shunts the appropriate track circuit.

D. **Fouling Point.** Rev. 01/09

Where train detection circuits extend into a switch off the main track, apply yellow paint (3 feet long) to the first fouling joint on the side of the rail head and base. Paint the rail web, side of rail head, and base, directly opposite the first fouling joint, with yellow paint (3 feet long) to clearly identify the fouling point.

8.1.6 Housekeeping

Rev. 04/14

A. **Kept Clean.**

Rev. 04/14

All crossing signals, enclosures and other associated signal apparatus must be maintained in good condition and kept clean. Relays must be properly seated. All doors must fit and work freely. Enclosures must be water tight and rodent free. Signal enclosures and signal apparatus (i.e. backgrounds, hoods, gate arm brackets and weights, etc.) shall be painted to avoid rust and maintain purpose as outlined in 1.1.9 on page 1-6.

B. **Signs.**

Rev. 10/15

Signs will be maintained in good condition and visible to the highway users. Verify crossing mast(s) have the correct cross buck(s) and multiple track sign(s). ENS or Emergency Notification Sign(s) must be correct and displayed as outlined in FRA Standard 234.311. All signs must be legible, reflectorized and secure. Crossing identification signs on enclosures shall be secure and legible. (FRA Standard 234.245)

Figure 8-2 **Example of ENS**

8.1.7 Lamps and Lenses

Rev. 03/13

A. **Lamp Voltage**.

Rev. 03/13

The proper lamp must be secured in all electric signal units. Voltage at the lamp terminal must not be less than 85% of the rated lamp voltage, (FRA Standard 234.221) Lamp voltages on Solid State Crossing Controllers should be measured with a True RMS AC + DC meter, or use the conversion chart for a TS-111 found in the manufacturer’s manual. All lenses and reflectors will be kept clean and in good condition. (FRA Standard 234.217b)

B. **LED Light Units.**

Rev. 05/15

Voltage at the LED light unit must not be less than 85% of the manufacturers maximum rated operating voltage. See example in Table 8-2.

Rated Operating Voltage	Maximum Operating Voltage	85%
8-12 V	12V	10.2 V
8-14 V	14V	11.9 V

Table 8-2 Operating Voltage

Warning: Do not exceed manufacturer maximum operating voltage.

All light units (mast lights, cantilever lights & gate lights) will be equipped with LEDs for any one direction of traffic when retrofitting highway grade crossings. Highway grade crossings currently utilizing incandescent gate light units will be retrofitted to LEDs during ordinary maintenance projects, or when damaged by a vehicle, vandalism, or weather.

8.1.8 Flashing Light Units and Audible Warning

Rev. 02/01

A. **Flashing Light Requirement.** Rev. 04/14

Each light unit must be visible and flash alternately between 35 and 65 flashes per minute (FRA Standard 234.217c) and within the rated flash rate of the flasher device. On each gate there will be three gate lights with the light nearest the tip lit continuously and the other two gate lights will flash alternately and in unison with the mast lights. (FRA 234.223 per MUTCD)

B. **Lenses and Reflectors.** Rev. 04/14

Each light unit will be maintained to prevent dust and moisture from entering the interior of the unit. All lenses and reflectors will be kept clean and in good condition. (FRA 234.217b)

C. **Backgrounds and Hoods.** Rev. 04/14

Backgrounds and hoods will be properly painted to avoid rust and maintained in good condition.

D. **Audible Warning.** Rev. 04/14

Crossing bells should operate between 100 - 225 impulses per minute and of sufficient audio to be clearly heard by pedestrian traffic at the crossing.

8.1.9 Light Alignment

Rev. 03/10

Light units will be aligned to provide appropriate approach warning to highway traffic. (FRA Standard 234.217a)

Mast mounted back flashing light units should be vertically aligned so that the axis of the beam is approximately 50 feet from the nearest rail to the approaching traffic.

Mast mounted sidelight flashing light units for traffic approaching on adjacent route will be aligned to provide appropriate warning prior to the point of intersect with the principal route.

Mast mounted front flashing light units and all cantilever flashing light units (here after referred to as front lights) should be vertically aligned so that the axis of the beam is to the alignment distance in the Manual of Uniform Traffic Control Devices (refer to Table 8-3 Minimum Sight Distance for Signal Visibility) based on the current posted speed limit over the grade crossing.

Verify the visibility of all light units is not affected by local conditions such as curves, road dips and rises, permanent obstructions, side road traffic and other traffic control devices.

If the visibility of the front lights is affected to the extent that the alignment distances in Table 8-3 Minimum Sight Distance for Signal Visibility cannot be obtained, verify the presence of a Grade Crossing Advanced Warning Sign (Figure 8-3 as example) and notify the Manager of Signal Maintenance. This condition would be recorded in the FSM as a result code “C” with additional comments describing the condition.

If a Grade Crossing Advanced Warning Sign (Figure 8-3 as example) is not present, place an XI order on the crossing and notify the Manager of Signal Maintenance. This condition would be recorded as a result code “R” in the FSM with additional comments describing the condition.

The MSM will contact the local Manager of Industry & Public Projects (MIPP) to evaluate an action plan.

If the alignment distance for the front lights is granted an exception from the Table 8-3 Minimum Sight Distance for Signal Visibility, verify the visibility of the light units at that distance and document the specific footage in the comment section of the FSM.

Posted Speed Limit (MPH)	Alignment Distance (Feet)
20	175
25	215
30	270
35	325
40	390
45	460
50	540
55	625
60	715

Table 8-3 Minimum Sight Distance for Signal Visibility

Figure 8-3 Railroad Advance Warning Sign

8.1.10 Gate Arms and Lights

Rev. 08/96

A. **Proper Operation.**

Rev. 04/14

Each gate arm shall be maintained to start its downward motion not less than three seconds after the flashing lights begin to operate. Gate arm shall assume the horizontal position at least five seconds before the arrival of any train at a crossing. (FRA Standard 234.223) Crossing gates will descend and ascend in unison, with the exception of exit gates delayed by an occupied crossing quadrant.

B. **Gate Lights.**

Rev. 04/14

Gate lights must be properly visible to approaching highway traffic and meet the requirements outlined in 8.1.7 on page 8-30 and 8.1.8 on page 8-31. Light units and light wires must be secured to the gate arm. (FRA Standard 234.219) Light wires will not be sleeved or spliced outside of a weatherproof connection.

C. **Gate Arm Torque.** Rev. 10/15

Gate arm torque must be checked and adjusted when placed in service and thereafter when modified, disarranged, or at least annually. Conditions that warrant check include, but are not limited to: motor contact issues (see 8.1.11C. Kept Clean and Debris Free.), gate arm length changes, or other changes that may affect the total weight of the gate arm assembly. Gate arm weights shall be properly secured and painted. Refer to manufactures specifications for weight placement and gate arm torque adjustment.

D. **Gate Arm Position.** Rev. 04/14

Gate arm position must be properly adjusted to be level and a clearance above the crown of the road of 42" to 54” when in the horizontal position. (FRA 234.223 per MUTCD) Gates should be full vertical when in the raised position except to avoid fouling. Stop adjustments should limit the possibility of travel beyond the desired raised position.

E. **Fouling of Gate Arms.** Rev. 04/14

Gate arms must be checked when in the raised position to avoid any possibility of the arm fouling on wires, cables, trees, cross-buck, lights, etc. Wind guards must be secured and properly aligned.

F. **Gate Arm Length.** Rev 10/15

The required length of each gate arm is determined by the design length as indicated on the circuit plans. In all cases, the gate arm must extend across at least 90% of each lane of approaching highway traffic. (FRA 234.223)

Single gate arm or crossing equipped with a median or a channelization device between the approach and exit lane(s), the gate(s) must be within 1’ or less of approach lane(s) width or the median or channelization device. (CFR 49, Part 222, Appendix A)

When multiple gate arms are used for approach lane(s) the gap between the ends of horizontal gate arms must be within 2’ or less. (CFR 49, Part 222, Appendix A)

Minimum gate(s) length calculations to comply with requirements: (measurement from edge of marked lane)

- Gate(s) must extend 7’3” ft across 8’ lane(s),
- Gate(s) must extend 8’2” ft across 9’ lane(s)
- Gate(s) must extend 9’ across 10’ lane(s)
- Gate(s) must extend within 1’ of total width of lane(s) greater than 10’ (i.e. 20’ lane(s) will have a 19’ minimum length gate(s)

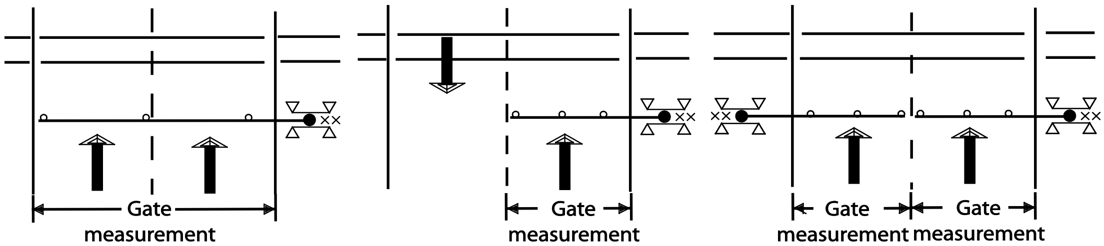


Figure 8-4 Gate measurement

8.1.11 Gate Mechanisms

Rev. 08/96

A. **Lubrication.** Rev. 08/96

Lubricants in accordance with manufacturer's recommendation must be used. Lubricate and oil mechanism, controller and buffer.

B. **Contamination of Hold Clear.** Rev. 08/96

Oil should be used sparingly between the ratchet wheel and snap ring to avoid contamination of the hold clear device.

C. **Kept Clean and Debris Free.** Rev. 10/15

Gate mechanisms shall be maintained to ensure proper operation. Ratchet wheel, pawl, magnet bar, core face of coil, commutator on motor armature, cams, contacts, and brushes will be kept clean and debris free. Inspect cams and contacts quarterly for damage.

Clean resistive contact(s) with approved measure (i.e. Store Stock# 4150255 contact cleaning file) that are discolored or show signs of burning. A resistive contact is indicated by reading a voltage drop across it while in operation. If the contact connection is pitted, smooth the surface with approved measure to ensure proper conductivity, or replace if excessively pitted.

Damage to motor contact(s) will have the horizontal and vertical torque checked as outlined in 8.1.10C. Gate Arm Torque. to ensure excessive gate weight is not the cause of issue.

D. **Aligned and Secured.** Rev 04/14

Gate mechanisms will be maintained for alignment and properly secured:

- To the designed alignment with the road
- According to state road authority requirement
- Using arrow indicators as shown in standard drawing

8.1.12 Adjusting Motion Devices and Predictors

Rev. 02/01

A. **Before Adjusting.** Rev. 02/01

Before changing the adjustment on crossing predictors or motion devices, the approach circuits in both directions must be walked, checking the rail, rail bonds, joint couplers termination shunts, and correcting any defects.

If all trackside equipment and track circuit components are verified to be in good working order, then module replacement or adjustment may be necessary. A comparison of vital parameters must be made with the information on the history card. Make note of all readings to permit comparison values after module adjustment or disarrangement. Additionally, if equipped with a recording device, verify adequate warning time for the last 10 train moves.

B. **After Adjusting.** Rev. 01/09

Motion Sensors.

Place a .06 ohm shunt at 90% of each approach as determined from the print, and verify the crossing system activates at the proper place for the design speed or observe the operation of a train over the crossing in both directions. If no trains are available and the crossing does not activate with a shunt at 90% of the approach, verify that the distance voltage drops by at least 10% when the shunt is placed at 90%.

Constant Warning Device.

Compare the vital parameters to the information on the history card, and to the readings that were taken before adjustment or replacement was made. When possible, verify the proper warning time of the crossing system by observing a train or engine approach the crossing at a constant speed.

Where predominant train movements are in a single direction, to verify the integrity of the opposite approach, monitor the distant voltage (e.g. ED, EZ) with a meter or chart recorder. As train approaches the crossing the voltage should smoothly decrease to zero, and then smoothly increase back to its original level as the train moves off the leaving track. If there are any jumps or spikes in the distant voltage, the unit cannot be placed back in service until the cause is determined and corrected. Additionally, in bi-directional applications, as the train is moving through the crossing approach tracks at a constant speed, the time that takes the distant voltage on an inbound move to go from 100% to 0, should be compared to the time that it takes the outbound move to go from 0 to 100%. These times should be about the same. If there is a significant difference, determine the cause and correct if necessary.

If no train movements are expected in the near future, and all the vital parameter readings match the History Card, the following alternate test may be made to determine proper operation. Shunt each approach track at the 100, 75, 50 and 25 percent points. The distant voltage should decrease by the appropriate percentage at each corresponding shunt. If the crossing is DAX, in addition to the 100, 75, 50 and 25 percent shunts, shunts must be placed at the 20, 10, and 5 percent points. In all cases, place a .06 ohm shunt in the island circuit and verify crossing warning system operation. If distant voltage does not drop along a linear line, an approaching train must be used to verify the appropriate warning time.

8.1.13 Changing Frequencies

Rev. 08/96

The approach and island frequency and any sub-tone of audio frequency for overlay track circuits, crossing predictors, and motion devices must be maintained in agreement with track layout and circuit plans. Only after consulting with Signal Design it is determined, because of an equipment failure, there is approval to substitute equipment of a different frequency; the following steps must be taken:

1. Verify the frequencies are in agreement with circuit plans and make note of all readings to permit comparison after disarrangement for all audio frequency track equipment closer than two sets of un-bypassed insulated joints from the equipment to be substituted.
2. Install approved substitute equipment and follow manufacturer's instructions for proper setup procedures.
3. Complete comparison of the readings for all audio frequency track equipment closer than two sets of un-bypassed insulated joints from the equipment substituted.
4. Test crossing as outlined for Rule 234.259 - Warning Time on page 8-21.

8.1.14 Inspection After Incident

Rev. 05/15

When there is an incident at a crossing where an automatic highway grade crossing warning system is in use, the Signal Maintainer must follow the instructions as outlined in 3.1.2 Grade Crossing and Other Third-Party Incidents. on page 3-2.

When authorized by the Manager of Signal Maintenance, perform the following:

1. Complete secured download of any electronic recording device at the crossing (Main and Standby) and associated remote devices (Main and Standby) as soon as practical. Download shall contain the entire history of event recorders. Ensure download is secured prior to taking any action that may prevent data retrieval. Current configuration files will be downloaded and secured, which includes the PAC file for GCP4000 locations.
   - In the event the recorder is not able to produce a download, all screens displaying an error code or fault shall be documented
2. Perform a FSM (SATS) Audit to verify assets in the location.
3. Check the warning system for proper operation as outlined in the Monthly Test Procedure on page 8-3, in addition, shunt each track circuit involved and observe the warning system operates as intended. Remote locations within the design shall be checked for proper operations as outlined above.

8.1.15 Highway Grade Crossing Warning System – Disabling and Enabling Rev. 01/14

Note: This entire instruction must be understood completely before any portion of the instruction is acted upon.

A. **Damaged or Malfunctioning Crossing Warning Systems.** Rev. 10/14

CONSULT YOUR SUPERVISOR OR MANAGER prior to taking a grade crossing warning system out of service or, disabling a crossing warning system, or portion thereof, due to crossing warning system damage or malfunction.

This includes, but is not limited to; disabling a gate mechanism to repair damage, temporarily relocating shunts due to weather issues or disabling while troubleshooting source of malfunction.

Due to the nature of having an inoperable crossing device, it is imperative that, if at all possible, a crossing not be completely disabled. At a minimum, it is desirable to have the island circuit working during crossing occupancy. Disabled crossings should be restored to full operation without undue delay.

If damaged or malfunctioning crossing is located on other than main track(s) or siding(s), in addition to following this instruction, refer to 8.1.18 Non-Controlled Crossing Out of Service Sign on page 8-50 for use and placement of Non-Controlled Crossing Out Of Service signs (NCC OOS signs).

Note: Non-controlled tracks are typically Industrial leads, Yard tracks, and etc.

B. **Familiarization of Circuits.** Rev. 01/14

Before beginning the disabling process, make sure you have a full understanding of all applicable interconnected circuitry, traffic signal preemptions, affected tracks and adjacent crossing controls. If you do not have a complete understanding of all these criteria, do not disable the crossing warning device. Contact your Signal Supervisor or Manager for further instructions.

C. **Interconnects.** Rev. 01/14

Crossing warning system disabling method must not interfere with interconnected parallel UPRR crossing(s), other railroads crossing(s) or traffic light preemptions. Before disabling crossing warning systems, ensure the disabling method will not adversely affect interconnected circuits. Interconnect information must be documented on Form 24235 . SOC must be contacted if interconnect is affected, a ticket created, and the other railroad notified. Alternative means of protection must be provided on the other crossing(s) by one of the following methods:

- Stop and Protect Form C track bulletin.
- Closing grade crossings (CEB 137.2.4)
- Flaggers (CEB 137.2.5)

D. **Permanently Removed From Service** Rev. 01/14

Highway grade crossing warning systems must not be permanently removed from service without written permission from the governing road authority. In most cases, this authority is received from the Public Utilities Commission (PUC), Corporation Commission of the State, or the State's Department of Transportation.

E. **Jumper Kit** Rev. 01/14

Each signal employee or gang must maintain a Jumper Kit. The purpose of the Jumper Kit is to organize all equipment necessary to safely disable and enable crossing warning devices. The following equipment is to be included in the Jumper Kit:

- Jumper Kit Bag
- Jumper Kit Checklist
- Disabling / Enabling Crossing Procedures Job Aid
- Form 24235 , Crossing Disable Planning/ Briefing Worksheets
- Approved Jumpers with Tags and Reminders
    - 6 each, Individual Signal Employee
    - 30 each, Signal Gangs
- “Danger Do Not Operate” Lockout Tags

- Dry Erase Pens
- Optional:
- Additional Jumpers Authorized by Non-agreement (Manager, Director, etc.) Signal Employee
- Track Shunts
- Additional Reminder Tags for Shunts
- Dummy Loads

The Checklist must remain accurate at all times. Document on the Checklist when any items are added to the Jumper Kit.

F. **Approved Jumpers** Rev. 01/14

Only approved jumpers may be used to bypass circuits when disabling a crossing warning device. These jumpers must be red, fluorescent yellow or fluorescent orange and at least five feet in length. No exceptions will be allowed. Jumper color must sharply contrast the color of the enclosure wiring.

Each jumper will indicate an identifying number and owner identification on a fluorescent yellow tag. When jumpers are associated with a signal construction gang, the owner identification may be the gang number in lieu of an individual's initials. In this case, the gang foreman or specified man in-charge will be responsible for all jumpers assigned to that work group. In all cases, each jumper will include a jumper number in addition to the owner's identification.

Each jumper will also have a detachable Reminder Tag. The Reminder Tag must be completed with the Jumper Number and Owner ID, and contain space to record the Specific Location of the jumper, Name of the Circuit to which the jumper is to be applied, Date, and Time.

Each individual agreement signal employee will be limited to six jumpers in his/her immediate possession. Each signal gang will be limited to thirty jumpers that indicate the gang number.

When special conditions merit an increase in the number of jumpers an employee or gang requires to perform their normal duties, permission to carry additional jumpers must be obtained from a non-agreement (manager, director, etc.) signal employee. The approving non-agreement signal employee will document the jumper quantity exception, including the employee's name and/or gang number, and the number of jumpers approved for possession.

G. Dummy Loads

Rev. 01/14

Crossing Warning System disabled by use of Dummy Load(s) must be documented on Form 24235 . One of the approved jumpers will be conspicuously applied to each Dummy Load. The Reminder Tag(s) must be completed with all applicable Test Jumper information.

H. Disable by Program

Rev. 01/14

Crossing Warning System disabled by use of programming must be documented on Form 24235 . One of the approved jumpers will be conspicuously applied to each disabled track. The Reminder Tag(s) must be completed with all applicable Test Jumper information.

I. Track Shunt

Rev. 01/14

Crossing Warning System disabled by use of Track Shunt(s) must be documented on Form 24235 . It is recommended to use Reminder Tags with Track Shunts.

J. Disable by Mechanical Measures

Rev. 01/14

Crossing Warning System disabled by use of mechanical measures (i.e. gate held in the clear by tie down) must be documented on Form 24235 . One of the approved jumpers will be conspicuously placed for each disabled gate. The Reminder Tag(s) must be completed with all applicable information. Attach all Reminder Tags to the Jumper Kit bag and retain until enabling procedure is complete.

K. Proper Authority and Documentation

Rev. 01/14

Prior to disabling a grade crossing warning system, signal employees must obtain proper authority as outlined in Chief Engineer's Bulletin CEB 137. The Dispatcher and Signal Operations (if not covered by planned work per CEB 137) must be notified that the crossing warning system or portion thereof will be disabled.

Signal personnel responsible for disabling a grade crossing warning system must document the location of the disabled crossing(s), and have such documentation in their possession. Form 24235 , Crossing Disable Planning / Briefing Worksheet, must be used. Original must remain in the employee’s possession and the pink copy must remain at the disabled crossing. In addition, the location of disabled crossings will be kept in the employee’s Job Briefing Book. Such documentation will serve as a reminder that, before releasing authority, all disabled crossing warning device(s) must be properly inspected and tested to ensure proper operation.

The Reminder Tags, indicating the Specific Location of the jumper, Name of the Circuit to which the jumper is applied, Date, and Time will remain in the possession of the employee who disabled the crossing, preferably attached to the outside of the Jumper Kit.

If that signal employee will not be available to return to the crossing warning location(s), the complete handoff instructions must be followed.

Documentation must be available for review after the affected crossing(s) have been inspected, tested and the proper authority released. Keep a copy of Form 24235 at each crossing location and the original in your possession until 24 hours after the crossings are restored to normal operation.

The completed yellow copy of Form 24235 must remain at the crossing until a recorded monthly crossing test and inspection is performed more than 7 days after the crossing was enabled.

Example:

A crossing is disabled by a Signal Maintainer on June 1, 2012. The Maintainer returns the crossing to service in the afternoon of the same day. The disabling form must be retained until June 8, 2012. The next scheduled Monthly Crossing Warning Inspection is due on June 6, 2012 and maintainer performs the scheduled test on that day. The disabling document must remain at the crossing until the maintainer performs the next scheduled test due on July 3, 2012.

L. **Planned Work** Rev. 01/14

Before planned track work is undertaken within the approach to any grade crossing equipped with automatic warning devices, the EIC must communicate with a signalman at least 24 hours in advance. The job briefing must include determination of which crossings will be affected and the protection required at each. (CEB 137.2)

Note: Crossing Warning Malfunctioning sign must not be used as a form of protection on controlled main track, siding or planned work on controlled main track or siding track.

Note: If planned work is being performed, the Warning Malfunctioning signs (NCC OOS sign) or Red Flags may be used to provide supplemental alternative protection on automatic grade crossings located on other than main track(s) or siding(s). (Industrial leads, yard tracks, i.e. non-controlled tracks) Refer to 8.1.18on page 8-50 for sign or flag placement.

M. **Unplanned Work** Rev. 01/14

When emergency track work is undertaken in the approach to a grade crossing equipped with automatic warning devices, the EIC will contact a signalman to advise of the work to be performed and to discuss proper methods of protecting the public at the affected crossings. (CEB 137.3)

Note: Crossing Warning Malfunctioning sign (NCC OOS sign) must not be used as a form of protection on controlled main track, siding or for planned work on controlled main track or siding track.

Note: Refer to 8.1.18on page 8-50 . If an "X" order is not in place, Warning Malfunctioning sign (NCC OOS sign) or Red Flag must be used to provide supplemental alternative protection on automatic grade crossings located on other than main track(s) or siding(s). (Industrial leads, yard tracks, i.e. non-controlled tracks)

N. **Disabling Procedure** Rev. 05/15

1. Review this entire section of instructions and CEB 137 before any portion is acted upon.
2. Perform a job briefing with all involved employees and review all applicable rules, safety concerns, circuit plans, disabling, and enabling procedures.
3. List each crossing to be disabled in the job briefing book.
4. Crossings to be disabled as a consequence of track work, damage, or malfunctioning must be protected with one of the following; confirm with the EIC of track work, which form of protection is to be used at each affected crossing (CEB 137.2.3.A.2):
   - Stop and Protect Form C track bulletin.
   - Closing grade crossings (CEB 137.2.4)
   - Flaggers (CEB 137.2.5)

Note: When it is known that no trains will be operating over the crossing(s) on any track, disabled crossings may be protected using exclusive track occupancy (track and time, track warrant, etc.) without the issuance of a Form C track bulletin or providing flaggers. (CEB 137.2.3.B.5)

Note: When interconnected to parallel UPRR, another railroad crossing(s), alternative means of protection must be provided on the other crossing(s) by one of the following methods:

- Stop and Protect Form C track bulletin.
- Closing grade crossings (CEB 137.2.4)
- Flaggers (CEB 137.2.5)

5. Determine which disabling procedures will maintain normal operation on as many tracks and approaches as possible. Verify that interconnected crossing(s) not intended to be disabled continue to provide warning and traffic preemption(s) continues to function as intended.
6. Confirm proper authority (Form B track bulletin, track and time, track warrant, track permit, etc.) is acquired from the dispatcher before applying a track shunt or dummy load (an inductor applied across track wire terminals) to disable a crossing. Regardless of the type of authority used, all train movements within these limits will be governed by the EIC after job briefing with the signalman to ensure safe train movements.
7. Ensure all jumpers are approved as indicated in the Approved Jumper section of 8.1.15F. on page 8-38. Each must have a numbered owner ID tag and reminder tag. Dummy loads must have an approved jumper attached to them.
8. Mark each circuit to be disconnected or equipment to be disabled by programming, with a conspicuously placed approved jumper.
9. Reconfirm, as needed, with the EIC and the dispatcher that all necessary protection is in effect.
10. PERFORM THE SELECTED DISABLING PROCEDURES.
11. Ensure that each track selected to be disabled is disabled and that all other tracks function normally.
12. Complete a Crossing Disabling Form 24235 for each disabled crossing.
13. Keep a copy of the form at each crossing location and the original in your possession, until 24 hours after the crossings are restored to normal operation.
14. Attach all Reminder Tags to the Jumper Kit bag and retain until enabling procedure is complete.

    Note: If the signal employee who disabled crossing will not be available to enable the crossing, Reminder Tags must be left in a conspicuous location at the disabled crossing.
15. Notify SOC, if the work is unplanned or is interconnected to parallel UPRR or another railroad crossing(s), and have a ticket created for each disabled crossing. (An example of unplanned work is failure to request a Form B, along with a Form C, at least 12 hours in advance.)
16. Insert a standard LO/TO tag through the door lock on each affected crossing case/enclosure.

17. Notify the EIC that all applicable crossings have been properly disabled and tested as per the job briefing.

    Note: If there is a need to handoff the enabling and testing of the crossing to another employee:

    - Complete Form 24235 indicating that a thorough job briefing of all existing disabling measures was performed. The job briefing must include designated location to return Form 24235 , all existing disabling measures, and Reminder Tags.
    - The employee being briefed accepts responsibility for the enabling and testing of the crossing and has received the Reminder Tags
    - Record the handoff in your job briefing book, including date, time, employee ID, and worksheet number before releasing Form 24235 to that employee

O. Enabling Procedure

Rev. 01/14

1. Verify, with the EIC of track work, that the need for the crossing warning devices to be disabled is no longer required.
2. Review the documentation of jumpers, track shunts, or other disabling procedures, used to disable each crossing.
3. Remove and account for each jumper and/or track shunt used in disabling each crossing, reattaching the reminder tags to the jumpers.
4. Ensure that all approaches on all affected tracks and all crossings are functioning normally. Verify that all interconnects and traffic preemptions are functioning properly.
5. Remove all reminder job aids and LO/TO tags.
6. Notify the EIC of track work that each crossing has been restored to normal operation. If crossing(s) are interconnected notify SOC that the crossing(s) have been restored and are functioning as intended.
7. Advise the Dispatcher of each disabled crossing that has been restored to normal operation and instruct the Dispatcher to remove each applicable "Stop and Protect" order.

   Note: When a signalman disables a crossing warning device, only a signalman may remove the "Stop and Protect" order from the Form C track bulletin. (CEB 137.2.3.A.5, 137.2.3.B.6, 137.2.6.A.2)
8. Release track and time or track permit, etc., if applicable.
9. Advise SOC (on unplanned track work) that each disabled crossing has been properly tested and is operating as intended.

10. The completed yellow copy of Form 24235 must remain at the crossing until a recorded monthly crossing test and inspection is performed more than 7 days after the crossing was enabled.

8.1.16 Speed Table

Rev. 05/15

(Based on 25 seconds warning plus equipment response time calculated from 1.467 feet per second at one mile per hour.)

Table 8-4 Speed Table

		AFO and Conventional Approaches	Motion Sensor Approaches	Processor Based Control Unit Approaches
Miles Per Hour	**Feet Per Second**	**Feet for 25 + 1 Seconds**	**Feet for 25 + 3 Seconds**	**Feet for 25 + 5 Seconds**
10	14.67	381	411	440
15	22.01	572	616	660
20	29.34	763	822	880
25	36.68	954	1,027	1,100
30	44.01	1,144	1,232	1,320
35	51.35	1,335	1,438	1,541
40	58.68	1,526	1,634	1,760
45	66.02	1,717	1,849	1,981
49	71.88	1,869	2,013	2,156
50	73.35	1,907	2,054	2,201
55	80.69	2,098	2,259	2,421
60	88.02	2,289	2,465	2,641
65	95.36	2,479	2,670	2,861
70	102.70	2,670	2,876	3,081
75	110.03	2,861	3,081	3,301
79	115.89	3,013	3,245	3,477

Approach circuit lengths and warning times in this table are Union Pacific Railroad standards for new installations and are not to be varied without prior approval from the Director, Manager or Sr. Circuit Designer of Signal Design.

Note: Constant warning time devices are to be set for 25 seconds warning plus any clearance time that is required.

The crossing signal approach distance is to be measured from the island track connections to the termination shunt. Approach distance used for set up and calibration procedures for constant warning devices should be from the island track connections to the termination shunts

Clearance Time - When the distance from a governing crossing signal to the clearance point of the far rail (six feet) exceeds 35 feet, the approaches must be lengthened for one second additional warning for each 10 feet or portion thereof over 35 feet. At locations using a constant warning device this additional warning time must be added to the 25 seconds.

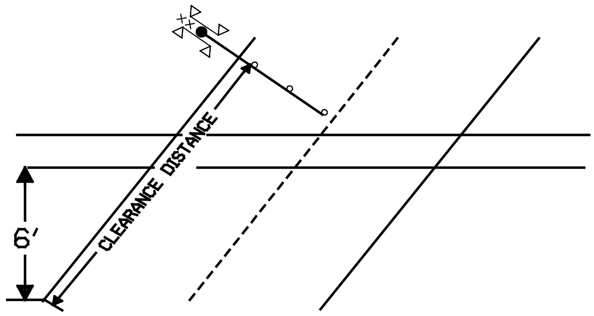


Figure 8-5

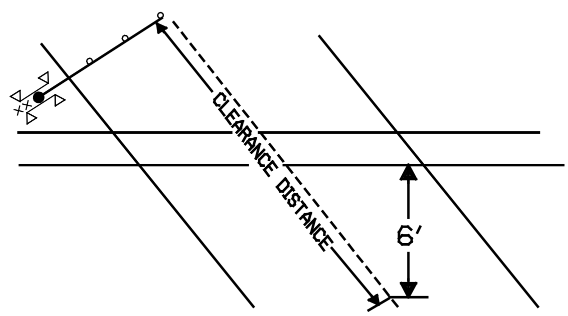


Figure 8-6

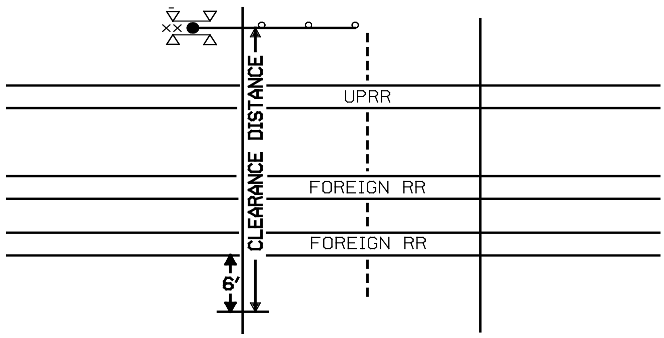


Figure 8-7

Propagation Delay Time - Additional time needed when calculating crossing approach distances, where 2 or more remotes (in same direction) are needed to DAX back to crossing. One additional second will be added to the approach for the second remote and an additional second for each remote location after. This delay time is NOT part of the crossings warning time, but the warning time at the remote

Advance Preemption Time - When Advance Preemption is required for traffic signals near a highway/railroad intersection, the approach must be lengthened for preemption time requested and constant warning control devices must be used with a DAX or AXC circuit providing the Advance Preemption time. The crossing signal warning time should remain at 25 seconds plus any Clearance Time required, and the Advance Preemption be provided to the traffic signals by an interconnection circuit, through double break, normal energized contacts of a DAX or AXC relay. Power and cable for the Advance Preemption circuits on non-UPRR crossings and traffic signals are to be provided by others.

NOTE: When programming Advance Preemption for GCP3000 or GCP4000, subtract 2 seconds from the Warning Time as recommended by manufacturer for the possibility of trains accelerating into the crossing.

Example = Warning Time of 25 seconds, Clearance Time requires 5 seconds, and Advance Preempt time requested is 10 seconds. The Warning Time for a GCP3000 or GCP4000 would be set at 28 seconds, the Advance Preempt would be set at 40 seconds, and the total approach would be for 45 seconds to allow for 5 seconds equipment reaction time.

8.1.17 Train or Engines Standing Within Crossing Warning Approaches

Rev. 01/09

A. **Purpose.** Rev. 01/09

To ensure that train and public safety is not compromised when crossing warning devices are activated because cars, train or engines are standing within the approach of a highway grade crossing.

B. **Procedure.** Rev. 02/15

After verifying that cars, train or engines are 250 feet (500 feet in Illinois, 330 feet in Wisconsin, 300 feet in Arkansas and Louisiana) or more from the edge of the road crossing, perform the following steps:

1. Place an XC order on the affected track(s).
2. If practical, take all switches that lead to the affected track out of service and notify the Dispatcher.
3. Deactivate the warning system utilizing the best method that will minimize affecting the normal operation of the crossing warning system.
4. Communicate with the Dispatcher and verify that the XC order is in effect and all trains approaching the crossing have the order. Additionally, have the Dispatcher or local train manager notify you when the cars, train or engines will be moved.

1. When cars, train or engines that affect the normal operation of the crossing warning device have been moved, verify proper crossing warning system operation.
2. Place all switches that were removed from service back in service and remove the XC order from the affected tracks.
3. If cars, train or engines are not 250 feet (500 feet in Illinois, or 330 feet in Wisconsin, 300 feet in Arkansas and Louisiana) or more from the edge of the road crossing, in addition to the steps above, perform the following:
4. Contact the Dispatcher and local train manager instructing them to have the cars, train or engines moved to provide at least 250 feet (500 feet in Illinois, or 330 feet in Wisconsin, 300 feet in Arkansas and Louisiana) of clearance to the edge of the road crossing per Operating Rule 6.32.4.

5. Place the XC order on every affected track on which the traveling public's sight is impaired.
6. At the discretion of the signal manager, sight impaired tracks may not need an XC order where designated track speed is 10 mph or less.
7. XC orders placed due to sight impairment may be removed if the cars, train or engines are moved beyond 250 feet (500 feet in Illinois, or 330 feet in Wisconsin, 300 feet in Arkansas and Louisiana) from the edge of the road crossing and crossing warning device is operating properly.

   Note: Use this same procedure if cars are less than 250 feet (500 feet in Illinois, 330 feet in Wisconsin, 300 feet in Arkansas and Louisiana) from the edge of the road crossing even if the warning system is not activated.

8.1.18 Non-Controlled Crossing Out of Service Sign

Rev. 03/10

Non-Controlled Crossing Out Of Service Sign (NCC OOS Sign) is used to provide supplemental alternative protection on automatic grade crossings located on other than main track(s) or siding(s). (Industrial leads, yard tracks, i.e. non-controlled tracks)

Figure 8-8
NCC OSS Sign

A. **Sign Placement.**

Rev. 03/10

NCC OOS sign must be placed on all non-controlled tracks in each direction having access to the crossing

NCC OOS sign must be placed At least 100 feet in approach to the crossing or as far as practicable considering:

- Sight distance
- Adjacent crossing distances
- Obstructions or obstacles

Sign must be placed to the right of the track(s) as viewed by an approaching train (on all tacks, in each direction). When the crossing is made inaccessible, this is a supporting option.

B. **General Conditions.** Rev. 03/10

The following conditions must be met prior to disabling or performing track or signal work at a crossing located on other than main track or siding that is equipped with automatic grade crossings warning devices:

- Review and comply with CEB 137
- Ensure NCC OOS Signs or Red Flags are in place
- X orders(s) are requested, in effect, and documented
- Disabling procedure is documented on Form 24235

C. **Signal Operations Personnel Requirements. (NCC OOS Signs)** Rev. 03/10

Upon receiving notification of a credible report of a malfunctioning automatic grade crossing warning device or a request to take a automatic grade crossing warning device out of service (in addition to complying with current instructions) comply with the following:

1. Upon dispatching Signal Personnel or while in contact with Signal Personnel who are disabling a crossing; inform the Signal Personnel that placing NCC OOS Signals or red flag is mandatory.
2. Document this communication in the Remedy Ticket
3. After being notified that the NCC OSS Signs or red flag has been placed, update the Remedy Ticket in the proper fields.
4. Upon being notified that the NCC OSS Signs or red flag have been removed, update the Remedy Ticket to indicate they have been removed and close the ticket per current instructions and guidelines.

D. **Field Personnel Requirements. (NCC OOS Signs)** Rev. 03/10

1. Upon being notified by SOC of a credible report of a malfunctioning automatic grade crossing warning device on other than main tracks or sidings, along with normal job briefings, advise SOC that upon arrival NCC OOS Signs or Red Flag will be placed on all tracks with access to the affected crossing.
   - If the crossing can be made inaccessible, the NCC OOS Signs or Red Flag may be a supporting option
   - If the report is not credible, but upon arrival the malfunction is confirmed, the report is now credible. Contact SOC:

   d. Advise the report is credible

   e. Request and document X orders

   f. Confirm NCC OOS Signs or Red Flags have been placed prior to beginning work

2. Upon arriving at the location:
   a. Place the first NCC OOS Sign or Red Flag facing the direction of the first expected train movement
   b. Place the second sign facing the opposite direction
   c. Contact SOC and advise that the NCC OSS Signs or Red Flags are placed
3. After repairs and testing for proper operation are complete, remove and store the NCC OSS Signs or Red Flags.
4. Upon closing the ticket with SOC, advise them that the NCC OSS Signs have been removed.

Chapter 9 Track Circuits and Bonding

Rule 236.104 - Shunt Fouling Circuit

Rev. 05/15

Record	Interval	Retention
Form 24094 FSM	3 Months	Until Next Record is Filed - in no case less than 1 year

Distribution

Test By	Original	Copies
Mtr.	MSM	Mtr.

Definition

The track circuit in the fouling section of a turnout, connected in multiple with the track circuit in the main track.

Purpose

To ensure that switch foulings are in condition to function properly and accommodate safe train movements by detecting equipment not in clear of main track.

Frequency

Test must be performed when placed in service and thereafter when modified, disarranged, or at least once every three months. Inspection must be performed monthly. Conditions or performance data may warrant more frequent inspections and tests.

Precautions

The employee(s) making the test must have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

When performing the monthly inspection ensure the following:

- **E.** Bonding consists of good rail joint bonds solidly connected to the rails, continuous from the switch points to the clearance point; each connection will consist of 2 wires.
- **F.** Fouling or jumper wires consist of two continuous conductors no smaller than No. 6 AWG.
- **G.** Fouling or jumper wires are solidly connected to the rails, securely attached to separate ties, properly protected from rail anchors, spikes, other foreign matter, and are visible for inspection.

Description of Test

Track Circuit Shunting Relays

Relay contacts that are designed to shunt track circuits must be tested when placed in service and thereafter when modified, disarranged, or at least once every three months. Test must be made to determine that each individual contact effectively shunts the appropriate track circuit.

ATC and ACS Territories

If the shunt fouling circuit is located in ATC (Automatic Train Control), or ACS (Automatic Cab Signal) territory, with the shunt applied, verify a restrictive condition with an AC ammeter (less than 280 ma.) Care must be taken that other overlay circuits are not being read. The restrictive condition must be effective to within 300 feet of the switch points (i.e. “hot” track or permissive cab over an open switch is permissible as long as there is a restrictive condition to within 300 feet of the open switch as approached by a train or engine).

Connect a voltmeter to the rails of the main track, or, if practical, observe the indication of the governing signal and ensure that the voltmeter or signal indicates the main track circuit is energized. Then, shunt fouling will be tested by applying three .06 ohm shunts separately:

1. One at the effective joint located beyond the clearance point
2. The second just behind the turnout insulated joints (on the frog side)
3. The third just ahead of the turnout polarity joints (on the point side)

With each shunt applied separately, the voltmeter or signal should indicate that the track circuit is shunted; track circuit voltage must not exceed .1 volt, except track circuits with 2 ohm or less relays, and that voltage must not exceed .05 volts. If the track circuit voltage exceeds these values with the shunt applied, the tester must observe that the track circuit relay, or device that functions as a track relay, is de-energized; if not de-energized, corrective action must be taken immediately.

Electro Code track circuits.

With each shunt applied separately, ensure that both track circuits are de-energized by observing the indication of the governing signal or the indication of the track relay or device that functions as a track relay. Allow sufficient time for both track circuits to recover between placing each shunt

Microtrax track circuits.

With each shunt applied separately, ensure that only the First Half (A) track is coding. The Second Half (B) track must be de-energized. Allow sufficient time for both track circuits to recover between placing each shunt. Testing by use of signal indication or device that functions as a track relay is acceptable.

Relay based coded track circuits.

With each shunt applied separately, the voltmeter or signal should indicate that the track circuit is shunted; track circuit voltage must not exceed 0.08 volt. If the track circuit voltage exceeds 0.08 volt, the tester must observe that the track relays, or devices that function as track relays, under test are de-energized; if not de-energized, corrective action must be taken immediately.

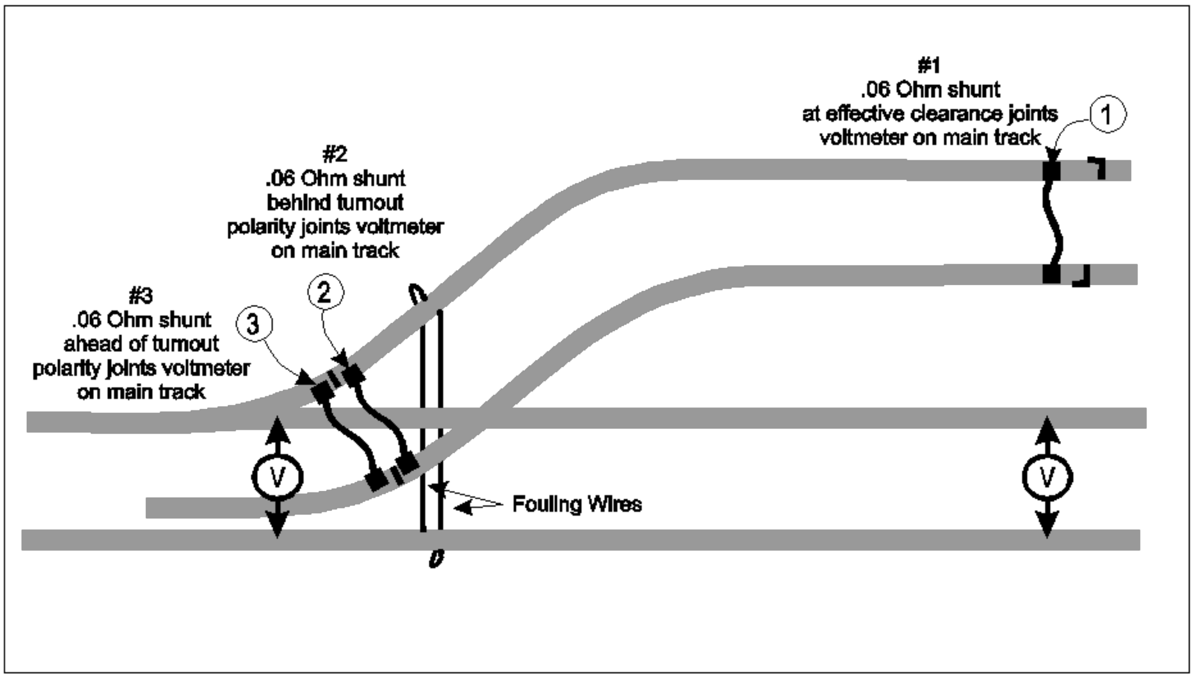


Figure 9-1
Fouling jumpers are located directly behind the turnout polarity joints

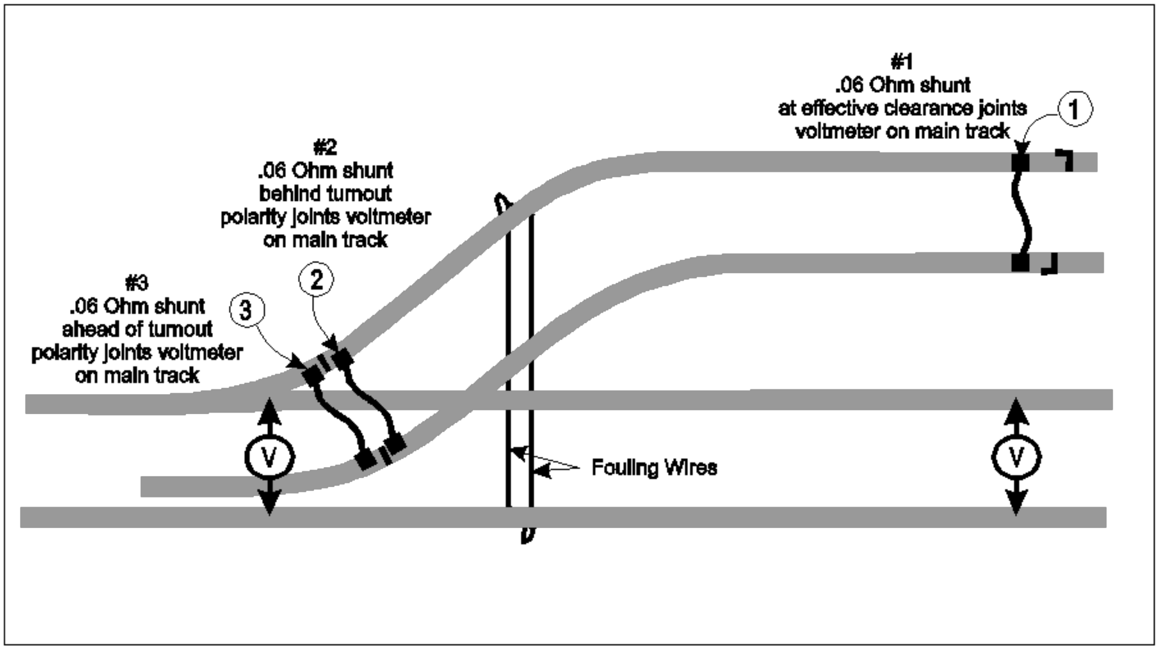


Figure 9-2
Fouling jumper wires are located behind the frog

Crossovers Between Main Tracks:

Six .06 ohm shunts must be applied separately. Connect a voltmeter to the rails of the appropriate main track. Do not place the voltmeter in the turnout.

1. The first and second on each side of the insulated polarity joints located in front of the frog on number 1 Track;
2. The third and fourth on each side of the insulated polarity joints between the main tracks;
3. The fifth and sixth on each side of the insulated polarity joints located in front of the frog on number 2 Track.

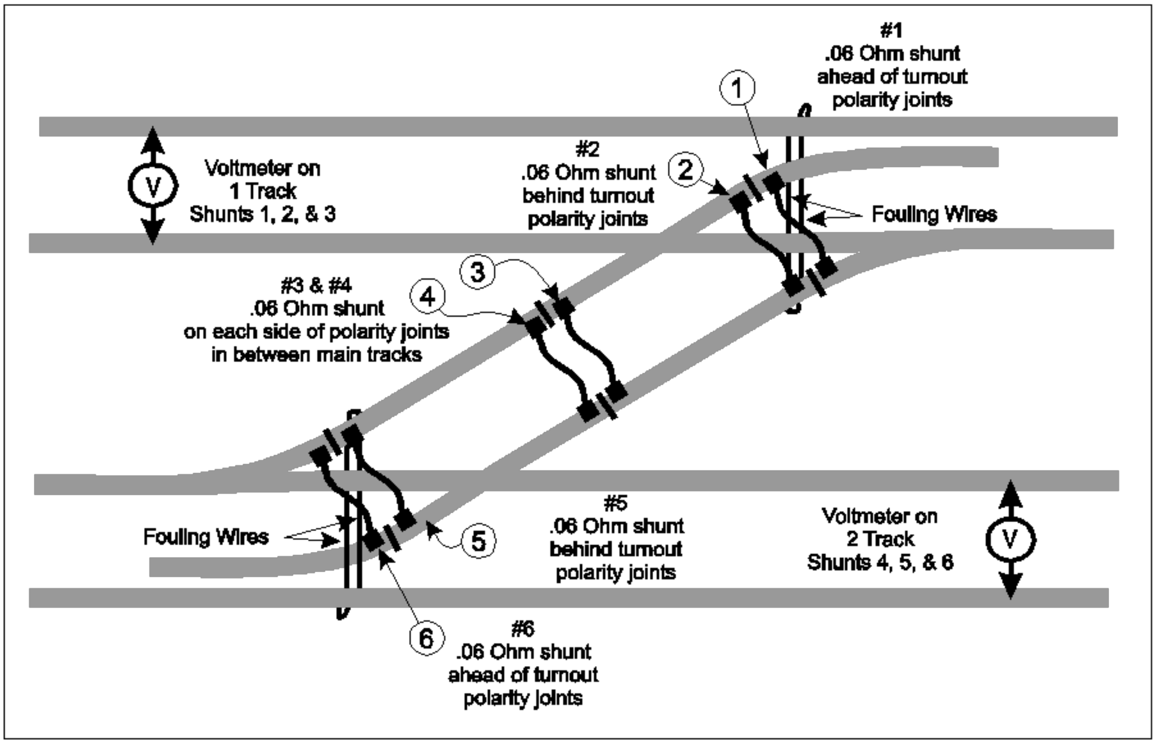


Figure 9-3

With each shunt applied separately,

the voltmeter or signal should indicate that the appropriate track circuit is shunted; track circuit voltage must not exceed .1 volt, except track circuits with 2 ohm or less relays, and that voltage must not exceed .05 volts. If the track circuit voltage exceeds these values with the shunt applied, the tester must observe that the track circuit relay, or device that functions as a track relay, is de-energized; if not de-energized, corrective action must be taken immediately.

Electro Code track circuits.

With each shunt applied separately, ensure that track circuits are de-energized by observing the indication of the governing signal or the indication of the track relay or device that functions as a track relay. Allow sufficient time for track circuits to recover between placing each shunt.

Microtrax track circuits.

With each shunt applied separately, ensure that only the First Half (A) track is coding. The Second Half (B) track must be de-energized. Allow sufficient time for track circuits to recover between placing each shunt. Testing by use of signal indication or device that functions as a track relay is acceptable.

Relay based coded track circuits.

With each shunt applied separately, the voltmeter or signal should indicate that the track circuit is shunted; track circuit voltage must not exceed 0.08 volt. If the track circuit voltage exceeds 0.08 volt, the tester must observe that the track relays, or devices that function as track relays, under test are de-energized; if not de-energized, corrective action must be taken immediately.

Series Wired Turnouts:

Five .06 ohm shunts must be applied separately:

1. One at the effective joint located beyond the clearance point;
2. The second and third on each side of the insulated polarity joints located behind the frog;
3. The fourth and fifth on each side of the insulated polarity joints located in front of the frog.

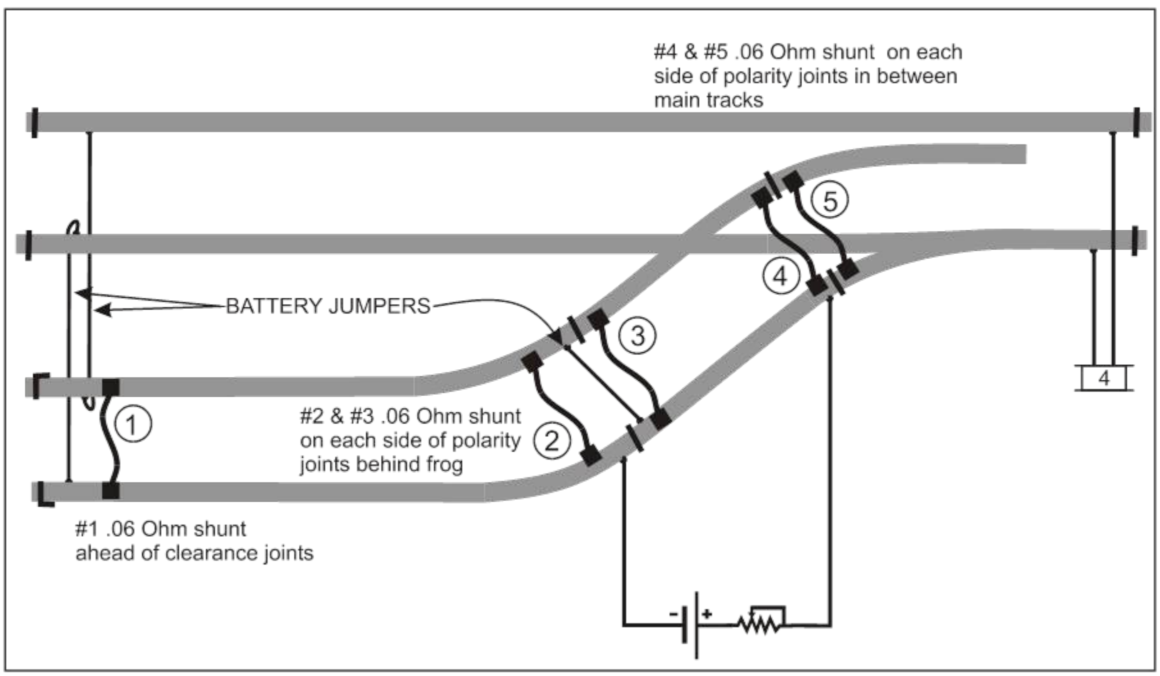


Figure 9-4

With each shunt applied separately,

the voltmeter or signal should indicate that the track circuit is shunted; track circuit voltage must not exceed .1 volt, except track circuits with 2 ohm or less relays, and that voltage must not exceed .05 volts. If the track circuit voltage exceeds these values with the shunt applied, the tester must observe that the track circuit relay is de-energized; if not de-energized, corrective action must be taken immediately.

Crossovers Between Main Tracks With Track Relay Wired In Series With Switch Circuit Controllers (refer to Standard Drawing 766160UP):

1. With Switch "A" open, apply a .06 ohm shunt across the lead rails on the frog side of the insulated polarity joints. Close the switch. With the shunt applied, visually observe that the track relay is de-energized, and ensure that the effective track repeaters are de-energized.
2. Repeat test at Switch "B."

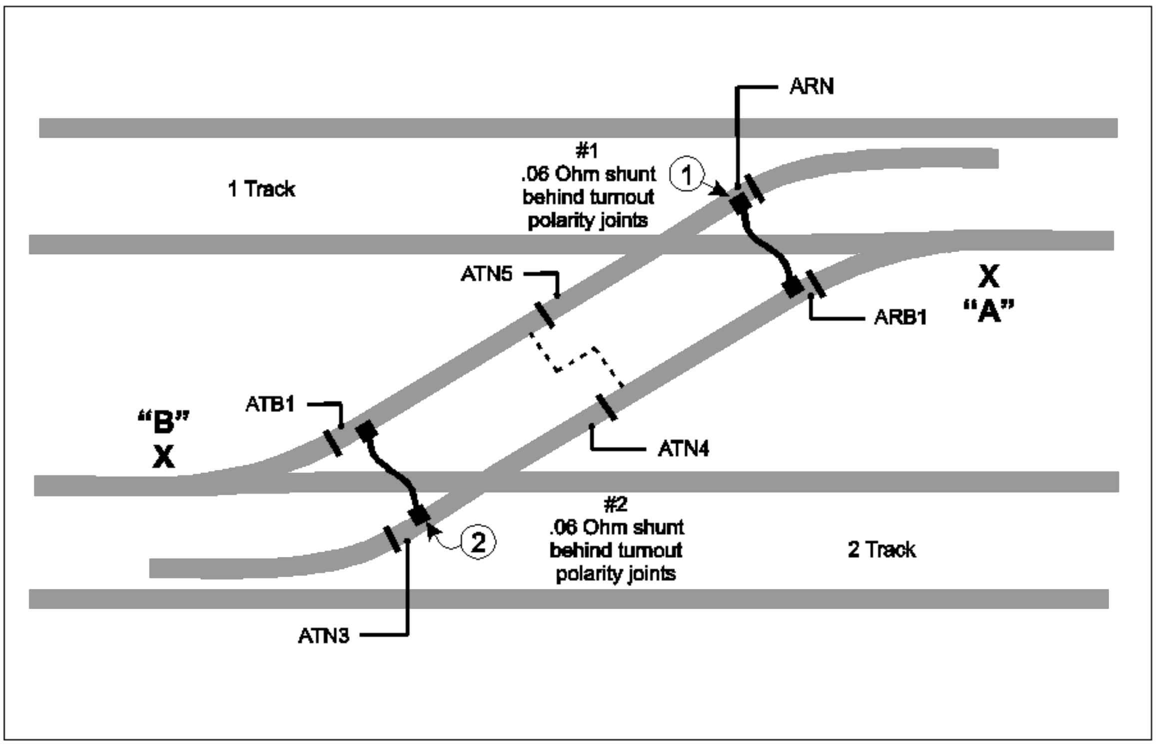


Figure 9-5

Relay Fouled Turnouts with One Battery and Two Relays

Connect a voltmeter to the rails of the main track, or, if practical, observe the indication of the governing signal and ensure that the voltmeter or signal indicates the main track circuit is energized. Then, the relay fouling will be tested by applying three .06 ohm shunts separately:

1. One at the effective joints located beyond the clearance point;
2. The second just behind the turnout insulated joints (on the frog side);
3. The third just ahead of the turnout polarity joints (on the point side).

With each shunt applied separately,

the voltmeter or signal should indicate that the track circuit is shunted; track circuit voltage must not exceed .1 volt, except track circuits with 2 ohm or less relays, and that voltage must not exceed .05 volts. If the track circuit voltage exceeds these values with the shunt applied, the tester must observe that the track circuit relay, or device that functions as a track relay, is de-energized; if not de-energized, corrective action must be taken immediately.

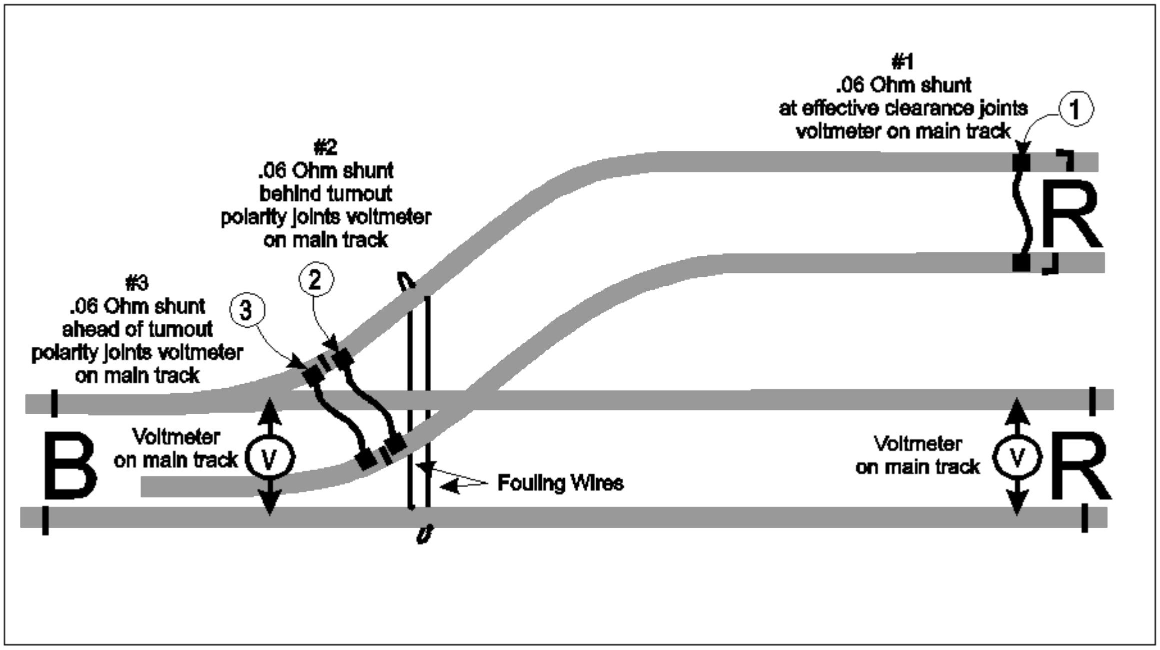


Figure 9-6

Relay Fouled Turnouts with Two Batteries and Two Relays

Connect a voltmeter to the rails of the track as indicated below or, if practical, observe the indication of the governing signal and ensure that the voltmeter or signal indicates the track circuit is energized. Test the track by applying three .06 ohm shunts separately:

1. One at the effective joints located beyond the clearance point; voltmeter on turnout track.
2. The second just behind the turnout insulated joints (on the frog side); voltmeter on turnout track.
3. The third just ahead of the turnout polarity joints (on the point side); voltmeter on main track.

With each shunt applied separately,

the voltmeter or signal should indicate that the track circuit is shunted; track circuit voltage must not exceed .1 volt, except track circuits with 2 ohm or less relays, and that voltage must not exceed .05 volts. If the track circuit voltage exceeds these values with the shunt applied, the tester must observe that the track circuit relay, or device that functions as a track relay, is de-energized; if not de-energized, corrective action must be taken immediately.

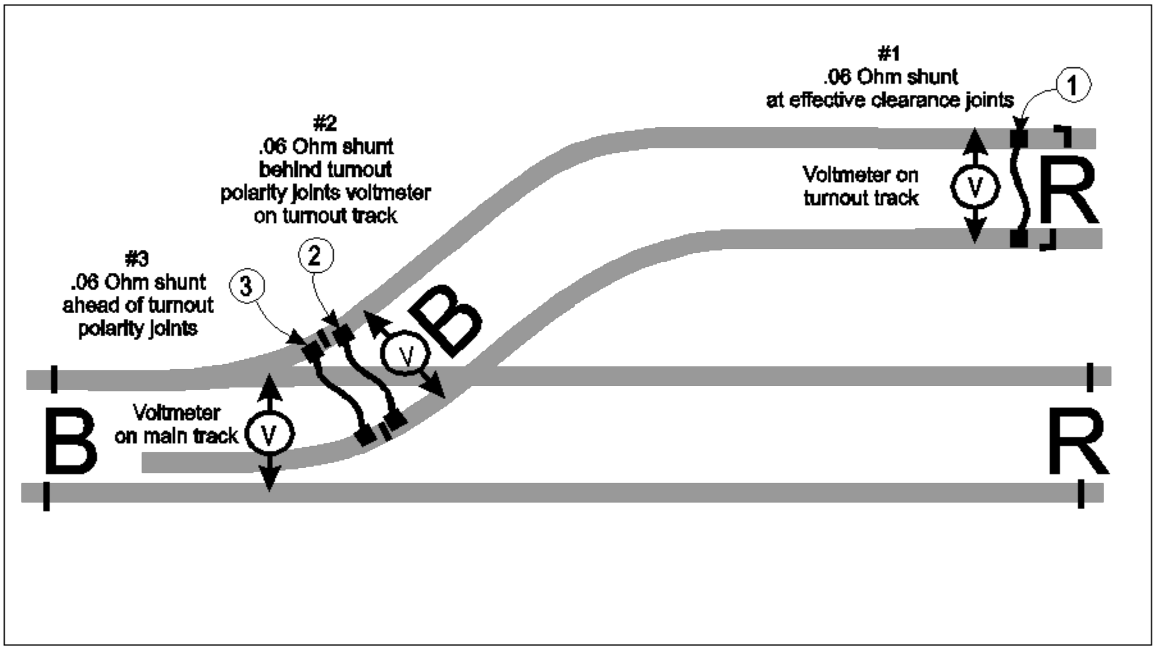


Figure 9-7

Note: This is the only fouling circuit that allows placement of the voltmeter on the turnout track.

9.1 General Instructions for Track Circuits

9.1.1 Shunting Sensitivity and Testing

Rev. 02/01

All track circuits must be adjusted so that the relay will drop away when a .06 ohm shunt is applied across the rails anywhere in the circuit, including all turnouts and under all conditions. Refer to setup procedure charts.

A. Shunting Sensitivity.

Rev. 05/15

A test must be made at least once a year when the track is dry or frozen (maximum ballast resistance) to ensure that track circuits are adjusted to shunt properly. Connect a standard test shunt of .06 ohms across the rails and observe that the track circuit relay drops away. If the relay fails to drop away with the .06 ohms shunt applied, the track circuit must be **immediately** adjusted so that it will shunt properly.

B. Multiple Track Relays.

Rev. 01/09

Where a single battery feeds multiple track relays; in addition to shunting each track with a .06 ohm shunt, determine that each relay is individually effective by opening the coil wire.

C. Polarity.

Rev. 08/96

Test at least once a year or when disarranged to ensure that the polarities of adjoining track circuits are in accordance with approved plans.

D. Shunt Test.

Rev. 08/96

When new track circuits are installed or changes are made in existing circuits, or track wires are disarranged, track circuit must be shunted each side of insulated joints and only the correct track relay must de-energize. A shunt must also be placed between the staggered insulated joints and neither track circuit relay should be de-energized.

E. Records.

Rev. 12/97

Records will be kept at each location that reflect the normal load current for each track circuit. To facilitate trouble-shooting procedures, weather condition should be noted when the normal current reading was obtained.

9.1.2 Bonding Inspection and Installation

Rev. 08/96

A. Properly Bonded.

Rev. 01/09

All rail joints will be properly bonded. Rail connections should be placed within 2 inches of the end of the insulated joint bar.

B. **Inspection.** Rev. 08/96

Inspect each bond visually and apply pressure with a long screwdriver, or similar tool, to ensure each end of the bond is secure in the rail. All bonding, bootlegs and rail taps, including the fouling wires between the clearance point and the main line on all turnouts and crossovers, must be carefully inspected. Particular attention should be given to any bonds that have been struck by dragging equipment. Replace loose or defective bonds.

C. **Insulation Inspection.** Rev. 08/96

Insulated joints, gauge plates, gauge rods and the insulation therein, should be given a thorough inspection. Replace defective items.

D. **Fire Prevention.** Rev. 01/09

Prior to applying bonds that require grinding and welding, the designated employee in charge must comply with the current Engineering Department Fire Prevention plan, as it applies to grinding and bonding operations.

E. **Bonding "OS" and Crossing Circuits.** Rev. 01/09

All bonding and rail connections throughout "OS" track and grade crossing circuits are to be a welded connected.

All welded connections to the web of the rail are to be made as close to the neutral axis as possible by one of the following methods:

- **112 lb and Above: Use a template designed to mark the neutral axis of the rail.**
- **Below 112 lb: Adjust the mold to make the connection on the web to the same height as the center of the joint bar bolt.**

F. **Standard Drawings.** Rev. 01/09

All bonding of switch points, heel block joints and rail connections must be made in accordance with standard signal drawings.

G. **Fouling Jumpers.** Rev. 01/09

Fouling jumpers must be two independent bond strands; the jumpers should be placed as close as possible to the insulated joints in the turnout for maximum broken rail protection. Wires are to be stapled to separate ties.

H. **Bond Removal.** Rev. 01/09

Welded bonds must never be removed from the rail with any tool that might score, gouge, notch or tear the parent material away from the rail. Never remove a weld bond using a hammer and chisel.

9.1.3 Insulation Inspection and Tests

Rev. 01/09

A. **Insulated Track Appliances.** Rev. 01/09

Track appliances that have insulated characteristics (e.g. insulated joints, gauge plates, gauge rods, switch heater ducts, etc.) must be inspected during periodic inspections. Gauge rods and switch heater ducts should be closely inspected for loose bolts, degradation of insulation, and external conductors that may short across insulation.

B. **Insulated Joint Inspections.** Rev. 01/09

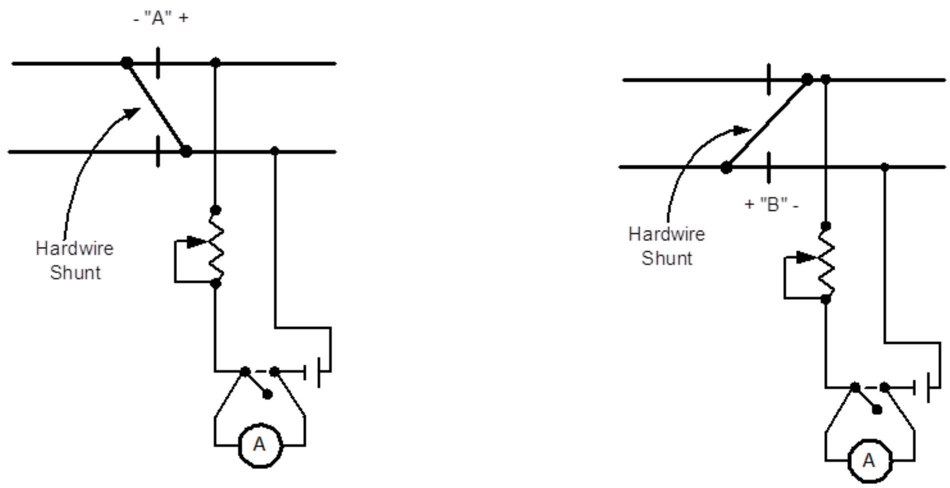
During insulated joint inspections, verify that the joint is properly supported and abrasion plate properly installed. Ensure that spikes are properly installed and not across the end-post. Inspect the joint for loose or broken insulation, cracked bars, broken or loose bolts, evidence of separation from the rail, and overall condition of the joint and surrounding track structure, including ties and plates.

C. **Insulated Joint Tests.** Rev. 01/09

In addition to periodic inspection of insulated joints, and regardless of the inspection results, insulated joints located on signaled main tracks must be tested when installed and at least once annually to determine that the insulated joint(s) provide adequate resistance to current flow. Ensure that no trains will be endangered or delayed before testing insulated joints. A voltmeter may be used to test an insulated joint as indicated in Standard Drawing #756160UP.

D. **Effective Method of Testing.**

The following is an effective method to test the integrity of insulated joints. When necessary to test one insulated joint, both insulated joints in the pair must be tested. While observing normal load current readings, perform current leakage tests by placing a hardwire shunt individually as indicated in Figure 9-8. If the load current increases with the placement of either hardwire shunt, the associated joint under test may not provide adequate resistance to current flow.



Test Joint "A” **Test Joint "B"**

Figure 9-8
Test Joint

It is recommended that shunted track circuit load current be documented prior to testing joints. The shunted load current will be used to determine insulated joint effectiveness by referencing it to a current increase when placing individual hardwire shunts during testing. For example if the documented shunted track circuit load current is 1.5 amps, and a test shunt is applied as indicated in Figure 9-8A, and the measured load current rises to 1.5 amps - insulated joint "A" is shorted and not offering any resistance to current flow.

If insulated joints under test are at a relay/relay location, observe the relay current and then place the hardwire shunt. If the relay current decreases with the placement of the cross hardwire shunt, the joint under test may not be providing adequate resistance to current flow. If the relay current drops to near zero, the associated joint under test is shorted and is not offering any resistance to current flow. This test can be performed with an external battery source; however, precautions must be taken to ensure that a track relay is not falsely energized during the testing procedure.

Shorted insulated joints must be reported immediately to the Manager of Signal Maintenance, who will document and maintain a list of shorted insulated joints for replacement.

E. **Remedial Action for Electrically Failed Insulated Joints.** Rev. 01/09

If the result of an insulated joint test indicates that the joint fails electrically, remedial action must be taken to provide safety of train operations as follows:

- If only one IJ fails electrically, work with track maintenance personnel to replace the IJ within 30 days. If the joint fails electrically because the rail ends are touching, remedial action is grinding or slotting the joint.
- If both joints fail electrically, the following actions must be taken - based on the type of relay or devices in use:
    - Biased relays or devices (on both sides of the IJ) - work with track maintenance personnel to replace at least one IJ within 24 hours unless slotting the rail ends will fix the problem.
    - Neutral relays (on one or both sides of the IJ) - place track shunt to disable signal system until at least one IJ is replaced unless slotting the rail ends will fix the problem.
- If a switch polarity joint fails, work with track maintenance personnel to replace the IJ within 24 hours unless slotting the rail ends will fix the problem.

F. **Insulated Joint Quick Test for Short.** Rev. 01/09

In most cases, there should be a difference of potential across an insulated joint, so a quick test to indicate if a joint is completely shorted, without placing shunts, is to measure the voltage across the joint. This test doesn't indicate the effectiveness of the joint, it will only indicate if the joint is completely shorted and not offering any resistance to current flow. If no voltage is measured, the joint is shorted. This test should not be used when performing periodic testing.

9.1.4 Typical Electro Code Track Circuit Setup

Rev. 10/15

Receive current parameters

Receive current should be setup at approximately 1250mA during normal conditions. On wet days, the initial current setting should be reduced (1.0 amp minimum) to compensate for the reduced ballast resistance. Under no circumstances will current exceed 1.8 amp maximum to ensure broken rail detection.

After setup, the current at the receive end of the circuit can be expected to decrease when the ballast is wet and/or contaminated, and increase when the ballast is dry or frozen.

Note: If Electro Code is setup or adjusted during wet conditions the receive current must be checked at the first opportunity of a dry or frozen condition to ensure the circuit does not exceed maximum receive current.

After setup during dry or frozen conditions, the reduced ballast resistance that occurs during wet weather may require additional adjustment to maintain minimum receive current.

If the current is less than 1.8 amps and the track circuit is working satisfactorily and in compliance with 9.1.1 Shunting Sensitivity and Testing on page 9-11 in all weather conditions, do not make any adjustments.

Electro Code transmit setup using a 2C/2R module

1. For track circuits over 6000 feet, set the 2R or 2C transformer taps in position 2 which provides approximately 2.1 volts. For track circuits less than 6000 feet, start with transformer taps in position 1 which provides approximately 1.5 volts. Position 3 provides approximately 2.6 volts.

Note: If 2C cards are being used instead of 2R cards make sure the batteries and charge systems are in good condition. The output current will change proportionally with battery voltage, so operating range of the unit will be affected by the difference between the charge and discharge voltage of the battery.

Electro Code transmit setup using VTI module

1. For track circuits over 6000 feet, set the voltage for 2.0 volts. For track circuits less than 6000 feet, set the voltage for 1.5 volts. The VTI module can generate voltage ranging from 0.5 volts to 4.0 volts.

Electro Code receive setup using the 7K module

1. Adjust the receive current to 1250mA under normal ballast conditions by cutting in (adjustment screw moved out) or shunting out (adjustment screw slide in) the four resistors on the module. The resistor values are from top to bottom: .22 ohms, .22 ohms, .47 ohms, and 1 ohm. If preferred current cannot be obtained, it may be necessary to change the output on the appropriate transmit module.

Note: Use a TS-1019 or TS-111 meter (or equivalent) for setup. If a TS111 meter is used, add 100mA to the peak current reading. A TS-111 meter will measure lower current than the TS-1019 meter. For example, when attempting to set the receive current at 1250mA, the TS-111 peak current reading should measure 1150mA.

2. **Current Too Low**. The LED on the 7K or 7H module should show two distinct flashes when vital codes are received. If one of the flashes is excessively short or missing and all connections to the track and bonds are known to be good, adjust the resistance on the 7H or 7K card to the next lowest value. Continue the process until the LED begins to give a solid double flash and the proper codes are being received. Verify current is within acceptable range.
3. **Current Too High.** If the ballast is dry and the LED on the 7K or 7H card gives one long flash or barely dims between flashes when a code 4 or 7 is received with code 5 (if code 5 is being used), increase the resistance on the 7H or 7K card to the next higher value. Continue the process until the LED begins to give a solid double flash and the proper codes are being received. Verify current is within acceptable range.

Electro Code receive setup using the VTI module

There is no way to adjust the receive current on the VTI, only the reference. The reference value determines at which points the unit starts and stops measuring the waveform. The track circuit is reliable when the reference value is set between 1/3 and 1/2 of the receive current. Nominal current should be approximately 1250mA (1.0 amp minimum to 1.8 amp maximum) Use the Table 9-1 VTI Reference provided for the receive current. If acceptable current cannot be obtained, it may be necessary to change the output on the appropriate transmit module.

Receive Current	Set Reference to:
<1200mA	.50
1250mA	.52
1300mA	.54
1350mA	.56
1400mA	.58
1450mA	.60
1500mA	.62
1550mA	.64
1600mA	.66
1650mA	.68
1700mA	.70
1750mA	.72
1800mA	.75

Table 9-1 VTI Reference

Track circuit verification

Note: Electro Code track circuits must be verified in both directions when placed in service and thereafter when modified or disarranged.

1. Ensure receive current is within acceptable range of 1 amp minimum to 1.8 amp maximum.
2. Test for partial shorts by comparing the current at the transmit end of the circuit to the current at the receive end of the circuit. Troubleshoot any unexplainable current loss.
3. Test for partial opens (high resistance) by comparing the voltage at the transmit end of the circuit to the voltage at the receive end of the circuit. Troubleshoot any unexplainable voltage loss.
4. Ensure that track circuit polarity is correct.
5. Test the track circuit according to the information in 9.1.1 Shunting Sensitivity and Testing on page 9-11.
6. Repeat for the opposite direction.

9.1.5 Alternate Electro Code 7K Module Setup Procedure Rev. 10/15

The resistor settings shown in the following chart should provide reliable operation over a wide range of ballast conditions. The chart is intended for initial setup of new circuits, or to provide guidance for circuits that may be out of adjustment.

Instructions (Refer to Table 9-2 on page 9-20)

1. Determine the approximate total one-way distance of #6 track wire in the track circuit. This must include both ends of the circuit and also any wire running to controllers or cases at series-shunt switches and derails in the track circuit. If there is any #9 or #10 wire, double its length to compensate for its higher resistance. Find the proper column for the length of track wire at the top of the chart.
2. Find the proper row for the length of track circuit at the left of the chart.
3. The intersection of the row and column will show the best setting for the resistance at the receiver. The adjustment chart shows the screw positions on the 7H or 7K cards to obtain the correct resistance. In some cases, further adjustment may be needed as explained below.

Table 9-2
Resistor Setting on Electro Code 7H or 7K Card

TRACK CIRCUIT LENGTH (IN FEET)	TOTAL ONE-WAY DISTANCE OF #6 TRACK WIRE (IN FEET)												
	0 to 100	100 to 200	200 to 300	300 to 400	400 to 500	500 to 600	600 to 700	700 to 800	800 to 900	900 to 1000	1000 to 1100	1100 to 1200	1200 to 1300
0-2000	0.91	0.91	0.91	0.91	0.69	0.69	0.47	0.47	1.44	1.47	1.44	1.22	1.00
2000-4000	0.91	0.91	0.69	0.69	0.47	0.47	1.44	1.22	1.22	1.22	1.00	1.00	0.91
4000-6000	0.47	0.47	0.47	0.47	1.22	1.00	1.00	0.91	0.69	0.69	0.69	0.47	0.44
6000-8000	0.47	1.22	1.22	1.00	1.00	1.00	0.91	0.69	1.69	1.69	1.69	1.47	1.47
8000-10,000	1.44	1.22	1.22	1.00	1.00	1.00	0.91	0.69	1.47	1.47	1.44	1.22	1.22
10,000-12,000	1.44	1.22	1.22	1.00	1.00	1.00	0.91	0.69	1.47	1.44	1.22	1.22	1.00
12,000-14,000	1.44	1.22	1.22	1.00	1.00	1.00	0.91	0.69	1.47	1.44	1.22	1.22	1.00
14,000-16,000	1.22	1.22	1.00	1.00	1.00	0.91	0.69	1.47	1.44	1.22	1.22	1.00	1.00

Table Notes: 1.In clear area use tap 1 on 2C or 2R card.
2. In light grey area use tap 2 on 2C or 2R card.
3. In dark grey area use tap 3 on 2C or 2R card.

9.1.6 Typical 0.3 Ohm CD Relay Coded Track Circuit Setup Rev. 01/09

Note: Use a TS-111 meter (or equivalent) for track circuit setup. If equivalent meter does not have peak reading capability, circuit must be arranged to provide steady battery to accurately set the relay current.

1. Adjust the relay current to 1250 mA (1 amp minimum to 1.8 amp maximum) under normal ballast conditions. On wet days, this current setting should be reduced to compensate for the reduced ballast resistance.
2. Test for partial shorts by comparing the track current at the battery end of the circuit to the track current at the relay end of the circuit. Troubleshoot any unexplainable current loss.
3. Test for partial opens (high resistance) by comparing the track voltage at the battery end of the circuit to the track voltage at the relay end of the circuit. Troubleshoot any unexplainable voltage loss.
4. Ensure that track circuit polarity is correct.
5. Test the track circuit according to the information in 9.1.1 on page 9-11.
6. Repeat steps 1, 4 and 5 for the opposite direction.

9.1.7 Alternate 0.3 Ohm CD Relay Coded Track Circuit Setup for Difficult Circuits Rev. 01/09

The resistor settings shown in the following charts should provide reliable operation over a wide range of ballast conditions. The current at the relay end of the circuit can be expected to vary between .75 amps when the ballast is very wet and dirty, to 2 amps when the ballast is very dry or frozen. Maximum current from the battery while the circuit is shunted should be less than 3 amps. If the circuit is working satisfactorily in all weather conditions, do not make any adjustments. The chart is intended for initial setup of new circuits or to provide guidance for circuits that may be out of adjustment. No current readings are involved since it is often difficult to determine whether the ballast is damp, wet, or dry.

Instructions (Refer to Table 9-3 on page 9-23)

1. Determine the approximate total one-way distance of #6 track wire in the track circuit. This must include both ends of the circuit and also any wire running to controllers or cases at series-shunt switches and derails in the track circuit. If there is any #9 or #10 wire, double its length to compensate for its higher resistance. Find the proper column for the length of track wire at the top of the chart.
2. Find the proper row for the length of track circuit at the left of the chart.

3. The intersection of the row and column will show the best setting for the resistor at the battery end of the track circuit. The values on the charts should be considered to be guidelines. Adjust resistors so they are to the closest possible value above that shown on the chart. Do not worry about adjusting resistors to the exact values on the charts. The charts assume that no resistance is inserted at the relay end. If there is a resistor at the relay end of the circuit, adjust it to 0.3 ohms and set the battery end resistance to 0.3 ohms less than the value shown on the table. On long track circuits, it might not be possible to shunt the relay with a .06 ohm shunt in dry conditions if steady dc voltage is being fed. The relay will drop, however, when the track voltage is coded. In some cases, further adjustment may be needed as explained below.

Current Too Low

If the CD relay is barely picking up or not following code and all connections to the track and bonds are known to be good, the resistance at the battery end should be decreased only enough to obtain about a 30% "on" time on the CD relay. If a resistor is in the relay end of the circuit, it may be used to "fine tune" the circuit. Care must be used to remove only enough resistance for proper operation. Over adjustment could cause the circuit to fail when the ballast dries out.

Current Too High

If the ballast is dry and the CD relay is barely dropping out when a 180 code is received, resistance may be increased slightly at either end of the track circuit. Care must be used to insert only enough resistance for proper operation. Over adjustment could cause the circuit to fail when the ballast dries out.

Table 9-3
Resistor Setting For .3 Ohm CD-Relay with B4H Battery

(BASED ON 2 VOLTS PER CELL)

TABLE	TOTAL ONE-WAY DISTANCE OF #6 TRACK WIRE (IN FEET)												
CIRCUIT LENGTH IN FEET	0 to 100	100 to 200	200 to 300	300 to 400	400 to 500	500 to 600	600 to 700	700 to 800	800 to 900	900 to 1000	1000 to 1100	1100 to 1200	1200 to 1300
	0.079	0.158	0.237	0.316	0.395	0.474	0.553	0.632	0.711	0.79	0.869	0.948	1.028
0-2000	1.90	1.82	1.74	1.66	1.58	1.50	1.43	1.35	1.27	1.19	1.11	1.03	0.95
2000-4000	1.30	1.22	1.14	1.06	0.98	0.90	0.83	0.75	0.67	0.59	0.51	2.23	2.15
4000-6000	1.00	0.92	0.84	0.76	0.68	0.60	1.93	1.85	1.77	1.69	1.61	1.53	1.45
6000-8000	0.87	0.79	0.71	0.63	1.58	1.50	1.43	1.35	1.27	1.19	1.11	1.03	0.95
8000-10000	0.70	0.62	1.34	1.26	1.18	1.10	1.03	0.95	0.87				

BASED ON 1.5 VOLTS PER CELL

TRACK	TOTAL ONE-WAY DISTANCE OF #6 TRACK WIRE (IN FEET)												
CIRCUIT LENGTH IN FEET	0 to 100	100 to 200	200 to 300	300 to 400	400 to 500	500 to 600	600 to 700	700 to 800	800 to 900	900 to 1000	1000 to 1100	1100 to 1200	1200 to 1300
	0.079	0.158	0.237	0.316	0.395	0.474	0.553	0.632	0.711	0.79	0.869	0.948	1.028
0-2000	1.16	1.08	1.00	0.92	0.84	0.76	0.69	0.61	0.53	0.45	1.77	1.69	1.61
2000-4000	0.88	0.80	0.72	0.64	0.56	0.48	0.41	1.75	1.67	1.59	1.51	1.43	1.35
4000-6000	0.78	0.70	0.62	0.54	0.46	1.35	1.28	1.20	1.12	1.04	0.96	0.88	0.80
6000-8000	0.62	0.54	0.46	1.16	1.08	1.00	0.93	0.85	0.77	0.69	0.61	0.53	0.45
8000-10000	0.47	1.04	0.96	0.88	0.80	0.72	0.65	0.57	0.49	0.41	0.33	0.25	0.17

Table Notes:

1. In clear area use 1 cell.
2. In light gray area use 2 cells in series.

9.1.8 OS Track Circuits

Rev. 01/09

OS Circuits Using 2TC DC-DC Converter.

On all track circuits up to 1000 feet long, including double relay circuits, the resistance in series with the track relay should be no less than 5 ohms to ensure broken rail detection.

9.1.9 Typical DC Track Circuit Setup

Rev. 01/09

Instructions for Track Circuits with a Relay Resistor

Track circuits should be adjusted to provide proper shunting sensitivity and broken rail protection. In order to accomplish both requirements, ensure a high inter-rail potential and enough current to operate the relay in all weather conditions. Some track circuits may need additional adjustments or fine tuning in order to work under all weather conditions. Track circuits that are set-up under good ballast conditions must be checked and tested the first time track conditions deteriorate due to weather changes. Track circuits that are set-up during poor ballast conditions must be checked and tested under good ballast conditions when weather improves.

The following procedure applies to all end-fed track circuits with resistors at the battery end (limiting resistor) and relay end (relay series resistor).

1. Place a hard wire shunt across the feed wires at the battery end of the track circuit and adjust the limiting resistor to limit the shunted current to 1.5 amps.
2. Remove the hard wire shunt.
3. Utilize the relay series resistor to adjust track relay current to approximately 2 times the working current of the relay. In poor ballast conditions, adjust the relay current to no more than 1½ times the working current.

   Note: If the relay current cannot be adjusted within the proper range, return to the battery end of the circuit and adjust the limiting resistor to increase or decrease the current as needed. In no case should the series resistance between the battery and the rails be less than 1 ohm. The resistance includes the track wires and the limiting resistance.
4. Test for partial shorts by comparing the battery load current to the relay current. Troubleshoot any unexplainable current loss.
5. Test for partial opens (high resistance) by comparing the track voltage at the feed wires to the track voltage at the relay end of the circuit. Troubleshoot any unexplainable voltage loss.
6. Ensure that track circuit polarity is correct.

7. Test the track circuit according to the information in 9.1.1 on page 9-11.

9.1.10 Alternate Instructions for Difficult or Hard-to-Adjust DC Track Circuits

Rev. 01/09

End Fed Battery-Relay Track Circuits with a Single Relay. Refer to Table 9-4 on page 9-26

The best stability and shunting characteristics of DC track circuits is obtained by inserting as much resistance as possible at the relay end of the circuit. The settings shown below will limit the shunt current from the battery to less than 1.5 amps. The resistance in a 4 ohm relay circuit is limited by the ability to detect a broken rail. Its value, surprisingly, does not change with length of the track circuit. The resistance shown at the relay end is a minimum value. Using less resistance could compromise broken rail detection.

Instructions for Track Circuits with a Relay Resistor (High Voltage Track Circuits) Refer to Table 9-4 on page 9-26

The top line shows the maximum shunt current. In most cases, the 1.5 amp value should be chosen. However, if the track circuit is long or has poor ballast and the rectifier has sufficient output, the 3 amp values provide a more stable circuit.

The table shows three values of battery voltage on the second line. Choose the voltage closest to the voltage of the battery being used in the circuit. Note that the lower the voltage, the better the track circuit will work.

The third line shows the recommended minimum value for the battery resistor. To compensate for track wire resistance, subtract 0.1 ohm per 100 feet one-way of #6 wire. For example, if there was 400 feet of wire at the battery end of the circuit and a resistance of 1 ohm was desired, the battery resistor would be adjusted to 0.6 ohms (1 ohm - .4 ohm = .6 ohm). Set the battery resistor to the nearest possible value greater than the resistance on the chart minus the resistance of the track wire.

The bottom line shows the minimum working ballast resistance in ohms per 1000 feet. This value normally will not go lower than 2 ohms per 1000 feet when the ballast is wet. As expected, if the track circuit length doubles, the minimum ballast resistance also approximately doubles, since there is twice as much ballast to shunt the track. Notice that the lower the battery voltage and the higher the shunt current, the lower the working ballast resistance.

EXAMPLE

Assume we have a 4000 feet track circuit using a B4H battery and a Craig Railcharger; also assume there are only 10 trains a day and there is little possibility of the track being shunted for long periods. The ballast is not very good due to pumping mud in several places and there are two dirt and plank crossings within the track circuit. Finally, assume there is 50 feet of underground wire at the battery end, and 200 feet of underground wire at the relay end of the circuit. Since the rectifier can handle a 3 amp drain, there is minimal shunting time, poor ballast, and the battery voltage is 1.5 volts, the best choice would be a 0.5 ohm battery resistor minus .05 ohm to compensate for the 50 feet of track wire or .45 ohm. The relay resistance would be 3 ohms minus .2 ohms to compensate for the 200 feet of 2 conductor #6 wire at the relay end of the circuit or 2.8 ohms. If the resistors were adjusted to these exact values, the circuit should be able to work down to as low as 2.2 ohms per 1000 feet.

Instructions for Track Circuits without a Relay Resistor

Basically, the battery resistor is set to 1.5, 4 or 6 ohms, as shown in the three columns at the right of the table. To compensate for track wire resistance, subtract 0.1 ohm per 100 feet one-way total distance of track wire. Include the length of the wires at both ends of the track circuit. Note that the maximum shunt current is quite low which limits drain on the battery. Note that the minimum ballast resistance is much higher for the longer track circuits than the high-voltage track circuit. The maximum limit for these circuits, except in very good ballast, is about 4000 feet.

Table 9-4
Setup Chart For 4-Ohm, 4 Point Relays

	WITH RELAY RESISTORS						WITH NO RELAY RESISTOR		
MAXIMUM SHUNT CURRENT (AMPS)	**1.50**	**3.00**	**1.50**	**3.00**	**1.50**	**3.00**	**0.67**	**0.37**	**0.33**
BATTERY VOLTAGE	**1 V**	**1 V**	**1.5V**	**1.5V**	**2 V**	**2 V**	**1 V**	**1.5V**	**2 V**
BATTERY RESISTOR (OHMS)	**0.70**	**0.30**	**1.00**	**0.50**	**1.30**	**0.60**	**1.50**	**4.00**	**6.00**
RELAY RESISTOR (OHMS)	**2.00**	**3.00**	**5.00**	**6.00**	**7.00**	**9.00**	**N/A**	**N/A**	**N/A**
MIN. BALLAST RES. FOR 1000′ CIRCUIT	0.66	0.40	0.90	0.70	1.00	0.60	0.80	1.40	1.50
MIN. BALLAST RES. FOR 2000′ CIRCUIT	1.30	0.70	1.80	1.10	2.00	1.20	1.60	2.70	2.90
MIN. BALLAST RES. FOR 3000′ CIRCUIT	2.00	1.10	2.70	1.60	3.00	1.80	2.40	3.90	4.40
MIN. BALLAST RES. FOR 4000′ CIRCUIT	2.60	1.40	3.60	2.20	4.00	240	3.00	5.40	5.90
MIN. BALLAST RES. FOR 5000′ CIRCUIT	3.50	1.80	4.60	2.70	5.00	3.00	4.00	6.90	7.30
MIN. BALLAST RES. FOR 6000′ CIRCUIT	3.90	2.20	5.50	3.20	6.00	3.70	4.80	8.20	8.80
MIN. BALLAST RES. FOR 7000′ CIRCUIT	4.60	2.50	6.50	3.80	7.00	4.20	5.60	9.70	10.50

Calculated Total Ballast Resistance =

$$\frac{\text{voltage on rails at feed-point} + \text{voltage on rails at the relay end}}{2(\text{current at feed-point} - \text{current at relay})}$$

Multiply Total Ballast Resistance by track length in feet and divide by 1000 for ballast resistance per 1000 feet.

9.1.11 Typical Microtrax Track Circuit Setup Rev. 01/09

Setting up the Microtrax coded track circuits is a five-step process. This process involves:

A. **Verify Track Interface Unit (TIU).** Rev. 05/15

Determine the type of Track Interface Unit (TIU) being used.

B. **Checking/adjusting the track circuit lengths.** Rev. 05/15

Checking or adjusting track circuit lengths stored in the CPU board may be accomplished by utilizing the controls and displays located on the front panel of the CPU PCB or using the Microlok II Maintenance Tools program. The following process must be followed for each coded track board installed in the system:

1. Verify the system coded track circuit board configuration is set to Enable.
2. Determine whether the First Half (A) or Second Half (B) or both tracks are to be setup by setting the corresponding side to Enable. For example, if only the First Half (A) track for the track module is to be used, make certain that only the First Half (A) indicates Enable.
3. Once the side to be configured is determined, set the actual length of the associated track circuit in thousands of feet. The allowable range is 0 – 36,000 feet.

   Note: If the N4518305-0104 Track Interface Unit (TIU) with the 30mH inductor has been installed, use the track circuit distance adjustment shown in Table 9-5 on page 9-29 to set the length of the associated track circuit.
4. Save changes made to the settings and repeat steps for the second coded track circuit board if installed.

C. **Checking the track circuit operating margin.** Rev. 01/09

The track circuit operating margin is a value that is used to determine whether or not a track circuit is properly adjusted. The operating margin represents the signal strength relative to the track circuit receiver's operating sensitivity. Operating margin can also be described as percentage of shunt.

For example, an operating margin value of 100 indicates that the circuit is on the verge of shunting. A value of 200 indicates that the signal strength is twice the level required for operation.

With dry ballast, the margin should nominally be between 190 and 240 percent. With wet ballast, this margin will typically be a lesser value. If the margin is too high, the track circuit may not shunt at 0.06 ohm.

The easiest way to display the track operating margin is to use the Microlok II Maintenance Tools program. However, track circuit operating margin can be displayed on the Microlok II CPU board 4-character displays.

Check track circuit margin for each enabled track. Margins can vary based on track circuit length, condition of ballast, and other factors. The track circuit should show a margin value of roughly 190 to 240 percent. If the margin is found to be outside of this range proceed as follows:

1. If the indicated margin is substantially greater than 240 percent, decrease the track circuit length by 1000 feet. Then recheck the margin to see if it is now within the recommended range.
2. If the indicated margin is substantially less than 190 percent, increase the track circuit length by 1000 feet. Then recheck the margin to see if it is now within the recommended range.
3. If the indicated margin is excessively out of range, contact the Manager of Signal Maintenance or Manager of Signal Construction.

Table 9-5
Microtrax Track Distance Settings
For 60hz Cab Signal Territories Only
Chart Applies When Using the N451835-0104 Track Interface Unit (TIU) with 30mH Inductor

Actual Track Circuit Length				Microlok Track Distance Setting
0 - 4,999'	X	Default	=	12,000'
5,000' - 5,399'	X	2.5	=	13,000'
5,400' - 5,799'	X	2.5	=	14,000'
5,800' - 6,199'	X	2.5	=	15,000'
6,200' - 6,599'	X	2.5	=	16,000'
6,600' - 6,999'	X	2.5	=	17,000'
7,000' - 7,399'	X	2.5	=	18,000'
7,400' - 7,799'	X	2.5	=	19,000'
7,800' - 8,199'	X	2.5	=	20,000'
8,200' - 8,599'	X	2.5	=	21,000'
8,600' - 8,999'	X	2.5	=	22,000'
9,000' - 9,399'	X	2.5	=	23,000'
9,400' - 9,700'	X	2.5	=	24,000'
9,800' -10,199'	X	2.5	=	25,000'
10,200' - 10,599'	X	2.5	=	26,000'

D. **Track Circuit Shunting Test.** Rev. 05/15

Perform shunt test utilizing a 0.06 ohm shunt. (Refer to Figure 9-9 on page 9-30) This test is conducted using the following procedure:

1. Display the operating margin for the track circuit under test.
2. Install a 0.06 ohm shunt across the track at the First Half (A) end of the track circuit. The margin indicated for the First Half (A) track should be less than 100 percent and may be close to zero. The margin indicated for the B track should not change. Leave the shunt in place for at least 30 seconds to make certain that the occupancy indication remains constant.
3. Remove the shunt from First Half (A) end of the track circuit. Verify that the First Half (A) track margin returns to the value indicated before the shunt was installed.

4. Install the 0.06 ohm shunt across the track at the Second Half (B) end of the track circuit. The margin indicated for the Second Half (B) track should be less than 100 percent and may be close to zero. The margin indicated for the First Half (A) track should not change. Leave the shunt in place for at least 30 seconds to make certain that the occupancy indication remains constant.
5. Remove the shunt from Second Half (B) end of the track circuit. Verify that the Second Half (B) track margin returns to the value indicated before the shunt was installed.
6. If the shunting test fails, the track circuit margin is probably too high. Decrease the track circuit length by 1000 feet. Then repeat steps 1 through 5.

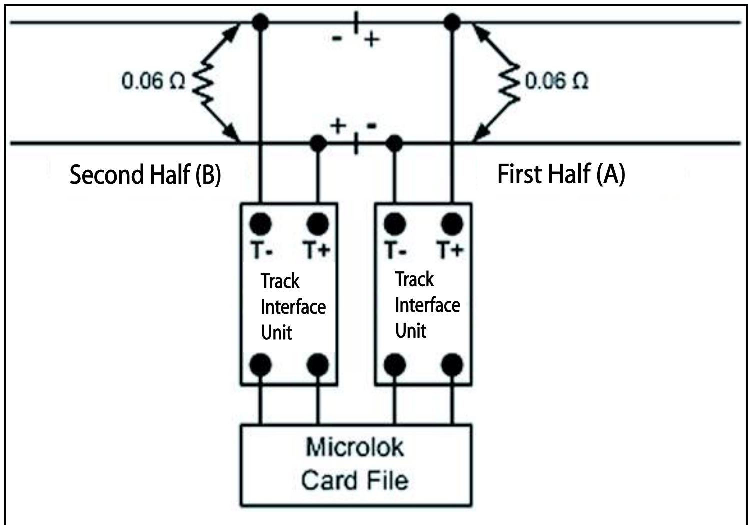


Figure 9-9

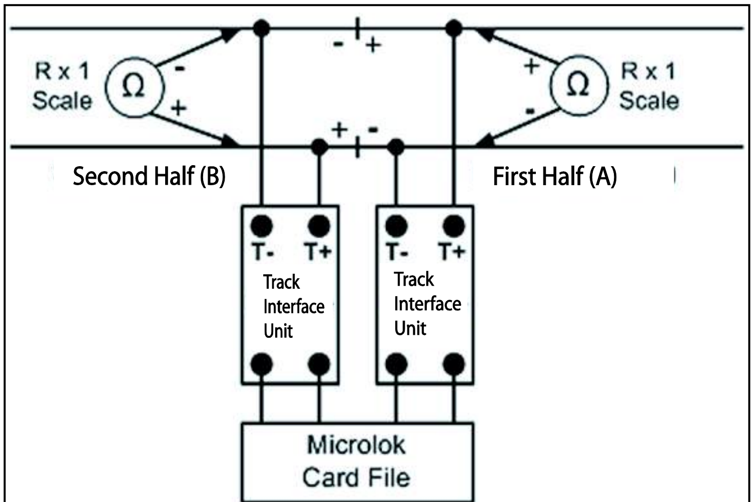


Figure 9-10

E. **Track Circuit Polarity Check.** Rev. 10/15

Ensure that the polarities of adjoining track circuits change and are in accordance with approved plans. TS-111 meter or the equivalent must be used to perform this test. (Refer to Figure 9-10)

1. Set the meter on the Rx1 ohms scale.
2. Connect the meter leads together. Activate the ohmmeter and adjust for an initial reading of 2 ohms.
3. Ensure the Microlok unit is transmitting code on both sides of the insulated joints.
4. Connect the positive meter lead to the (T+) rail and the negative meter lead to the (T-) rail on the First Half (A) side of the insulated joints and activate ohmmeter.

   Monitor the ohmmeter for the following:

   A. During intervals when code is not being transmitted, the meter should indicate 2.0 ohms.

   B. During transmit intervals the meter should read about 5.0 ohms of needle movement and is positive first moving towards zero ohms.

   C. During receive intervals the meter should read less than 2.0 ohms of needle movement and is positive first moving towards zero ohms.

   D. The actual meter readings may vary depending on track circuit length. However, if the needle movements are not as described, correct the polarity of the connections between the Microlok unit and the Track Interface Unit (TIU), and between the interface panel and the rails.

Note: Do not connect the ohmmeter between the Microlok unit and the L+/L- side of the Track Interface Unit (TIU) for a polarity check.

5. Move the ohmmeter to the Second Half (B) side of the insulated joints. Connect the positive meter lead to the (T+) rail and the negative meter lead to the (T-) rail and repeat steps 1 thru 4.
6. If polarity is not changed from First Half (A) to Second Half (B) make necessary wiring correction(s) and repeat steps 1 thru 5

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Chapter 10 Yards

10.1 **Yard Maintenance**

10.1.1 Yard General Instructions

Rev. 05/15

A. **Precaution.**

Rev. 05/15

All employees working in yards must be familiar and compliant with all:

- On-Track Safety Rules
- Company Safety Rules
- Chief Engineers Instructions
- Manufacturer's manuals that address all maintenance guidelines and safety precautions for the equipment to be worked on.

It is crucial that the Yard Master be informed of any failure that will affect the production of humping operations. This will permit an alternate plan to be addressed to ensure minimum impact on car delays.

B. **Maintenance Guidelines.**

Rev. 05/15

Maintenance guidelines apply to:

- Automated flat yards and RCL zones
- Large classification or hump yards
- Other locations with power switches and signal equipment in yard environments outside the mainline signal systems.

Note: Even though mini hump and small hump yards with a single point of control in each track are not specifically addressed, a scheduled maintenance program should be developed by the MSM applying the guidelines in this section.

C. **Maintain Established Standard.**

Rev. 05/15

When any devices in the yard is replaced due to rail change or derailment etc., replacement must be of the same type and in the same location as the device being replaced. If the device must be moved to a different location, contact the MSM or designated employee in charge to determine if the different location will affect yard operations.

This is particularly important with wheel detectors but applies to all devices in the yard.

D. **Record Keeping. .**

Rev. 05/15

To facilitate the data gathering process, while performing tests and inspections, utilize the following tools, reports and information:

- Remedy ticket system
- Large erasable board
- Log book

- Over speed reports
- Derailment reports
- Yard delay reports
- Coupling speed information,
- Retarder gauge speed information
- The appropriate maintenance schedule as set up in FSM/Maintenance Planner

E. **Enter Test Results.** Rev. 05/15

Upon completion of tests, enter result into FSM or on Form 24052 Yard Tests on page 1-65.

10.2 **Yard Maintenance Schedule**

10.2.1 Hump Yard Maintenance Items. Rev. 05/15

Frequency of tests reflect the minimum level of testing required for compliance. Based on each specific yard's level of traffic, tonnage, and usage, the frequency of some tests may be required more often than the minimum set forth in this section. The specific frequency of tests will be established and maintained in FSM.

A. **Daily Items.** Rev. 05/15

1. Walking Inspection – Daily. on page 10-15
2. Notification – on page 10-15
3. Speed Errors, Misroutes, and Stalls - Daily Test. on page 10-16
4. Rail Lubricator - Daily Test. on page 10-13

B. **Weekly Items.** Rev. 05/15

5. Constant Velocity or Piston Retarder - Weekly Test. on page 10-10
6. Weight Rails and /or Strain Gauge - Weekly Test. on page 10-14
7. Crest Equipment - Weekly Test. on page 10-14

C. **Bi-Weekly Items** Rev. 05/15

8. Designated Master Retarder - Bi-Weekly Test. on page 10-8
9. Hump Computer System - Bi-Weekly Test. on page 10-13

D. **Monthly Items.** Rev. 05/15

10. Yard Power Switch General Inspection - Monthly Test. on page 10-4
11. GRS Model 6 Switch Machine - Monthly Test on page 10-4
12. US&S DA-10 Switch Machine - Monthly Test. on page 10-4
13. Nortrak Hydraulic Switch Machine - Monthly Test. on page 10-5
14. RCL Type Switches – LP3000 and TS-4500 - Monthly Test. on page 10-5

E. **Quarterly Items.** Rev. 05/15

F. **Semi-annual Items.** Rev. 05/15

G. **Annual Items.** Rev. 05/15

10.3 **Yard Switches and Derails**

10.3.1 Yard Power Switch General Inspection. Rev. 05/15

A. **Monthly Test.** Rev. 05/15

1. Lubricate switch plates.
2. Inspect machine for worn or defective parts. Replace as needed.
3. Inspect layout per 2.1.4 on page 2-4
4. Grease and lubricate machine according to manufacturer's specifications.

10.3.2 GRS Model 6 Switch Machine. Rev. 05/15

A. **Monthly Test.** Rev. 05/15

1. Clean motor contacts and half circle contact with non-flammable contact cleaner.
2. Inspect motor contacts and half circle contact and replace if worn.
3. Check motor brushes for sufficient pressure and wear, adjust or replace if needed.
4. Clean motor armature.
5. Insert a 1/4" gauge between the switch point and stock rail to verify that the indication contacts do not indicate the position. Repeat for both normal and reverse positions of the switch point.

Note: When checking the adjustment of switch machine, test with switch throwing under power, if possible. Follow the recommended manufacturer's precautions and instructions.

10.3.3 US&S DA-10 Switch Machine. Rev. 05/15

A. **Monthly Test.** Rev. 05/15

1. Line the switch using air, and verify the piston is not striking the cylinder when lined. Adjust operating rod if necessary.
2. Remove air from the switch machine. Center the points with a lining bar and adjust centering contact.
3. Test by re-applying air to the switch machine.
4. Place a track jack between the heel of the switch and the switch point.
5. Jack the point open. When the switch point reaches the center position, the switch will automatically line over.
6. Test in both normal and reverse.
7. Adjust indication contacts to not indicate on a 1/4 inch, but may indicate on 3/16 if possible.

8. Test kick-back feature and verify proper operation.

10.3.4 Nortrak Hydraulic Switch Machine. Rev. 05/15

A. **Monthly Test.** Rev. 05/15

1. Check that hydraulic fluid level is within 1” of the top of hydraulic fluid reservoir.
2. Apply grease to the concave surface of the spindle cam that is contacted by the ram cylinder end for switch throw.
3. Using a grease gun, apply grease to the fittings on the switch stand and pivot points in the switch machine to prevent wear.
4. Insert a 1/4" gauge between the switch point and stock rail to verify that the indication contacts do not indicate the position.
5. Repeat for both normal and reverse positions of the switch point.

10.3.5 RCL Type Switch Including LP-3000 and TS-4500 . Rev. 05/15

A. **Monthly Test.** Rev. 05/15

1. Complete inspection 2.1.3A. on page 2-3, and 2.1.3D. on page 2-3. Inspect switch for overall integrity.
2. Inspect RCL switch machine assembly and hand throw stand if applicable. Ensure equipment is secure to ties with no lost motion.
3. Inspect hydraulic hoses and connections to ensure there are no leaks.
4. Ensure hydraulic fluid level in reservoir is as recommended. Information is usually marked on the tank.
5. If equipped, Inspect linkage used to pump switch manually. Ensure the linkage is not showing signs of metal fatigue and cotter pins are securely in place.
6. Inspect the connecting rods and linkage from the RCL switch machine to the switch points for tightness. Ensure there is no lost motion.
7. If equipped with a track circuit, inspect to ensure the bonding and track connections comply with 9.1.2 on page 9-11.
8. If equipped with a PD loop system, ensure bonding and track connections comply with 9.1.2 on page 9-11. Ensure the loop is fastened to the ties at a consistent position relative to the rail throughout the length of the circuit to maintain proper operation.

9. If equipped with a wheel detector system, inspect to ensure wheel pickup transducers are tight on the bracket or rail and the wire connections to transducer are tight. Ensure there are no spikes under the transducer. This could cause the unit to indicate a wheel count due to the motion of the rail. Visually inspect transducers for damage.
10. Inspect the switch circuit controller to ensure the unit is securely fastened to the ties. Ensure there is no lost motion.
11. Complete 2.1.3E. on page 2-3 for the associated switch circuit controller.
12. Insert a 1/4" gauge between the switch point and stock rail to verify that the circuit controller does not indicate the position. Repeat for both normal and reverse switch point positions.
13. Inspect the overall operation of the RCL switch. Perform a complete throw and ensure proper indication, using either the pushbutton or control operator. Repeat for both normal and reverse switch point positions.
14. Ensure all needed repairs from the inspection are complete. If defects cannot be corrected immediately or without downtime (and do not present an unsafe condition or hazard), schedule the work for the next maintenance window.

B. **Quarterly Test.** Rev. 05/15

1. Complete Monthly Test.
2. Check hydraulic fluid in reservoir: Level should be 1inch to 1 1/2 inches from the top of the tank.
3. Grease the 7 lube points or refer to manufacturer’s instructions.
4. Inspect the spring assembly. Ensure the shoulder bolts are tight.
5. Visually inspect hoses, fasteners, hand pump assembly, etc. for worn or loose parts. Tighten or replace as needed. Keep area around throw lever, located under the machine, and the switch circuit controller arm and connecting rods free from any debris.
6. When equipped with the RTI wheel sensor system, ensure wheel sensors are clean of any metal debris, tight to the rail and at the proper height. Height should be set at 1 7/8 inch (+0.00” to -1/16 inch) below the top of the rail.
7. Check battery voltage as referenced in manufacturer’s instructions.
8. Check proximity sensors and switch circuit controller adjustments (ask MSM for preferred obstruction gauge to be used, either ¼” or 3/8”). Refer to manufacturer’s instruction manual for proximity sensor adjustment procedures.

9. Make operational test using the radio, push-button, and hand pump. Listen for the proper announcements on both the normal and reverse positions.
10. Check actual throw time against the manufacturer's specifications. Excessive throw time may be an indication of the machine’s impending failure.
11. Ensure switch will not throw, using remote controls (whichever is applicable), during simulated occupancy.
12. Ensure crossovers throw in unison as required. Perform obstruction test on each machine. Ensure switch indicates properly.
13. Inspect for physical damage.
14. If so equipped, inspect the solar panel and voltage regulator for proper voltage output as noted by manufacturer.
15. Upgrade software as needed.
16. If enabled, verify throwback feature operates properly.
17. Complete inspection as outlined in 2.1.3 on page 2-3.

10.3.6 Delectric Blue Flag and/or Derail.

Rev. 05/15

A. **Quarterly Test.** Rev. 05/15

1. Check while in derailing position the derail is secure to the rail.
2. Check to ensure derail is clearly visible by maintaining a coat of yellow paint on the derail.
3. Ensure the blue flag sign is clean and any words on the sign are legible.
4. If equipped with a blue light, ensure the light is illuminated while in the derailing position or when the blue flag is raised. Additionally, the light lenses should not be broken or faded.
5. Test to ensure any corresponding circuits attached to the blue flag and/or derail is responding properly to the position of the equipment.
6. Adjust slider derail by placing a 3/8" gauge between the top of rail and slider (holds slider 3/8" above top of rail). Adjust circuit controller or indication contact to de-energized position (non derailing). Remove gauge and ensure that indication is energized with derail in position on top of rail (derailing)

10.3.7 Split Point Derail.

Rev. 05/15

A. **Quarterly Test.** Rev. 05/15

1. Adjust indication contacts so that associated safety circuits will be activated when the point is 1/2 inch from the normally closed (derailing) point all the way to the reverse non-derailing point.
2. Test that all associated circuits attached to the derail operate properly when the derail is removed from the derailing position and when in the derailing position.

10.4 **Retarder**

10.4.1 Designated Master Retarder. Rev. 05/15

A. **Bi-Weekly Test.** Rev. 05/15

1. Gauge retarder following the instructions and precautions per the manufacturer's manual.
2. Check for broken or cracked shoes. Replace any defects found.
3. Inspect retarder for damaged beams, hold down clips, rail bolts, chairs, fulcrum pins, etc. and repair as needed.
4. Complete necessary Level test for the model used as a Master, as designated by the manager.

B. **Quarterly Test.** Rev. 05/15

1. Complete Bi-Weekly Test.
2. Grease and lubricate following the manufacturer's precautions and instructions.
3. Complete necessary Level test for the model used as a Master, as designated by the manager.

10.4.2 Designated Group Retarder. Rev. 05/15

A. **Monthly Test.** Rev. 05/15

1. Gauge retarder, following the instructions and precautions per the manufacturer's manual. Check gauge and adjust as necessary.
2. Check for broken or cracked shoes. Replace any defects found.
3. Inspect retarder for damaged beams; hold down clips, rail bolts, fulcrum pins, etc. and repair as needed.
4. Complete necessary Level test for the model used as a Group, as designated by the manager.

B. **Quarterly Test.** Rev. 05/15

1. Complete Monthly Test.
2. Grease and lubricate following the manufacturer's precautions and instructions.
3. Complete necessary Level test for the model used as a Group, as designated by the manager.

10.4.3 Designated Tangent Point Retarder. Rev. 05/15

A. **Monthly Test.** Rev. 05/15

1. Visually inspect tangent point retarders and correct any defects.
2. If defects cannot be corrected immediately or without downtime (and do not present an unsafe condition or hazard), schedule the work for the next maintenance window.
3. Complete necessary Level test for the model used as a Tangent, as designated by the manager.

B. **Semi-annual Test.** Rev. 05/15

1. Complete Monthly Test.
2. Gauge retarder. Follow the recommended manufacturer's precautions and instructions.
3. Check for broken or cracked shoes. Replace if defects are found.
4. Inspect retarder for damaged beams; hold down clips, rail bolts, chairs, and fulcrum pins etc... Repair as needed.
5. Grease and lubricate retarder.
6. Complete necessary Level test for the model used as a Tangent, as designated by the manager.

10.4.4 E-160 Retarder. Rev. 05/15

A. **Quarterly Test.** Rev. 05/15

1. Test pump output pressure. Correct if needed.
2. Clean motor armature and check motor brushes for sufficient pressure and wear. Adjust or replace if needed.
3. Clean the magnet in the hydraulic tank of any metal shavings that have accumulated.
4. Replace oil and air filters in the hydraulic unit

B. **Annual Test.** Rev. 05/15

1. Complete Quarterly Test.

2. Replace graphite rod.
3. Replace micro switches.
4. Adjust micro switches following the recommended manufacturers precautions and instructions.
5. For yards with newer controllers using potentiometer feedback system for ram position: Perform calibration using the “auto calibrate” function of the control unit.

10.4.5 Constant Velocity or Piston Retarder. Rev. 05/15

A. Weekly Test. Rev. 05/15

1. Inspect piston zones for broken capsules or assemblies and replace during maintenance day.
2. If piston is damaged and fouling the flange way of the rail, it should be replaced or removed immediately.

B. Quarterly Test. Rev. 05/15

1. Complete Weekly Test.
2. Torque nuts according to manufacturer’s recommendations.
3. Grease and lubricate.
4. Remove dirt, rocks and debris from around and under assemblies.
5. Monitor retarder cycles and replace when cycles reach the number set by the manufacturer (usually 750,000 actuations). When replacing retarders due to cycle numbers reached, replace entire zone at same time.

10.4.6 Model 50A, 50B Retarder. Rev. 05/15

A. Semi-annual Test. Rev. 05/15

1. Inspect that gage is proper according to the manufacturer’s standards. Adjust gage if necessary.
2. Inspect to ensure all ties and pedestals are in good condition.
3. Inspect to ensure all shims and shim bolts are in good condition.
4. Inspect all beams and shoes for proper installation. Adjust or replace if necessary.
5. Where hydraulic release is utilized, ensure all hydraulic lines and fittings are secure and not leaking, and all rams are operating properly.
6. Where hydraulic release is utilized, ensure that release control and indication circuits are operating as intended.
7. Ensure the hydraulic pressure is adjusted to manufacturer’s specifications.

10.4.7 Model Tr-5120-300, and TR-5301-2072-1H Operable Skate Retarder. Rev. 05/15

A. **Semi-annual Test.** Rev. 05/15

1. Inspect to ensure gage is correct according to the manufacturer's standards. Adjust gage if necessary.
2. Inspect thickness of brake beam, and/or shoes. Replace if necessary.
3. Inspect to ensure all foreign debris is clear of the compression springs, and that all nuts and bolts are tight and secure.
4. Where hydraulic release is utilized, ensure all hydraulic lines and fittings are secure and not leaking.
5. Where hydraulic release is utilized, ensure that release control and indication circuits are operating as intended.
6. Ensure the hydraulic pressure is adjusted to manufacturer's specifications

10.4.8 Model AR2 Inert Skate Retarder. Rev. 05/15

A. **Semi-annual Test.** Rev. 05/15

1. Inspect that gauge is correct according to the manufacturer's standards. Adjust gauge if necessary. (Top bolts should be tightened prior to gauging the retarder. This greatly affects the reading acquired).
2. Inspect thickness of brake rails. Replace if necessary.
3. Ensure all debris is clear of the compression springs, and that all nuts and bolts are tight and secure.
4. If work must be performed, the retarder must be gauged afterwards to ensure the retarder will perform to at least minimum acceptable standards.

10.4.9 HS-2 Unit . Rev. 05/15

A. **Quarterly Test.** Rev. 05/15

1. Inspect bourdon tube contacts for pitting. Clean or replace if necessary.
2. Adjust the contacts of each bourdon tube to respond to the prescribed air pressure corresponding to the weight class as used at that facility.

B. **Annual Test.** Rev. 05/15

1. Complete Quarterly Test.
2. Clean HS-2 units.
3. Clean Bourdon tube contacts.
4. Verify proper air pressure per weight class and adjust if needed.

5. Clean air filter and drain off liquids in the air filter. Follow the recommended manufacturer's precautions and instructions.

10.5 **Yard Detector**

10.5.1 D.E.D for Yard. Rev. 05/15

A. **Monthly Test.** Rev. 05/15

1. Inspect dragging equipment detector for defective or damaged parts. Replace as needed.
2. Inspect that all hinged attachments are moving freely and greased to manufacturer's specifications.
3. Activate D.E.D. to ensure that all safety circuits attached are working properly. If equipped, ensure the visual and audible alarms to the operator are functioning properly.

10.5.2 Shove Signal . Rev. 05/15

A. **Quarterly Test.** Rev. 05/15

1. Inspect batteries for compliance with 5.1.1 on page 5-1 and 5.1.2 on page 5-2.
2. Test batteries according to 5.1.3 on page 5-3.
3. Inspect that shove signal track circuit complies with 9.1.2 on page 9-11.
4. Inspect each signal to ensure it is visible, operational, secured, and undamaged.
5. If equipped with a radio, inspect the radio and antenna for visible signs of deterioration or misalignment.

B. **Annual Test.** Rev. 05/15

1. Complete Quarterly Test.
2. Test to ensure all track circuits are in compliance with 9.1.1Shunting Sensitivity and Testing on page 9-11.
3. Test each shove signal aspect by shunting the track circuit and observing the associated signal for proper indication.

10.5.3 Car Space and Calibration. Rev. 05/15

A. **Annual Test.** Rev. 05/15

1. Test car space. Adjust according to the recommended manufacturer's precautions and instructions.
2. Monitor coupling speeds and yard calibrations. Adjust according to the recommended manufacturer's precautions and instructions.

Note: Car retarders, switch machines, and other signal apparatus used in classification yards shall be installed and maintained in accordance with these rules and instructions in so far as they apply. Car retarders shall be installed and maintained in accordance with manufacturer's instructions.

10.6 **Computer Room**

10.6.1 Hump Computer System. Rev. 05/15

A. **Bi-Weekly Test.** Rev. 05/15

1. When the hump computer system is rebooted weekly, or as directed by the MSM, bring system online with opposite computer in lead as when reboot started. For example:
   - If the system had the "A" computer online and the "B" computer on standby
   - When rebooting, bring the "B" computer online with the "A" computer as standby
2. Systems should be rotated from online and standby periodically to ensure that both computer and I/O systems are viable and functioning properly.

Note: Prioritize all work to be performed on the next heavy maintenance day.

10.6.2 Ground Test, Battery Buss in Computer Room. Rev. 05/15

A. **Monthly Test.** Rev. 05/15

Perform ground test according to Rule 234.249 - Ground Test on page 8-1.

10.6.3 UPS System. Rev. 05/15

A. **Monthly Test.** Rev. 05/15

1. Inspect that all terminal connections are tight and secure.
2. Measure input voltage, output voltage, and output frequency (should maintain 60Hz). This should be recorded and maintained for reference.
3. If equipped, inspect surge suppressors/arrestors for damage from surges or lightning strikes. Repair or replace as needed.
4. If equipped, check the trouble log on the UPS for problems or messages that pertain to problems since the last inspection.

10.7 **Trackside Electronic**

10.7.1 Rail Lubricator. Rev. 05/15

A. **Daily Test.** Rev. 05/15

1. Inspect lubricator head for proper adjustment and installation.

2. Inspect modifier tank for sufficient fluid level to maintain functionality until next scheduled inspection.
3. Inspect hydraulic hoses for leaks or deterioration, and inspect all fittings for leaks and proper installation.
4. If rail greasers are used, inspect to ensure the units are functioning and notify track forces if found defective.

10.7.2 Weight Rails and/or Strain Gauge. Rev. 05/15

A. Weekly Test. Rev. 05/15

Compare the actual weight of cars to the weight class set by the rail or strain gauge and adjust when needed. Follow the recommended manufacturer's precautions and instructions.

10.7.3 Crest Equipment. Rev. 05/15

A. Weekly Test. Rev. 05/15

1. Clean outer lens of radar where applicable.
2. Clean wheel detectors, and ensure bolts are tight.
3. Clean photocell, infra red, and light cell lenses; check alignment and correct as needed. If system equipped with "Banner Array" style cut light, check indicator lights on bottom of array receiver for illuminated green LED. If yellow LED is illuminated, the array may be slightly misaligned, or the lens may need to be cleaned. Correct any defects found.

B. Monthly Test Rev. 05/15

1. Complete Weekly Test.
2. Inspect to ensure that the wheel detector is secured properly to the rail. Re-secure if necessary. Inspect wiring to wheel detector and junction box to ensure proper connections.
3. Check activation length if procedures are available to perform this function. Adjust if out of tolerance.
4. Clean the wheel detector, and remove any foreign matter that may interfere with the operation of the equipment.

10.7.4 Track Circuit Rev. 05/15

A. Shunting Sensitivity and Testing Rev. 05/15

Track circuits will maintained and tested in compliance with 9.1.1 Shunting Sensitivity and Testing on page 9-11.

B. **Bonding Inspection and Installation** Rev. 05/15

Required bonding on track circuits will be maintained in compliance with 9.1.2 Bonding Inspection and Installation on page 9-11.

C. **Insulated Joints** Rev. 05/15

Insulated joints will be maintained and tested in compliance with 9.1.3 Insulation Inspection and Tests on page 9-13.

D. **High Frequency Track Circuit Annual Test** Rev. 05/15

Tune high frequency track circuits according to manufacturer's specifications. Test to ensure track circuits are in compliance with 9.1.1 on page 9-11.

10.7.5 Radar Maintenance. Rev. 05/15

A. **Annual Test.** Rev. 05/15

1. Test radar frequency and deviation. Calibrate to manufacturer's specifications and within any FCC regulation tolerances if needed.
2. Test gain on radar to ensure it does not extend beyond necessary boundaries.
3. Inspect alignment of radar to ensure maximum efficiency.
4. Inspect surrounding area. Remove obstructions from the front of the radar that may impede, or adversely affect the radar from detecting and accurately tracking railcars moving in front of the radar. Weeds in front of the radar window will create noise that interferes with the proper performance of the radar unit, and must be removed. Rocks or dirt piled in front of the radar window will adversely affect the tracking performance of the radar unit, and must be removed.

10.8 Additional Items

10.8.1 General Maintenance. Rev. 05/15

A. **Walking Inspection – Daily.** Rev. 05/15

Walk assigned area at the beginning of each shift and perform a visual inspection noting damaged or defective parts.

If any defects are found that are unsafe, or may cause a derailment or personal injury; institute protective measures, or remove the defective equipment and verify area is safe until the appropriate repair or replacement can be made.

B. **Notification – Daily.** Rev. 05/15

Notification shall be made daily concerning hump yard performance for the previous 24 hour period (402) 636-6017. Include pertinent information regarding delays, such as:

- Total downtime
- Problem found
- Repairs made, etc.

On HPC systems that do not report to the web based "Hump Reporting System", fax "Daily Summary Report" to (402) 636-7898

C. **Kept in Good Condition - Quarterly.** Rev. 05/15

All signal equipment within the yard will be inspected for compliance with the following Yellow Book Instructions:

- 1.1.6 on page 1-5
- 1.1.7 on page 1-5
- 1.1.8 on page 1-6
- 1.1.9 on page 1-6

D. **Standby Power Generator** Rev. 05/15

Yards equipped with a standby generators must be tested in accordance with 13.1.2 Standby Power Generators on page 13-1.

E. **Light Unit** Rev. 05/15

Any equipment that provides a signal for train movement will be maintained according to instructions 7.1.4 Proper Light Unit Voltage, Replacement and Storage on page 7-3 and 7.1.5 Focusing, Alignment and View of Signals on page 7-4.

10.8.2 Speed Errors, Misroutes, and Stalls. Rev. 05/15

A. **Daily Test.** Rev. 05/15

Technician or RYM, as assigned by the MSM, will perform the following functions at the beginning of their shift:

- Note all speed errors in a 24 hour period. If excessive errors are noted determine the cause and correct.
- Investigate all stalls, when practicable. If cause is due to equipment failure, correct defect.
- Investigate misroutes to determine the cause. If cause is due to equipment failure, correct defect.

10.8.3 Ground Test - Other Than Computer Room. Rev. 05/15

A. **Quarterly Test.** Rev. 05/15

1. Perform ground test according to Rule 236.2 and 107 – Quarterly Ground Test on page 7-1.
2. In centralized control yards, the ground test can be performed in the computer room on the main terminal board.

3. Be sure to test all cables and conductors entering/exiting the computer room to determine they are ground free.
4. In distributed control yards, the ground test must be performed in each I/O Cabin.
5. At the main terminal board, test all cables and conductors entering/exiting the IO Cabin to determine they are ground free.
6. Perform tests for each remote cabin in the yard containing signal apparatus.

10.8.4 RCL Zone. Rev. 05/15

A. **Semi-annual Test.** Rev. 05/15

1. Inspect the zones to verify the position of all pucks match with the current puck map. (Current maps are available in EDM).
2. Inspect and replace AEI tags, transponders, covers, mounting boards, or plywood if missing, worn or damaged. Inspect each puck to ensure it is properly fastened to the ties, and the protective cover is in place.
3. Verify proper operation of the pucks by obtaining a current download of the locomotive equipment, or scanning the pucks with a hand held scanner.
4. In lieu of a locomotive download, use online web based systems available from GE and Canac. Monitor zones and verify operation of zones via RCL equipment in operation at the yard.

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Chapter 11 Relays

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Rule 236.102 - Searchlight and Semaphore Mechanisms (Six Months)

Rev. 01/09

Record	Interval	Retention
24094 FSM (SMP)	6 months	Until Next Record is Filed - in no case less than 1 year

Distribution

Test By	Original	Copies
Mtr.	MSM	Mtr.

Purpose

Test to determine that signal mechanism operates smoothly, free from obstruction with no sign of sticking or hanging in any position.

Frequency

When placed in service and thereafter when modified, disarranged, or at least once every six months.

Precautions

The employee(s) making the test must have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

Note: Before testing, proper steps must be taken to ensure that a proceed signal is not mistakenly displayed to any train or engine. This would include any upgrade to an approach signal to the location under test.

Test Procedure For Searchlight Mechanisms (Rocking Test)

After disconnecting a single control wire or plug coupler, energize the coils of the mechanism with a separate battery; energize the mechanism center to left, then center to right, each time making sure that the mechanism returns smoothly to the center (red) position without any delay. Careful inspection will be made to ensure that all parts are operating properly.

Note: Flat roundels may have one straight crack provided no white light is visible through the crack. Flat roundels with more than one crack or evidence of chipping must be replaced. Conical type roundels of any color must not be cracked. Roundels must not be loose in the retaining rims.

Test Procedure For Semaphore Signals

Operate the signal mechanism to all positions and determine that it operates properly, with no sign of sticking or hanging in any position. Additionally, determine that the hold clear mechanism latches and releases properly. Snubbing circuit must operate properly. The spectacle casting should rest against the stop when the blade displays a stop indication.

Rule 234.265 and 236.109 - Time Releases

Rev. 10/15

Record	Interval	Retention
24239 24094 FSM	Yearly	Until Next Record is Filed - in no case less than 1 Year

Distribution

Test By	Original	Copies
Mtr.	MSM	Mtr.

Definition

Timing relay - A relay which will not close its front contacts or open its back contacts or both until the expiration of a definite time interval after the relay has been energized.

Time release - A device used to prevent the operation of an operative unit until after the expiration of predetermined time interval after the device has been actuated.

Microprocessor Based System Clock (MBSC) – The one internal system generated or real-time clock that all timer function(s) are derived from within a microprocessor based unit

Non-adjustable timer(s) within microprocessor based equipment – Fixed value timer(s) run by the MBSC that cannot be altered without affecting the Checksum or CRC

Adjustable timer(s) within microprocessor based equipment – Timer(s) within the program run by the MBSC that are user programmed and may be changed without affecting the Checksum or CRC

Purpose

Test to determine that timing devices are functioning properly and will not release for a period less than 90 percent nor more than 110 percent of the time interval as shown on the plans or marked on the time release or relay.

Frequency

When placed in service and thereafter when modified, disarranged, or at least once every year.

Precautions

The employee(s) making the test must have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

Description of Tests

Time Relays

Apply normal operating voltage to the timing relay by some means. Record the actual time interval observed, and compare that time interval with the required predetermined interval. Relays not operating between 90 and 110 percent of the required predetermined interval must be changed or adjusted.

Time Releases

Actuate the time release, record the actual time interval observed, and compare that time interval with the required predetermined interval. Releases not operating between 90 and 110 percent of the required predetermined interval must be changed or adjusted.

Microprocessor Based System Clock (MBSC)

Note: The timer(s) derived from the MBSC must be tested as outlined in 1.2.4 Solid State Interlocking on page 1-14 when placed in service, modified or disarranged.

1. Verify the current CRC and/or Checksum value(s) match designed value(s).
2. Verify all current programmed adjustable timer value(s) match designed value(s).
3. Actuate the longest programmed timer, record the actual time interval observed, and compare that time interval with the required predetermined interval. Time not between 90 and 110 percent of the required predetermined interval must be corrected.

Note: Required predetermined time intervals must be marked on plans or timing device.

Note: The required predetermined time interval according to the print or timing device, and the actual tested time, must be recorded in FSM or on Form 24094 on page 1-31or Form 24239 on page 1-37.

Rule 236.102 - Searchlight Mechanisms (Two Years)

Rev. 01/09

Record	Interval	Retention
24096 FSM	2 Years	Until Next Record is Filed - in no case less than 1 year

Distribution

Test By	Original	Copies
Signal Inspector Mtce. Foreman	MSM	Signal Inspector Mtce. Foreman

For H-2, H-5 and SA Mechanisms

Purpose

Test to ensure that signal mechanism operating characteristics are within tolerance.

Frequency

When placed in service and thereafter when modified, disarranged, or at least once every two years.

Precautions

The employee(s) making the test must have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

Note: Before testing, proper steps must be taken to ensure that a proceed signal is not mistakenly displayed to any train or engine. This would include any upgrade to an approach signal to the location under test.

H-2, H-5 and SA Mechanisms Test Procedure

1. Remove the mechanism plug coupler if provided. If the mechanism does not have a plug coupler, remove only one of the coil wires. Remove the mechanism reflector to view roundels.
   - **a.** Energize mechanism with normal operating voltage or current. The vane should move to full stroke (center to right). Remove energy; the vane must return to center position and must not travel beyond the center position to show reverse position color.
   - **b.** Energize mechanism with reverse operating voltage or current. The vane should move to full stroke (center to left). Remove energy, the vane must return to center position and must not travel beyond the center position to show normal position color.
2. Attach the red lead of the test set to the negative post of the mechanism and the black lead to the positive post; apply the full output of the test set for center to left movement.
3. Slowly reduce the energy until the movable contact is made with the fixed back contact. This is the drop away value and must be within manufacturer specifications. Observe that the red roundel is displayed. Reduce energy to zero and the red roundel must be fully displayed.
4. Open the circuit for one second and slowly increase the energy until the movable contact is made with the front contact. This is the pick-up value and must be within the manufacturer specifications. At least half of the roundel must be displayed and rotating with the correct polarity.
5. Continue increasing energy until the full roundel is observed. This is the working value.
6. Put the test set in the neutral position and observe the mechanism rock back to the center position.
7. Position the test set in the reverse polarity position and repeat steps 3-6 for the center to right test.
8. Electric release, pickup and working values on slot armatures must comply with the requirements as outlined in the "Relays" section of this book utilizing the manufacturer's specifications. Values will be recorded in FSM and on Form 24096 on page 1-45. (See manufacturer specifications below for H-2 and H-5 mechanisms).
9. Mechanisms shall be carefully inspected to ensure that all parts are operating properly, and that the signal returns to the stop position when energy is removed from the mechanism.

10. Remove test leads, replace reflector, and reconnect the plug coupler or coil wire.

    Note: If movement of vane shows signs of friction or does not move smoothly when energy is increased or decreased, mechanism should be removed from service immediately and shopped for repairs.

Table 11-1
H-2 and H-5 Specifications

Mechanism	Drop-away	Pick-up	Working
H-2 (250 ohm)	2.0 volts	5.2 volts	5.5 volts
H-2 (500 ohm)	3.0 volts	7.6 volts	8.0 volts
H-5 (250 ohm)	2.0 volts	5.2 volts	5.4 volts
H-5 (500 ohm)	3.0 volts	7.95 volts	7.95 volts

If the tag values listed on the relay are different than the tag values in the table above, use the values listed on the relay for testing purposes.

Note: H-2 mechanism specifications are per US&S service manual 2377 pg. 29. The difference in pickup values from center to right and center to left must not exceed .5 (one-half) volt.

Note: H-5 mechanism specifications per US&S service manual 3079 pg. 27. The difference in pickup values from center to right and center to left must not exceed .6 (six tenths) volt.

SC Mechanism Test Procedure

Polar-Neutral

Disconnect one side of normal operating circuit (coil wire) and remove mechanism reflector.

1. Using normal polarity energize mechanism to at least the working value given on the relay tag. The vane must move in a clockwise direction displaying the yellow or center spectacle. Slowly decrease current observing value at which armature and left contacts drop out. Record value. This is the normal HG (yellow) drop away. Open circuit for one second. Slowly increase the current using same polarity until left contacts picks up and yellow or center spectacle is centered. Record value. This is the normal pickup and working value.

2. Position polarity switch to neutral.

3. Using reverse polarity, energize mechanism to at least the working value given on the relay tag. The vane must move in a clockwise direction displaying the spectacle furthest to the left (green). Slowly decrease current observing value at which right armature and contacts drop out. Record the value. This is the reverse drop away. Open circuit for 1 second. Slowly increase the current using same polarity until right contacts and DG (green) spectacle is centered. Record the value. This is the reverse pickup and working value

Note: If movement of vane shows signs of friction or does not move smoothly when current is increased or decreased, mechanism should be removed from service immediately and shopped for repairs.

Neutral-Neutral

Note: This relay has 2 independent sets of control wires. However, the right side (DG) control is broken through the left side (HG) front contacts therefore in order to pick up the DG side the HG side must be picked up.

1. Test HG (Left Relay-Yellow) by applying at least the working value given on the relay tag. The HG (Yellow or center spectacle) must be picked up to be positioned in the center of the relay. Slowly decrease the current or voltage until the relay drops. Record this value as Normal drop-away. Open circuit for one second. Slowly increase the current using same polarity until the HG relay picks. Record this value. This is the normal pickup and working value.
2. To test the DG (Green) side you will need to supply sufficient current to the HG side to ensure that it is in the energized (picked up) position. Test DG (Right Relay-Green) by applying at least the working value given on the relay tag. The DG (Green or far left spectacle) must be picked up to be positioned in the center of the relay. Slowly decrease the current or voltage until the relay drops. Record this value as the Reverse drop-away. Open the circuit for one second. Slowly increase the current using same polarity until the DG relay picks. Record this value. This is the Reverse pickup and working value.

Relay values must comply with the characteristics set forth in section 236.106 - Relays on page 11-11.

Mechanisms shall be carefully inspected to ensure that all parts are operating properly and that signal returns to stop position with energy removed.

Rule 236.102 - Semaphore Mechanisms (Two Years)

Rev. 01/09

Record	Interval	Retention
24096 FSM	2 Years	Until Next Record is Filed - in no case less than 1 year

Distribution

Test By	Original	Copies
Signal Inspector Mtce. Foreman	MSM	Signal Inspector Mtce. Foreman

Purpose

Test to ensure that semaphore signal mechanism operating characteristics are within tolerance.

Frequency

When placed in service and thereafter when modified, disarranged, or at least once every two years.

Precautions

The employee(s) making the test must have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

Note: Before testing, proper steps must be taken to ensure that a proceed signal is not mistakenly displayed to any train or engine. This would include any upgrade to an approach signal to the location under test.

Semaphore Mechanism Test Procedure

Motor Current

Insert an ammeter in series with motor control wire and record the operating current reading while the motor is clearing the signal.

Pickup and Drop Away of Slot (Hold Clear):

Insert a variable resistor in series with the hold clear coil and connect a voltmeter across the hold clear terminals. Apply energy to the hold clear coil and decrease the resistance of the variable resistor until the hold clear device is picked up. Record this value as the slot pickup. Then slowly increase the resistance, which will reduce the voltage, until the hold clear device drops. Record this value as the slot drop-away.

The following test is not required for this FRA rule, but does provide a means of measuring the torque available to move the semaphore blade from 90 degrees to 0 degrees.

1. Insert an ammeter and variable resistance unit in series in one motor lead. Energize the motor and reduce the resistance of the variable resistor until the motor will just move the arm upward. Note the current reading at this time, this is reading #1.
2. Just before the arm reaches 45 degrees quickly increase the resistance of the variable resistor to stop the upward movement of the arm. While holding the snubbing circuit open, continue to increase the resistance unit until the arm starts to the 0 position. Note the current reading at this time, this is reading #2.
3. Reading #2 must be at least 50% of reading #1. If reading #2 is below 50% of reading #1 it could indicate that some part of the signal mechanism is binding and preventing the full torque of the blade from returning to 0 degrees. Check to see that each brush is properly seated and not excessively worn as to need replacement, that the shafts and gears are lubricated and working freely, and there is no binding in the circuit controller. The test should also be repeated for the 90 degree position.

Rule 234.247, 263 and 265 and 236.8 and 106 – Relays

Rev. 12/10

Record	Interval	Retention
24095 FSM	1, 2 and 4 Years, as noted in the frequency information	Until Next Record is Filed - in no case less than 1 year

Distribution

Test By	Original	Copies
Signal Inspector Mtce. Forman	MSM	Signal Inspector Mtce. Forman

Purpose

Test to ensure that relay operating characteristics are within tolerance.

Frequency

Relays in service will be tested when placed in service and thereafter when modified, disarranged, or at least once every four years.

Exceptions:

1. Alternating current vane type relays, direct current polar type relays (e.g. DP-14, 21,25 and PC-50P, etc.) and relays with soft iron magnet structure will be tested at least once every two years.
2. Alternating current centrifugal type relays will be tested at least once every year.

Precautions

The employee(s) making the test must have information relative to train movements to ensure that the public, and train traffic will not be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

Description of the Test

All wires and jumpers must be removed from the positive control terminal before testing a relay.

Plug-in type relays must be unplugged for test. When a relay is changed out, the relay installed must be the correct relay for the signal circuit as designated on the circuit plan, and must have been tested within the designated testing interval for the specific relay. Operational test must be performed before placing in service.

When relay operation is tested in current, the drop-away, pick-up, and working values shall be tested and readings recorded.

When relay operation is tested with voltage, the ambient temperature must be determined and the readings corrected to the normal ambient temperature of 68 degrees Fahrenheit. The marked tag values must be adjusted by using Figure 11-1 Temperature Chart or the temperature conversion method in the FSM program, before comparing the slide values to the Manufacturers' Specifications.

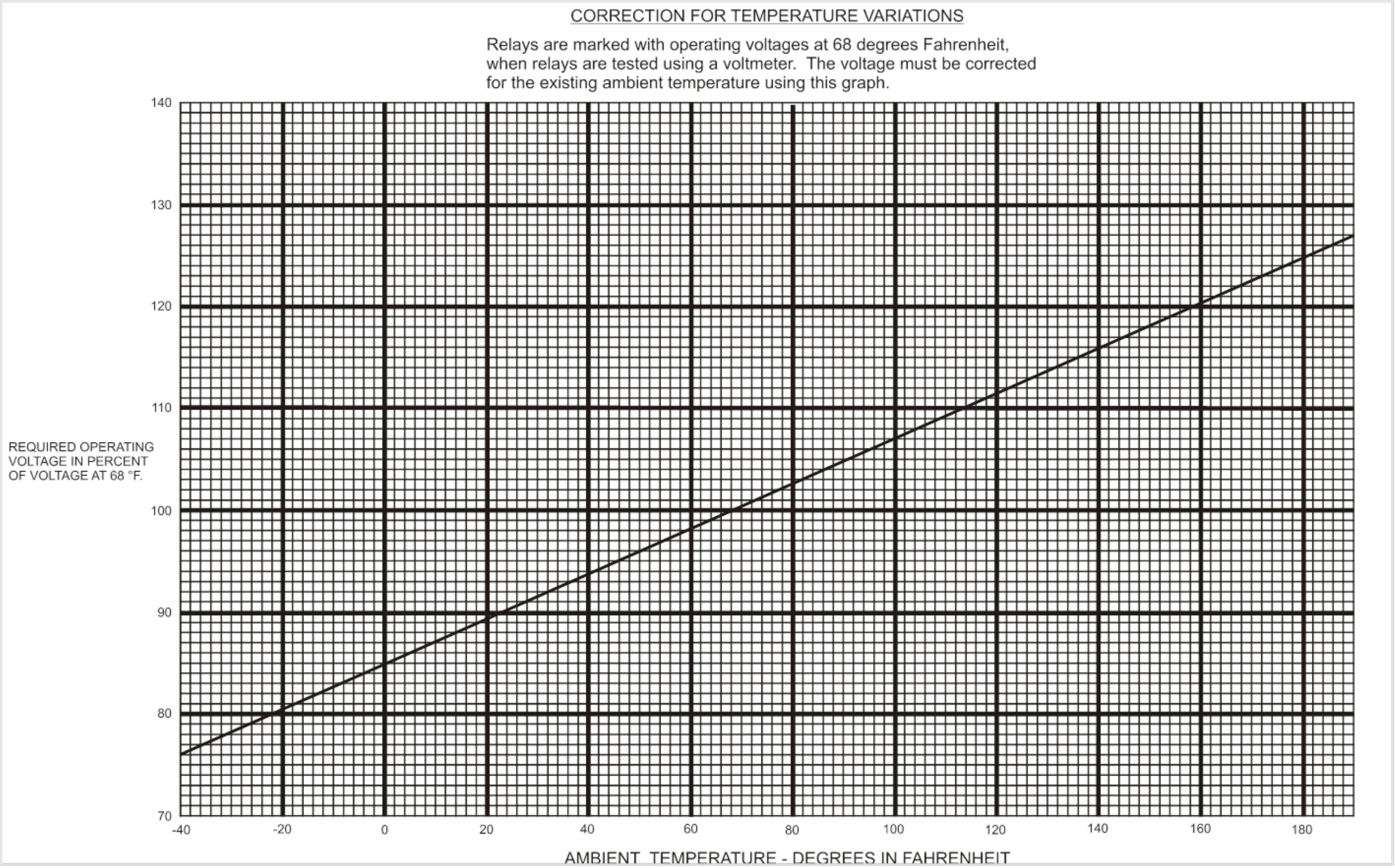

Figure 11-1 Temperature Chart

For example, if the ambient temperature was 110 degrees Fahrenheit and the relay tag marking was 5.5 volts, the corrected voltage to be compared to the meter reading would be 109.5% of the marked voltage, or 1.095 x 5.5 volts, which would be 6.02 volts.

Chapter 11 Top

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Neutral Relays

Drop-away, pick-up, and, when required, the working values of neutral relays must be measured as follows:

1. Apply an initial charge of at least the service working current or voltage to the coils in the normal direction and then gradually reduce the current or voltage until the armature drops away. This is the "drop-away" value.
2. Open the circuit for one second. Apply a gradual increase in current or voltage to the coils in the same direction until the front contact just makes with the heel contact. This is the “pick-up” value.
3. When required, the current or voltage must then be gradually increased until the armature is against the stop. This is the “working” value.

Values must be in accordance with the following requirements:

Drop-away Value	**Track Relays** - Not less than 85% of the original marking **Line Relays** - Not less than 67% of the original marking
Normal Pick-up Value	Not more than 110% of the original marking
Normal Working Value	Not more than 110% of the original marking

Note: Consideration must be given to the removal of resistors, capacitors or diodes added to the coils of a relay, before testing relay characteristics. Replace components after testing the relay and perform operational test.

D.C. Biased Neutral Relay

Drop-away, pick-up, and working values of neutral relays must be measured as follows:

1. Relay will be energized when positive energy is applied to the coil marked (+) and negative energy to the coil post marked (-).
2. Relay must be de-energized when negative energy is applied to the coil marked (+) and positive energy to the coil terminal marked (-). Reverse voltage applied to the relay shall be at least the normal working or pick-up voltage. The relay must not pick-up with reverse polarity applied.

Polarized Relays

Drop-away, pick-up, and working values of polarized relays must be measured as follows:

Note: If the relay does not have neutral contacts, ignore references that pertain to neutral contacts.

1. An initial charge of at least the service working current or voltage must be applied to the coils in normal direction and gradually reduced until the neutral armature drops away. This value is the "neutral armature drop-away" value.
2. The circuit must then be opened for one second and charge again applied to the coils in the same direction and gradually increased until the front contacts just make with the heel contacts. This is the "neutral armature pick-up" value.
3. The charge must then be gradually increased until the neutral armature moves against the stop. This is the "neutral armature normal working" value.
4. The charge must then be increased to at least the service working current or voltage and then decreased to zero. The circuit must then be opened for one second and charge applied in the reverse direction, gradually increasing from zero until the polar armature reverses against the stop. This is the "reverse polar pick-up and working" value.
5. Increase the charge gradually until the neutral armature is against the stop. This value is the "neutral armature reverse working" value.
6. The charge must then be increased to at least the service working current or voltage and then decreased to zero. The circuit must then be opened for one second and charge applied in the normal direction, gradually increasing from zero until the polar armature goes normal against the stop. This value is the "normal polar pick-up and working" value.
7. After obtaining the normal polar pick-up and working values, continue to increase the energy in the same direction until the neutral armature is against its stop. This is the "neutral armature normal working" value, and must not exceed that specified for the neutral armature reverse working.
8. Polar armatures must remain in the last energized position without current in either direction in the coils. When the polar armature is changed from normal to reverse or vise-versa, neutral armatures must retain its energized position on relays equipped with neutral retaining features.

Values must be in accordance with the following requirements:

Drop-away Value	**Track Relays -** Not less than 85% of the original marking **Line Relays -** Not less than 67% or the original marking
Normal Pick-up Value	Not more than 110% of the original marking
Normal Working Value	Not more than 110% of the original marking
Reverse Working Value	Not more than 110% of the original marking
Normal and Reverse Polar Pick-up and Working Value	Not more than 80% of the neutral armature pick-up value

Electro Code Receiver Cards

Electro code receivers are not required to be tested periodically. If testing is performed, follow the procedure as outlined below and record the results in FSM and on Form 24095 on page 1-43.

Note: This test applies to Electro Code for rail only. Where Electro Code for line is used, other track circuits are used. Follow specific testing instructions for these track circuits.

Instructions for Testing Test utilizing a standard relay test set; do not use a test box meter. Test box meters are not calibrated and are intended as an indicator only.

Test Procedure

1. Turn the Electro Code unit power switch to the off position. Remove the front cover to expose the modules. Disengage the 2C/2R module from its socket. Turn the power switch on.
2. Open the track wire test nut. This will be located on the CTB-lC or CTB-lD current test board. If neither of these is used, disconnect the negative track wire isolating the Electro Code unit from the track.
3. Connect the test set to Electro Code track terminals
4. Observe the pickup and release currents listed on the module.
5. Adjust the current into the Electro Code track terminals to four (4) times the listed pickup current +/- 10%. Observe that the LED indicator on the receiver module is illuminated to verify the proper current polarity into the receiver.

6. Maintain this saturation current for five to fifteen seconds.
7. Slowly decrease the current into the receiver until the LED indicator on the receiver module just extinguishes.
8. Note: The current for the 7H and 7K modules should be between the maximum and minimum values of 0.420 to 0.270 amps as shown in Table 11-2.
9. Slowly increase current into the receiver module until the LED indicator illuminates. Note this current level. This pickup current should be 0.440 to 0.590 amps as shown below.

Table 11-2
7 K and 7H Receiver Module Test Data

	Nominal	**Maximum**	**Minimum**
Pick-up	0.500A	0.590A	0.440A
Release	0.350A	0.420A	0.270A
4 X Charge	2.000A	2.200A	1.800A

10. Record the data obtained in FSM or on Form 24095 on page 1-43. Disconnect the test set and return all equipment to normal unless unsatisfactory readings are recorded. Replace any defective equipment. When the receiver card is changed or adjusted, perform the shunt test with a standard .06 ohm track shunt wire as follows:

    A. Connect .06 ohm test shunt rail to rail in the Electro Code track circuit.

    B. Observe that the LED indicator on the receiver module is extinguished.

    C. Lift test shunt, record data, and return all equipment to normal.

CD-F Relay

Test will be made every four years. Test drop-away, pick-up, and working values of relay, utilizing a code timer N330208 and code meter N291610 or equivalent for the following test.

With relay energized at 25% above the lowest value given under "Recommended Working" in Table 11-3 and the non-tuned contacts coding at 33% on-time, the front tuned contact percent should be checked as follows:

1. For the 120 CD-F, apply 120 code frequency and read the front tuned contact percent on-time. Apply 125 code frequency and read front tuned contact percent on-time. If the relay is properly tuned, both readings should show a minimum of 33% on-time.
2. Procedure for the 180 CD-F is the same as step 1, except 180 and 187 code frequencies are used
3. Finally, apply 75 code with the front non-tuned contacts on-time at 48% and check that the tuned back contacts remain closed, with the contact spring never touching its spring stop.

Relay Resistance	**Recommended Working**	**Field Limits Pick-up**	**Drop Away**
		Minimum/Maximum	**Minimum**
0.15Ω	1.13A	0.750A / 1.070A	0.396A
0.30Ω	.820A	0.550A / 0.780A	0.287A
0.60Ω	.600A	0.386A / 0.570A	0.210A
18.5Ω	.090A	0.054A / 0.085A	0.021A
135Ω	10-12V	0.012A / 0.030A	0.005A
225Ω	10-12V	0.010A / 0.028A	0.004A

Table 11-3

PC-250TR Relay

Tests will be made every two years. Connect test set to positive and negative coil terminals of the relay.

1. Slowly apply voltage until the pendulum begins to oscillate. This must not exceed the Max. Starting Voltage on Table 11-4.
2. Increase voltage to Rated Min. Voltage on Table 11-4. Each contact heel-front and heel-back will be measured for percent on-time of each contact (heel-front and heel-back). Contacts must not be less than 38% on-time.
3. Additionally, verify the Code Frequency Cycles per Minute for each contact (heel-front and heel-back) as shown in Table 11-4 are within tolerance for Min. Voltage, Nominal Voltage, and Max. Voltage.

Note:

At Min. Voltage, code frequency must not exceed the listed value.

At Max. Voltage, code frequency must not be less than the listed value.

Table 11-4
PC-250 Relay Test Values

Rated Code	Coil Ohms	Voltages				Code Frequency Cycles per Minute		
		Rated Nominal	Rated Min.	Rated Max.	Max. Starting	At Nominal Voltage	At Min. Voltage	At Max. Voltage
75	60	10/12	8	14	5	72 +/- 0.5	74	70
120	40	10/12	8	14	7.5	123 +/- 0.5	125	121
180	60	10/12	8	14	6	184 +/- 1	187	131

DM Code Transmitter Relay

Tests will be made every two years. Connect test set to positive and negative coil terminals of the relay.

1. Ensure pendulum is not oscillating. Slowly apply voltage until the pendulum begins to oscillate. This must not exceed the Maximum Starting Voltage on Table 11-5.

Rated Volts	Coil Ohms	Maximum Starting Voltage
8 - 12	55	7.5
8	23	5.5
4	5.7	2.8
2	1	1.4

Table 11-5

2. Increase voltage to the Low Test Voltage on Table 11-5. Each contact heel-front and heel-back will be measured for:

   A. Percent on-time of each contact (heel-front and heel-back). Contacts must not be less than 38% on-time.

   B. Code Frequency Cycles per Minute of each contact (heel-front and heel-back) are within tolerance for Min. Voltage. At the Low Test Voltage, code frequency must not be less than the Min. or more than the Max. Frequency Limits listed.

3. Increase voltage to the High Test Voltage on Table 11-6. Each contact heel-front and heel-back will be measured for:

A. Percent on-time of each contact (heel-front and heel-back). Contacts must not be less than 38% on-time.

B. Code Frequency Cycles per Minute of each contact (heel-front and heel-back) are within tolerance for Max. Voltage. At the High Test Voltage, code frequency must not be less than the Min. or more than the Max. Frequency Limits listed.

Note: If the on-time percentage falls below 38% on any contact, remove the relay from service.

Table 11-6
DM Code Transmitter Relay Test

Rated Code Freq.	Low Voltage Tests				High Voltage Tests			
	Test Voltage	Frequency Limits		Min. On Time %	Test Voltage	Frequency Limits		Min. On Time %
		Min.	Max.			Min.	Max.	
180	7.5	180	187	38%	16	180	187	38%
120	7.5	120	125		16	120	125	
75	7.5	68	77		16	68	77	
180	6	180	187	38%	11	180	187	38%
120	6	120	125		11	120	125	
75	6	68	77		11	68	77	
180	3	180	187	38%	5.5	180	187	38%
120	3	120	125		5.5	120	125	
75	3	68	77		5.5	68	77	
180	1.6	180	187	38%	2.6	180	187	38%
120	1.6	120	125		2.6	120	125	
75	1.6	68	77		2.6	68	77	

GRS Code Transmitter Relay

Tests will be made every two years. Connect test set to positive and negative coil terminals of the relay.

1. Ensure rotor is not oscillating. Gradually increase current until rotor starts to oscillate. Starting current must not exceed the value shown in Table 11-7. If starting current is greater than the Maximum Starting Current, the relay must be removed from service.

Relay Type	Maximum Starting Current
2 Volt	.250 Amperes
10 Volt	.055 Amperes

Table 11-7

2. While at Starting Current, each contact heel-front and heel-back will be measured for:

   A. Percent on-time of each (heel-front and heel-back). Contacts must not be less than 40% on-time.

   B. Code frequency Cycles per Minute of each contact (heel-front and heel-back). Ensure frequency is within the tolerance for Starting Current shown in Table 11-7.

3. Increase current to 10% under the normal current indicated on the tag and measure each contact heel-front and heel-back for:

   A. Percent on-time of each (heel-front and heel-back). Contacts must not be less than 40% on-time.

   B. Code frequency Cycles per Minute of each contact (heel-front and heel-back). Ensure frequency is within the tolerance for 10% Under Current shown in Table 11-8.

4. Increase current to Normal Current shown on the tag and measure each contact heel-front and heel-back for:

   A. Percent on-time of each (heel-front and heel-back). Contacts must not be less than 40% on-time.

   B. Code frequency Cycles per Minute of each contact (heel-front and heel-back). Ensure frequency is within the tolerance for Normal Current shown in Table 11-8.

5. Increase current to 20% over the normal current shown on the tag and measure each contact heel-front and heel-back for:

   A. Percent on-time of each (heel-front and heel-back). Contacts must not be less than 40% on-time.

   B. Code frequency Cycles per Minute of each contact (heel-front and heel-back). Ensure frequency is within the tolerance for 20% Over Normal Current shown in Table 11-8.

6. Increase current to maximum current value, observe spiral spring for:

   - Secondary Vibration
   - Adjacent coils touching each other

Note: If coils touch at any time during operation, the relay must be removed from service.

Code Rate	Normal Current	10% under Normal Current	20% Over Normal Current	Starting Current
75	± 2	± 3	± 3	± 5
120	± 1	± 2	± 2	± 5
180	± 1	± 1	± 1	+ 5

Table 11-8

11.1.1 Additional Instructions for Relays Rev. 12/97

A. **Replacement Parts.** Rev. 12/97

When a component is changed out, the replacement will be an exact or equivalent replacement part. After replacement is made, an operating test shall be made to determine that all affected circuits that were disarranged are functioning properly. Tests must be performed as outlined in instruction 1.2.3 on page 1-12.

B. **Disarrangement.** Rev. 12/97

A disarrangement has occurred when a relay is replaced with another and all required tests must be performed.

C. **Changing Out a Relay.** Rev. 12/97

The person changing out a relay will determine that the proper relay is used according to the print. The Signal Inspector, Maintenance Foreman or Signal Technician must be notified immediately, and the Manager of Signal Maintenance informed. Test of circuits affected must be made in accordance with test instructions **before** returning the system to service, and the proper form(s) must be completed for the applicable tests. A calibration test of the relay will be made by the Signal Inspector or Maintenance Foreman within 30 days.

D. **Spare Relays.** Rev. 12/97

Maintainers' spare relays will be tested so they will be current with relays in service.

E. **Visual Inspection.** Rev. 01/09

Closely observe the action of relays during actual operation and verify the following:

1. When energy is reduced in the process of obtaining the drop-away value, closely observe the action of the neutral armature as it leaves the stop pin. It will usually move slowly at this point. A sudden movement of the armature as it leaves the stop pin may indicate that a sticky substance is on the stop surfaces.
2. Determine that the relay has a positive drop-away action when the circuit is opened and that the relay contacts open without retardation of movement due to friction or any other cause. Verify that the front, back, and polar contact openings are adequate.
3. Determine that adequate clearance exists between the cover and moving parts, and between all visible fixed and moving parts. Inspect seals and gaskets for wear and proper position.
4. Determine that parts inside the relay have a clean appearance and are free from rust and corrosion. Ensure that there is not any loose or foreign matter inside the relay. Look through the relay parallel to the armature and determine there is no visible foreign matter on the armature or pole pieces.
5. Inspect relay for pitted or burnt contacts, broken or cracked glass, broken terminals, burnt heel ribbons, and moisture on or inside the relay.
6. Ensure that relay is positioned to prevent other objects from possibly bridging relay contacts.
7. With the control wires disconnected or relay otherwise de-energized, rock the relays from side to side to determine there is a small amount of endplay. The armature should slide freely on its trunnion within the limits of the play.

F. **Securely Fastened.** Rev. 01/09

Inspect all screws, nuts, and binding posts to determine that they are securely fastened and lock washers are effective. All terminals will have double nuts, and relays will be properly seated.

G. **Field Requirements.** Rev. 01/09

Relays not meeting field requirements, or found to be defective through visual inspection, must be repaired or removed from service as soon as practicable. Sealed relays will not be opened and repaired in the field.

H. **Records.** Rev. 02/01

Relays will be recorded in FSM or on the proper form, one relay on each form. All records will be filed in accordance with company and FRA requirements.

Chapter 12 Insulated Wires and Cables

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Rule 234.267 and 236.108
Insulation Resistance Tests, Wires in Trunking and Cables

Rev. 01/09

Record	Interval	Retention
24097 FSM	10 Years	Until Next Record is Filed - in no case less than 1 year

Distribution

Tested By	Original	Copies
Insp. Mtce. Foreman	MSM	Insp. Mtce. Foreman

Purpose

Test to determine that the insulation of wires and cables offer adequate resistance.

Frequency

When placed in service and at least once every ten years.

Precaution

The employee(s) making the test must have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

Description of Test

Megger voltages must not exceed the rated voltage of cables and wires.

1. Insulation resistance of wires and cables, except wires connected directly to track rails, shall be tested when wires, cables, and insulation are dry. Insulation resistance tests shall be made between all conductors and ground, between conductors in each multiple conductor cable, and between conductors in trunking, when wires or cables are installed and at least once every 10 years thereafter.
2. When insulation resistance of a wire or cable is found to be less than 500,000 ohms, prompt action shall be taken to repair or replace the defective wire or cable; until such defective wire or cable is repaired or replaced, insulation resistance test shall be made annually.

   Note: Removing defective conductor(s) from service constitutes repair of a cable if all remaining conductor(s) test above 500,000 ohms. Cable may then be tested once every ten years. When a conductor is removed from service, it must be cut off or tagged “Bad Order - Do Not Use” on each end of the conductor.
3. In no case shall a circuit be permitted to function on a conductor having an insulation resistance to ground or between conductors of less than 200,000 ohms during the period required for repair or replacement.
4. Each cable identification and the appropriate “Recording Mark” will be entered on Form 24097 on page 1-51. If any conductor within a cable has an insulation resistance of less than 500,000 ohms, each conductor’s identification, resistance value, and the appropriate “Recording Mark” will be entered within that cable.

12.1 **Pole Line and Associated Equipment**

12.1.1 Pole Line and Associated Equipment Standards   Rev. 08/96

A. **Inspected Frequently.**   Rev. 08/96

Pole line and associated equipment shall be inspected frequently, maintained in good condition, and line wires securely tied to insulators.

B. **Clearance.**   Rev. 01/09

Signal and communication lines or cables over railroad tracks and highways shall be installed and maintained so as to provide the following minimum clearance from the top of the rail or crown of the highway:

High voltage wires or cables over railroad tracks	750 to 15,000 Volts	28’
High voltage wires or cables over highways	750 to 15,000 Volts	22’
Low voltage signals or communication wires over railroad tracks	0 to 750 Volts	27’
Low voltage signal or communication wires/cable over highways	0 to 750 Volts	22’

C. **High Voltage.**   Rev. 01/09

Signal employees must familiarize themselves with M/W Rule 54.1 regarding high voltage wires and open wire transmission lines. Wires carrying 750 volts or more shall be placed at least four feet above the nearest cross-arm carrying signal and communications circuits.

12.1.2 Installation and Maintenance of Wires and Cables   Rev. 08/96

A. **Avoid Damage.**   Rev. 08/96

In order to avoid the possibility of damage to insulation, wires must not be crowded or jammed. Care must be exercised when handling and installing cables to avoid sharp bends or kinks. Cables in service must be protected to avoid damage by Maintenance of Way equipment and from right-of-way fires.

B. **Do Not Puncture For Testing.**   Rev. 08/96

The insulation of wire must not be punctured for testing purposes.

C. **Tight and Clean.**   Rev. 08/96

Wire connections must be kept tight and clean and wires properly marked in accordance with authorized practice. Wires must be so arranged that they cannot foul moving parts.

D. **Splicing.** Rev. 08/96

Permanent splices in underground signal cable may only be made by using approved splicing materials. Prescribed procedures for making such splices must be closely followed.

E. **Underground Cables.** Rev. 08/96

Track wires and underground cables shall be installed not less than 30 inches below the surface of the ground. Care will be exercised to prevent sharp projections, such as rocks, from coming in contact with the wire or cable.

F. **Possibility of Damage.** Rev. 12/97

When there is a possibility that damage to underground signal cables might have occurred, cables must be meggered (Rule 234.267 and 236.108 Insulation Resistance Tests, Wires in Trunking and Cables) and the operation of signals checked before restoring signals to their normal operation.

G. **Cable Locators.** Rev. 05/15

Before using a cable locator on cables or wires, employees must read and be in compliance with 1.1.11 Cable Locators on page 1-7.

Chapter 13 Other

13.1 Additional Instruction and Maintenance

13.1.1 Protection Where Tracks Are Used For Loading or Unloading Flammables

Rev. 08/96

At least once each year a test must be performed to determine that the protective apparatus is in good condition.

13.1.2 Standby Power Generators

Rev. 08/96

To ensure the most effective operation of standby power generators the following maintenance and operation criteria shall be followed:

A. Automatic standby power generators shall be started and run a minimum of 30 minutes each week. Monthly they must be started and put on line for at least 30 minutes. Readings shall be recorded of amperage, voltage, and frequency. Frequency shall be maintained between 59 and 61 cycles, loaded or not loaded.

B. The engine shall be maintained to ensure it will start in extreme cold weather. All water-cooled engines will be equipped with electric tank-type hot water heaters of at least 1500 watts if unit is not in a heated building. All heaters shall be thermostatically controlled.

C. Engine oil, coolant, and fuel supply shall be checked before the engine is started.

D. The starting battery must be properly maintained and replaced before expiration of guarantee, or more frequently, if battery indicates signs of deterioration.

E. Manual standby power generators shall be started monthly and run for at least 30 minutes. Quarterly, they must be started and put on line for at least 30 minutes. Readings shall be recorded of amperage, voltage, and frequency. Frequency shall be maintained between 59 and 61 cycles, loaded or not loaded.

13.1.3 New installations

Rev. 05/15

New installations must be given a complete operational check before placing in service. All subsequent changes must be checked and plans marked promptly upon completion.

All checks and inspections of the location will be made jointly by the Manager of Signal Maintenance and Manager of Signal Construction or their representatives and the results entered into the Signal Project Assessment.

at the address
https://home.www.uprr.com/emp/engineering/apps/secure/cpi/index.cfm

A detailed check of the layout, locking and circuits will be made including

A. Check signal apparatus for agreement with the layout plan as to track arrangement, number, locations, type, aspects and the routing of signals. If conditions are found that are not in accordance with approved plans, corrections shall be made as promptly as practicable and steps taken to protect train movement.

B. Check that signal light units are focused to provide the best possible view of the aspects, including all gate lights, flashers and cantilever lights. Ensure that the proper voltage is applied to the light units.

C. Check each relay location and interlocking tower case, to verify that it contains all the apparatus called for on plans. Remove excess apparatus and foreign material from the case. Verify that the signal apparatus is the proper type and has had the proper inspections. Power and battery supplies must be the correct voltage, capacity and properly fused.

D. Ground system resistance shall be maintained in compliance with 1.1.5 Proper Grounding. on page 1-4.

E. Test to ensure that all circuits are free of grounds and the proper form is completed.

F. Check the adjustment of contacts in electric locks, circuit controllers, gate mechanisms, releases and similar devices.

G. Check that all signal assets have been bar coded and recorded in FSM, wires are tagged and that tagging is in accordance with the plans.

H. Test all circuits to ensure that they function properly. including, but not limited to track circuits

I. Check that all cables are properly stripped and installed in cable entrances to prevent damage to the cable insulation. All cable entrances and openings must be completely sealed.

J. Check that plans are in compliance with 1.1.7A. Layout and Circuit Plans. on page 1-5. If the approved plans do not seem to provide the proper protection or flexibility of operation, such conditions shall be reported to the Director of Signal Design and prompt action taken to protect train movement until corrections are made. After corrections are made, a complete set of AC'ed plans must be sent to Omaha.

K. Check that standard clearance requirements are provided for all signal facilities installed.

L. Properly dispose of old signal apparatus that has been removed from service.

M. Check the condition and proper installation per current standards of insulated joints, bonding, fouling wires, track circuit connections, wires and cables, switch circuit controllers and rods, transformers, relay locations, switch movements, electric switch locks, gates, cantilevers and all other apparatus on or about the track.

N. Ensure all appropriate tests are performed and documented on the proper form(s) or entered into FSM. Ensure that completed FRA forms are delivered to the Manager of Signal Maintenance or the maintenance employee on the territory where work is being preformed.

O. Check that all signal apparatus are properly adjusted and lubricated.

P. Instructions, maintenance manuals, warnings and licenses must be available or posted.

Q. Verify recording device(s) are working as designed, proper date and time set, all errors cleared, and proper battery voltage applied. Verify that all back up batteries are tested and working properly upon installation.

13.2 **Preparation for Winter**

13.2.1 Preparation of Signal Facilities for Winter Operation Rev. 08/96

A. **Preparing for Cold Weather.** Rev. 08/96

To ensure that all signal facilities are prepared for winter, all signal forces should begin sufficiently in advance of winter weather conditions, preparing their equipment for cold weather operation.

B. **Power Operated Switches.** Rev. 08/96

All power operated switch machines should be thoroughly inspected to ensure that no moisture has accumulated in the machine and that they are properly lubricated for winter. All electric and propane snow melters should be checked, reconnected for service and propane tanks filled. Snow melter database must be updated.

C. **Air Systems.** Rev. 08/96

Compressed air type air systems should have the air compressors checked, filters cleaned and alcohol feeders filled. Electric service must be reconnected and all air reservoirs, condensers, and air distribution lines drained of any accumulation of moisture.

D. **Batteries.** Rev. 08/96

All batteries should be checked at this time and watered if necessary to preclude the possibility of adding any appreciable amount of water during the cold weather.

E. **Heaters.** Rev. 08/96

Heat lamps or other heaters that are used around special equipment, such as recorders and hotbox detectors, should be checked and it must be known that thermostatic controls are operating properly.

F. **Gaskets.** Rev. 08/96

Gaskets on all signals, signal cases, switch machines, circuit controllers, and all junction boxes should be checked for leaks to prevent the entrance of blowing snow and water.

G. **Rock Slide Fences.** Rev. 08/96

Rock slide fences should be checked to see that they are in proper operating condition and that all plugs are clean. Where circuit controller boxes are installed, verify that they are adequately protected to prevent moisture from entering and freezing. Inspection should also be made at this time to make sure that falling rock and debris are not fouling any of the rock slide fences.

13.2.2 Snow Melter Monthly Duties Rev. 01/09

A. **Snow Melter Monthly Duties (Fall to Spring)** Rev. 01/09

1. Check the switch ties to ensure fire protection pads are properly placed and that the ties are not burned.
2. Check for gas leaks.
3. Check igniters and pilot jets for proper flame.
4. Check gas pressure in Venturi boxes (16 ounces)
5. Rail type heaters.(10 to 12 lbs.)
6. Jet type heaters.(5.50 to 8 lbs.)
7. Test excess flow valve. (Mid-season.)
8. Check gas volume in the tanks. Fill when necessary.
9. Ensure that switch heaters are functioning properly.

B. **Snow Melter Seasonal Duties (Spring)** Rev. 01/09

1. Turn off the gas at the tanks.
2. Disconnect the control wire from the switch heater control (KP) relay.
3. Remove the Edison relays and vibrators if equipped.
4. Disconnect valve wires.
5. Remove the rail-type switch heaters.

C. **Snow Melter Seasonal Duties (Fall)** Rev. 01/09

1. Remove the covers and inspect all pipe, pipe connections, hoses, and fittings.
2. Check all mounting brackets to ensure they are tight.
3. Fill the gas tanks as necessary.
4. Install the switch heaters and turn on the gas (check jets).
5. Install the relays and vibrators if equipped.
6. Check junction boxes to ensure gaskets are in good condition and connections are tight.
7. Test excess flow valve.

D. **Hovey Snow Melter** Rev. 01/09

1. Verify the correct control and indication wiring between the heater and the signal bungalow. See Field Notice 12336 Incorrect Field Wiring of Heaters to Signal Bungalow, Oct. 01.
2. Review stored error codes in Flame Safety Relay.

Total, FSR hours______________ and FSR cycles_________

Last 6 Codes found:

Fault History	**Code**	**Hour**	**Cycle**	**Fault History**	**Code**	**Hour**	**Cycle**
H1				**H4**			
H2				**H5**			
H3				**H6**			

3. Verify the correct air switch calibration. Block air intake 80%, verify heater still operates. Then block 90% and verify FSR alarms.
4. Clean the ASCO Solenoid valves per most recent service bulletin.
5. Inspect the condition of all the ducting particularly the flexduct. Repair or replace damaged ductwork (Not warranty).
6. Verify adequate surge protection of the service and the rail thermostat. See add on and upgrade brochure for part numbers and pricing.
7. Inspect Cycling and High Limit Thermostat installation. Repair or replace where required. Cycling 13340-02, High Limit 13340-01.
8. Check flame signal strength. Pilot_________ Main_________ minimum 2.5 micro VDC. If signal strength is low and replacement of flame rod does not increase strength, inspect manifold and mixing plate for blocked orifice.

9. Inspect track duct vents. Close vents if too many are open. Set vent openings to 1/8 inch – 1/4 inch maximum.
10. Inspect dirt trap for evidence of dirt or water in the line.
11. Adequate supply gas pressure when heater is operating: ______ psi.
12. Inspect for gas leaks.

Spare parts installed during inspection

Description	**Part #**	**Description**	**Part #**
Flame rod	14978	Spark igniter	14970
Cycling Thermostat	13340-02	High Limit Thermostat	13340-01
Thermostat box	13034	FR Bushing	18181
Flame rod wiring kit	14888		
FSR	9040-0017		

13.2.3 Snow Melter Ducting

Rev. 09/06

Where a heating or snow melting device is used at switches, heater and rail duct must be installed and maintained in such a manner to prevent shunting of the track circuit or fouling of the switch points and switch rods. Care must be exercised to avoid fire or heat damage to the heater, switch movement, wiring, and switch ties. When there is the appearance of damage, action must be taken to prevent any improper operation of switches and signals and a report made to Manager of Signal Maintenance.

Rule 236.576 - ATS Inductor Tests

Rev. 01/09

Record	Interval	Retention
24094 FSM	Inductor Gauging (Monthly) Impedance and Insulation Resist. (6 Month)	Until Next Record is Filed - in no case less than 1 year

Distribution

Test By	Original	Copies
(Inductor Test) Mtr.	MSM	Mtr.
(Impedance and Insulation Resist.) Insp. Mtce. Foreman	MSM	Insp. Mtce. Foreman

Purpose

Test to ensure that the proper height and alignment of the inductor are maintained and to test the inductor for defective conditions in its windings, external controlling circuits, trip arm valves, and return springs.

Frequency

A. Inductor Gauging Test –

When placed in service and thereafter when modified, disarranged, or at least once every month, whichever shall occur first.

B. Impedance and Insulation Resistance Test –

When placed in service and thereafter when modified, disarranged, or at least once every 6 months, whichever shall occur first.

Precautions

The employee(s) making the test must have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

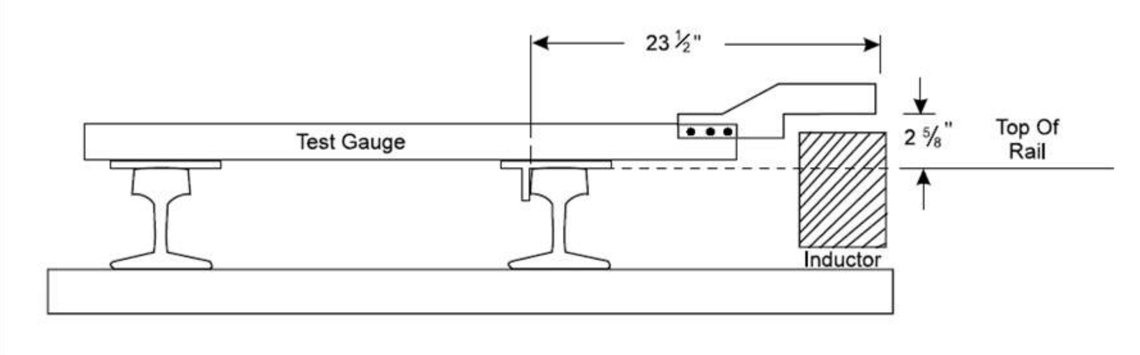
Description of Test

Inductor Gauging

1. Determine that the rails are properly seated in the tie plates. If there is pumping of the rail, or the rail is not seated properly in the plates, notify the Track Department for correction.
2. Place the inductor gauge across the rails as shown in Figure 13-1. Ensure that the gauge stop is against the gauge side of the rail.
3. Verify the following measurements:
   - **a.** Horizontal - The field side of the inductor must be 23 1/2inches (plus or minus 1/4 inch) from the gauge side of the nearest rail.
   - **b.** Vertical - The top of the inductor must be 2 1/2 inches (plus or minus 1/8 inch) above the top of the rail.

Impedance Test

Figure 13-1
Impedance Test



This test requires the use of an inductor test set and a laminated test bar. Clean excessive dirt and paint from the pole faces of the inductor before beginning the test. To ensure uniformity of test results, the gaps caused by dirt, paint, or other foreign material should not exceed 1/32 inch.

Note: This test is made with a S&C 400-1 train stop inductor tester. Read the manual for specific instructions and precautions.

First test is made without the shorting bar.

1. Open both sides of the inductor circuit in the relay case.
2. Turn AC output power control knob full counter clockwise.
3. Connect test leads to inductor wires.
4. Press and hold the power switch while slowly turning the AC output power control knob clockwise, observing current and voltage meters.

Note: Do not allow either meter to exceed full-scale deflection or meter damage may occur.

5. Adjust current to 100 mA and take a voltage reading. If voltage is less than 50% of the current reading, inductor has high current and should be replaced. If voltage is more than 80% of the current reading, inductor has high impedance; continue testing.

Second test made with shorting bar.

Repeat Steps 1, 2, 3, and 4 above. Additionally, perform step 6.

6. Adjust the voltage to 100 volts and take a current reading. The current reading for a good inductor will be between 50 and 90 milliamperes. If the current exceeds 90 mA, disconnect the inductor from the feed wire and connect the test set directly to the inductor terminals. If the inductor current reading is still above 90 mA, replace the inductor.

Insulation Resistance Test -

Connect a megger to the inductor control circuit with the inductor connected to the circuit. Megger total circuit to ground and verify that the “megger” reading is not less than 10,000 ohms to ground.

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Rule 236.577 - Test, Acknowledgement and Cut-In Circuits

Rev. 01/09

Record	Interval	Retention
24094 FSM	1 Year	Until Next Record is Filed - in no case less than 1 year

Distribution

Test By	Original	Copies
Mtr.	MSM	Mtr.

Definitions

A. Acknowledgment circuit.

A circuit consisting of wire or other conducting material installed between the track rails at each signal in territory where an automatic train stop system or cab signal system of the continuous inductive type with 2 indication cab signals is in service, to enforce acknowledgment by the engine man at each signal displaying an aspect requiring a stop.

B. Cut-in circuit.

A roadway circuit to the entrance at automatic train stop, train control, or cab signal territory by means of which locomotive equipment of the continuous inductive type is actuated so as to be in operative condition.

C. Test circuit.

A circuit including portable and on-board test equipment, used for performing the prescribed tests of apparatus on equipped locomotives.

Frequency

When placed in service and thereafter when modified, disarranged, or at least once each year, whichever shall occur first.

Precaution

The employee(s) making the test must have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

Procedure	Results Expected
Place AC ammeter across the rails of the test circuit at the opposite end from where the transmitter is located and apply steady energy to the circuit.	Current flow must not be less than 0.800 amperes.
On loop style test circuits, place the ammeter in series with the loop	Current flow must not be less than 0.800 amperes.

Test must be made to ensure that code rates of 180 pulses per minute, 120 pulses per minute, 75 pulses per minute, and 00 pulses per minute are applied and must be sequenced in the given order. Each code rate must be applied at least the amount of time that is shown on the circuit plans.

Visual inspection must be made of all the apparatus involved in the operation of the test circuit.

13.3 **Train Approach Warning System (TAWS)**

13.3.1 TAWS - Maintenance, Inspection, Testing, and Repair Rev. 01/09

The following instructions apply to certified TAWS locations that have met all of the requirements outlined by the FRA to allow the TAWS to be used as a means of roadway worker protection. Certified TAWS locations will be clearly identified with a sticker on the TAWS cabinet door which reads "TAWS Certified for On-Track Safety".

A. **Testing of TAWS** Rev. 01/09

Train Approach Warning System will be tested when placed in service and thereafter when modified, disarranged, or at least once each designated time period. Conditions or performance data may warrant more frequent inspections and tests.

B. **System Modification.** Rev. 01/03

If the Train Approach Warning System, or any part thereof, is modified, the system must be re-certified before the TAWS can be utilized as the sole means of On Track Safety.

C. **Kept Clean.** Rev. 01/03

Train Approach Warning System will be kept clean and properly adjusted so when activated, the system will provide warning of an approaching train. Horns and lights will be kept free of dirt, debris, and in good working condition.

D. **Inspection.** Rev. 01/03

Train Approach Warning System lights and horns will be visually inspected monthly for the following:

- Structural damage which may affect proper operation
- General condition of enclosures
- Lens cleanliness
- Condition of exposed electrical and mechanical connections
- Horn alignment

E. **Testing Lights and Horns.** Rev. 01/03

Lights and horns will be tested quarterly to ensure that lights are visible and horns are audible. Verify that the indicator light is operational and visible to an employee located in the track area near the control box when the TAWS test switch is in the ON position. Document completed test on Form 24094 on page 1-31.

F. **Repair.** Rev. 01/03

If damage to any essential component is detected that will impair the proper operation of the Train Approach Warning System, repair components promptly. If the system cannot be repaired promptly, tag the control box with an "Out of Service" tag and lock the control box with a personal lock to ensure the system is secured until repairs are made. Notify the Director of Signal Maintenance of the exception.

Train Approach Warning System Test

Rev. 01/09

Record	Interval	Retention
24094 FSM	2 Year	Until Next Record is Filed - in no case less than 1 Year

Distribution

Test By	Original	Copies
Insp. Mtce. Foreman	MSM	Insp. Mtce. Foreman

Purpose

The purpose of this test is to ensure that the certified Train Approach Warning System (TAWS) is operating properly. This test procedure applies to only certified TAWS locations that have met all of the requirements outlined by the FRA to allow the TAWS to be used as a means of roadway worker protection. Certified TAWS locations will be clearly identified with a sticker on the TAWS cabinet door, which reads "TAWS Certified for On-Track Safety".

Frequency

When placed in service and thereafter when modified, disarranged, or at least once every two years, whichever shall occur first.

Precautions

The employee(s) making the test must have information relative to train movements to ensure that no trains will be endangered or delayed while tests are being made. Also, it must be known that no unsafe conditions are set up by the application of testing equipment.

Description of Test

1. Place the TAWS switch in the TEST position and ensure that the horns and lights are operating properly.
2. After verifying proper operation of horns and lights, place the TAWS switch in the ON position.
3. With no signal cleared, shunt each track circuit within the Control Point or Interlocking individually and verify that the TAWS activates.
4. Clear each home signal.
5. Shunt the approach track to the cleared home signal.
6. Ensure that the TAWS activates.
7. Repeat steps 4 through 6 for each route in the Control Point or Interlocking.
8. Restore TAWS switch to the OFF position.

All approach circuits to the Control Point or Interlocking must be of sufficient length to allow the TAWS to be activated for a minimum of 60 second when a maximum speed train is cleared through the Control Point or Interlocking.

Chapter 14 Testing Matrices

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14.1 **Overview**

14.1.1 Testing Matrix Overview

Rev. 01/13

A. **Rules and Instructions.** Rev. 01/13

The information contained in each testing matrix is not intended to replace, substitute, or override; regulations, rules and guidelines published by product manufacturers, FRA, UPRR GCOR, or Signal Maintenance, Inspection, Tests and Standard Instructions.

B. **Employee Assessment.** Rev. 01/13

The employee must assess each event and apply all applicable rules, tests, and precautions prior to, during, and after performing work related to this document.

C. **Locations.** Rev. 01/13

All physical characteristics, design, and construction of each location must match the Signal Design prints and associated Standard Drawings.

D. **Available Tests.** Rev. 01/13

All testing performed, both FRA and UPRR, outside of normal scheduled rotation cycle, require an unscheduled test entry be added to FSM (SMP). The last page of 14.2.2 Highway Grade Crossing Unscheduled Test List on page 14-6 and 14.3.2 Power Switch Unscheduled Switch Test List on page 14-11, provide a list of current available tests to select from in the event that one may not already be added into the normal test rotation.

14.2 **Highway Grade Crossing**

14.2.1 Highway Grade Crossing Testing Matrix

Rev. 10/15

Actions Legend
A. Action Required
B. Action Recommended

Event	Test Name	Actions	FRA Tests Reference	UPRR YB Test	Page #
False Activation	Alternate Warning	A	234.107	8.1.4D.	8-29
Activation of All or Part of Crossing Equipment	Warning System Operation	A	234.257	1.2.3	1-12
	Ground Test	A	234.249	Ground Test	8-1
	Fouling, Bond Wires And Shunting Relays	B	234.271	8.1.5 9.1.2	8-29 9-11
	Hold Clear Devices	B	234.255	Hold Clear Devices	8-17
	Standby Power	B	234.251	5.1.3	5-3
Power Off Indication or Power Indication Light is Flashing or Dark	Ground Test	A	234.249	Ground Test	8-1
	Standby Power	A	234.251	5.1.3B. 5.1.3C.	5-3
	Warning System Operation	A	234.257	1.2.3	1-12
	Standby Power	B	234.251	5.1.3A. 5.1.3E. 5.1.3F.	5-3 5-3 5-3
Burned Out/Bad Bulb Broken Lens/Light Unit	Ground Test	A	234.249	Ground Test	8-1
	Flashing Light Units and Lamp Voltage	A	234.253	8.1.7 8.1.8 8.1.8A.	8-30 8-31 8-31
Replace, Rehang, or Repair Gate Arm	Alternate Warning	A	234.105, 106, 107	8.1.4D.	8-29
Gate Mechanism Operation Failure	Alternate Warning	A	234.255	1.2.3 8.1.11	1-12 8-35

Event	Test Name	Actions	FRA Tests Reference	UPRR YB Test	Page #
Replace Gate Complete or Repair of All or Part of Gate	Ground Test	A	234.249	Ground Test	8-1
	Flashing Light Units and Lamp Voltage	A	234.253	8.1.7 8.1.8 8.1.8A.	8-30 8-31 8-31
	Gate Arm and Mechanism	A	234.255	1.2.3 8.1.8A. 8.1.10	1-12 8-31 8-33
	Warning System Operation	A	234.257	1.2.3	1-12
	Lamps and Lenses	B	234.253	8.1.7 8.1.8 8.1.8A.	8-30 8-31 8-31
Mechanism Knockdown	Alternate Warning	A	234.105, 106, 107	8.1.4D.	8-29
	Emergency Procedures	A		3.1.2A.	3-2
	Inspection After Incident	A		8.1.14	8-37
Replacement of Mechanism from Damage	Ground Test	A	234.249	Ground Test	8-1
	Standby Power	A	234.251	5.1.3	5-3
	Lamps and Lenses	A	234.253	8.1.7 8.1.8 8.1.8A.	8-30 8-31 8-31
	Gate Mechanism	A	234.255	1.2.3 8.1.10	1-12 8-33
	Warning System Operation	A	234.257	1.2.3	1-12
	Insulation Resistance Tests	A	234.267 LT	Insulation Resistance Tests	12-1
Alleged Short Warning Time	Alternate Warning	A	234.105, 106, 107	8.1.4D.	8-29

Event	Test Name	Actions	FRA Tests Reference	UPRR YB Test	Page #
Activation Failure	Ground Test	A	234.249	Ground Test	8-1
	Standby Power	A	234.251	5.1.3	5-3
	Lamps and Lenses	A	234.253	8.1.7 8.1.8 8.1.8A.	8-30 8-31 8-31
	Warning System Operation	A	234.257	1.2.3	1-12
	Warning Time	A	234.259	Warning Time	8-20
	Fouling, Bond Wires And Shunting Relays	A	234.271	8.1.5 9.1.2	8-29 9-11
Electronic Failure Replacement ***Include Electronic Adjustment Items**	Alternate Warning	A	234.105, 106, 107	8.1.4D.	8-29
Electronic Adjustment	Ground Test	A	234.249	Ground Test	8-1
	Disable/Disarrange	A	234.257	1.2.2 1.2.4	1-11 1-14
	Warning System Operation, Adjusting Motion Devices And Predictors	A	234.257	1.2.3 1.2.4 8.1.12	1-12 1-14 8-35
	Warning System Operation	A	234.257	1.2.3	1-12
	Lamps and Lenses	B	234.253	8.1.7 8.1.8 8.1.8A.	8-30 8-31 8-31
Replace Gate Mechanism Due to Failure	Alternate Warning	A	234.105, 106, 107	8.1.4D.	8-29

Event	Test Name	Actions	FRA Tests Reference	UPRR YB Test	Page #
Replacement of Mechanism	Ground Test	A	234.249	Ground Test	8-1
	Gate Mechanism	A	234.255	1.2.3 8.1.10	1-12 8-33
	Warning System Operation	A	234.257	1.2.3	1-12
	Standby Power	B	234.251	5.1.3	5-3
	Lamps and Lenses	B	234.253	8.1.7 8.1.8 8.1.8A.	8-30 8-31 8-31

List of Unscheduled Tests that are available to select in the FSM application are found on the following page.

14.2.2 Highway Grade Crossing Unscheduled Test List

Rev. 10/15

Test Description	Test Source	Rule	Facility Type	Frequency
Cabin Level	UPRR	926130UP	CROSSING(XING)	365
Circuit Plans Complete and Legible	UPRR	8.1.3D.	CROSSING(XING)	365
Crossing Recorder Test	UPRR	8.1.3	CROSSING(XING)	365
Cutout Circuits	FRA	234.269	CROSSING(XING)	90
Dragger	UPRR	6.5.5	CROSSING(XING)	30
Event recorders downloaded and proper operation verified	UPRR	7.1.7B.	CROSSING(XING)	730
Flash rate	FRA	234.253 (a)	CROSSING(XING)	365
Gate and Mech Condition	FRA	8.1.10, 8.1.11	CROSSING(XING)	30
Gate Level Horizontally	UPRR	8.1.10D.	CROSSING(XING)	365
Gate Operation	FRA	8.1.10A.	CROSSING(XING)	30
Grounds	FRA	234.249	CROSSING(XING)	30
Grounds	FRA	236.107	CROSSING(XING)	90
Hazard Detector	UPRR	6.5	CROSSING(XING)	365
Hold Clear	FRA	234.255 (c)	CROSSING(XING)	365
Insulated Joint Test	UPRR	9.1.3C.	CROSSING(XING)	365
Interconnection Inspection	UPRR	8.1.3C.	CROSSING(XING)	365
Island Shunt Sensitivity	UPRR	8.1.4C.	CROSSING(XING)	90
Lamp Voltage	FRA	234.253 (b)	CROSSING(XING)	365
Light Unit Alignment	FRA	234.253 (a)	CROSSING(XING)	365
Mast Level	UPRR	796120UP	CROSSING(XING)	365
Polarity Check	UPRR	9.1.1C.	CROSSING(XING)	365
Power Co Name Verified	UPRR	5.1.3B.	CROSSING(XING)	365
Power Meter Number Verified	UPRR	5.1.3B.	CROSSING(XING)	365
Power Phone Number Verified	UPRR	5.1.3B.	CROSSING(XING)	365
Shunt Fouling	FRA	236.104	CROSSING(XING)	90
Shunt Sensitivity	UPRR	9.1.1A.	CROSSING(XING)	365
Standby Power	FRA	234.251	CROSSING(XING)	30
Time Release	FRA	234.265	CROSSING(XING)	365
Track Connections	FRA	234.271	CROSSING(XING)	90

Test Description	Test Source	Rule	Facility Type	Frequency
Monthly Procedure Traffic Signal Preempt	FRA	234.261	CROSSING(XING)	30
Monthly Procedure Visibility- Damage	FRA	234.253 (c)	CROSSING(XING)	30
Monthly Procedure Warning System Operation	FRA	234.257 (a & b)	CROSSING(XING)	30
Warning Time	FRA	234.259	CROSSING(XING)	365

14.3 **Power Switch**

14.3.1 Power Switch Testing Matrix

Rev. 01/14

Actions Legend
A. Action Required
B. Action Recommended

Event	Test Name	Actions	FRA Tests	FRA Reference	UPRR Test	Page #
General Switch Issues						
Yellow Book General Switch Guidelines As Applicable for all Events. In addition to specific inspections and testing guidelines, it is imperative to be familiar with general switch maintenance, inspection and guidelines. These instructions may apply to specific events and consideration must be taken to comply with these instructions	Adjustment, Installation and Protection				2.1	2-1
	When Necessary to Disconnect Switch Stand, Controller, etc				2.1.2	2-2
	Maintenance of Switches				2.1.3	2-3
	Inspection of Rods, Plates, Transit Clips, Overtees, and Track Material				2.1.4	2-4
	Additional Instructions for Maintenance of Power Switches				2.2.1	2-5
Lock rod out of adjustment	Adjustment, Installation and Protection	A			2.1.1A. 2.1.1B.	2-1 2-1
	Maintenance of Switches	A			2.1.3A. 2.1.3D.	2-3 2-3
	Switch Obstruction	A	236.382	236.327		2-5
	Point Detector	B	236.103	236.334		2-11

Event	Test Name	Actions	FRA Tests	FRA Reference	UPRR Test	Page #
Point Detector Out of Adjustment	Adjustment, Installation and Protection	A			2.1.1A. 2.1.1B.	2-1 2-1
	Maintenance of Switches	A			2.1.3A. 2.1.3D.	2-3 2-3
	Point Detector	A	236.103	236.334		2-11
	Switch Obstruction	B	236.382	236.327		2-5
Obstruction in Switch	Adjustment, Installation and Protection	A			2.1.1A.	2-1
	Maintenance of Switches	A			2.1.3B. 2.1.3C.	2-3 2-3
	Point Detector	B	236.103	236.334		2-11
	Switch Obstruction	B	236.382	236.327		2-5
Switch Out of Adjustment Due to Running Rail	Adjustment, Installation and Protection	A			2.1.1A. 2.1.1B.	2-1 2-1
	Inspection of Rods, Plates, Transit Clips, Overtees, and Track Material	A			2.1.4B. 2.1.4C.	2-4 2-4
	Maintenance of Switches	A			2.1.3A. 2.1.3D.	2-3 2-3
	Point Detector	A	236.103	236.334		2-11
	Switch Obstruction	A	236.382	236.327		2-5
OOC During Train Passage or After Train Passage	Adjustment, Installation and Protection	A			2.1.1A. 2.1.1B.	2-1 2-1
	Maintenance of Switches	A			2.1.3A. 2.1.3D.	2-3 2-3
	Point Detector	A	236.103	236.334		2-11
	Grounds Tests	B	236.107	236.2		5-47
	Maintenance of Switches	B			2.1.3E.	2-3

Event	Test Name	Actions	FRA Tests	FRA Reference	UPRR Test	Page #
Occupied Track Indication (Shorted Track Circuit) After Power Switch Operation or After Train Passage	Adjustment, Installation and Protection	A			2.1.1A. 2.1.1B.	2-1 2-1
	Inspection of Rods, Plates, Transit Clips, Overtees, and Track Material	A			2.1.4A. 2.1.4B.	2-4 2-4
	Insulation Inspection and Tests	A			9.1.3A. 9.1.3B.	9-13 9-13
	Inspection of Rods, Plates, Transit Clips, Overtees, and Track Material	B			2.1.4C.	2-4
	Insulation Inspection and Tests	B			9.1.3C. 9.1.3D. 9.1.3E. 9.1.3F.	9-13 9-13 9-15 9-15
Replacement of Switch Machine	Switch Obstruction	A	236.382	236.327		2-5
	Point Detector	A	236.103	236.334		2-11
	Indication Locking	A	236.38 LT	236.307		4-12
	Testing	A			1.2.3	1-12
	Grounds Tests	A	236.107	236.2		5-47
	Disable/Disarrange	A	234.257		1.2.2	1-11
	Additional Maintenance of Power Switches	A			02.2.1E. 2.2.1F. 2.2.1H. 2.2.1I. 2.2.1J. 2.2.1K. 2.2.1L.	2-5 2-5 2-6 2-6 2-7 2-7 2-7 2-8
	Insulation Resistance Tests	B	234.267 LT			12-ii
List of Unscheduled Tests that are available to select in the FSM application are found on the following page.						

14.3.2 Power Switch Unscheduled Switch Test List

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Test Description	Test Source	Rule	Facility Type	Frequency
ACS Cut In Circuits	FRA	236.577	SWITCH(Power Operated)	365
Circuit Plans Complete and Legible	UPRR	1.1.7A.	SWITCH(Power Operated)	365
Cross Protection	FRA	236.384	SWITCH(Power Operated)	180
Hazard Detector	UPRR	6.5	SWITCH(Power Operated)	365
Insulation Joint Test	UPRR	9.1.3C.	SWITCH(Power Operated)	365
Model 5 Timing	UPRR	2.2.1K.	SWITCH(Power Operated)	365
MPF Inspection	UPRR	2.1.4C.	SWITCH(Power Operated)	30
Overload	UPRR	2.2.1E.	SWITCH(Power Operated)	90
Point Detector	FRA	236.103	SWITCH(Power Operated)	90
Polarity Check	UPRR	9.1.1C.	SWITCH(Power Operated)	365
Restoring Feature	FRA	236.386	SWITCH(Power Operated)	90
Rule 236.104 - Shunt Fouling Circuit	FRA	236.104	SWITCH(Power Operated)	90
Shunt Sensitivity	UPRR	9.1.1A.	SWITCH(Power Operated)	365
Rule 236.6 and 236.103 - Switch Circuit Controller	FRA	236.103	SWITCH(Power Operated)	90
Switch Obstruction	FRA	236.382	SWITCH(Power Operated)	30
Time Release	FRA	236.109	SWITCH(Power Operated)	365
Valve and Valve Magnets	FRA	236.383	SWITCH(Power Operated)	365
Valve Locks	FRA	236.383	SWITCH(Power Operated)	90
Walk OS Track	UPRR	2.2.1C.	SWITCH(Power Operated)	30

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Maintenance of Way Services

Appendix G

Inspection of Structures

Inspection of Structures

FRA Bridge Safety Standards

The Contractor shall develop a Bridge Management Plan for ACTA pursuant 29CFR237 Bridge Safety Standards for ACTA-maintained rail bridges. (See attached inventory.) The program shall contain the elements of Subpart B 237.33 including an inventory of the rail bridges, record of the safe loading capacity of each, maintaining design documents and documenting of repairs, and a bridge inspection program covering inspection personnel safety, types of inspection, definition of defect levels and condition codes, documentation including standard forms, structure and component types, and numbering and identification protocol.

A bridge supervisor and qualified inspectors are to be made available pursuant to Subpart C 237.53 and 55.

Necessary manpower, track time, and inspection equipment and vehicles, including that required for underwater bridge components, shall be made available to perform and document such inspections.

Other Structures

Qualified inspectors shall be provided for other bridges (see attached inventory), and other railroad structures including signal bridges, signal masts, crossing warning devices, signal huts, radio towers, antennas, drainage facilities, manholes, vaults, retaining structures, pump stations, emergency ladders, overhead casings, fencing, concrete barriers, and other railroad-related structures. Inspectors shall be experienced in maintenance, inspection and construction; trained in the appropriate safety and inspection techniques; and qualified per FRA Track Safety Standards.

Inspections shall include routine and required annual inspections, as well as emergency inspections following accidents, derailments, floods, earthquakes, fire, and other conditions.

ACTA-Maintained Rail Bridge Inventory

Description	Location	Type	Crossing Number	Reference DWG	Length	# of Spans	Width
ACTA Mainline Over Washington	ACTA Mainline track over Washington Blvd e/o Santa Fe Ave.	Five Track Steel Under Girder	114-0.28-B	C0097 S-101 to S-127	176-3⅞" total 86'-8⅝" maximum	2	97'-1⅞" at east abutment
Compton Creek Bridge	ACTA Mainline over Compton Creek	3 track Steel Through Girder	N/A	C0101 S-001 to S-034	354'-9¾" total 100'-0" maximum	4	63'-0"
Dolores Yard Ped Underpass	ACTA Mainline over pedestrian tunnel @ Dolores Yard	Concrete box	114-13.70-BDX		Spans ROW at skew	1	
Dominguez Channel Bridge	ACTA Mainline tracks over Dominguez Channel	4 tracks on precast, prestressed concrete box girders	N/A	C0102 S-001 to S-017	204'-0" total 35'-6" Maximum	6	70'-4"
Alameda Street Underpass	Alameda Street under ACTA Mainline Tracks @ Huntway Curve	4 track on steel under girder/ concrete deck	114-16.16-B	C0131 S-001 to S-023	131'-0¼" total equal	2	70'-1" added 2'-3" northside 3'-8" southside
Long Beach Lead Bridge	Long Beach Lead Track across the Dominguez Channel	2 track Steel under Girder with concrete deck	N/A	C0103 S-001 to S-023	204'-6" total 42'-0" maximum	6	38'-4"
Henry Ford Grade Separation Segment 2	ACTA Mainline Across Dominguez Channel	2 Track - 2 spans Steel Plate Under Girder & 1 span Through Truss	N/A	C0104 S-200 to S-247	550'-8" total 127'-0" PG maximum 296'-9⅜" truss	3	36'-2" Plate Girder 38'-6" truss
Henry Ford Grade Separation Segment 3	ACTA Mainline across Henry Ford / Peir A Way Intersection	2 Track on Steel Through Truss	114A-17.38-B	C0104 S-300 to S-309	295'-3⅜"	1	38'-6"
Henry Ford Grade Separation Segment 4	Viaduct Section over UP San Pedro Branch Line	2 track on precast concrete box girders		C0104 S-400 to S-440	856'-0" total 58'-0" maximum	19	36'-0"
Henry Ford Grade Separation Segment 5A	Continuation of Viaduct Section	2 track on precast concrete box girders	N/A	C0104 S-500 to S-509	554'-0" total 42'-6" maximum	13	36'-0"
ACTA -3 Dominguez Channel Bridge	ACTA-3 Track over the Dominguez Channel at Henry Ford Ave.	Single track on steel girders with timber ties	N/A				

ACTA-Maintained Trench Bridges

(Superstructure and substructure, roadway surface maintenance by others)

Description	Location	Type	Crossing Number	Reference DWG	Length	# of Spans	Width	Surface Maintenance
25th Street Overpass	25th Street over Trench e/o Alameda Street	4 Lane Road on Precast Concrete Girders with Cast in Place Concrete Deck	114-0.70-A	Segment 2 S-500 to S-522	51'-0"	1	180'-6"	Vernon
27th Street Overpass	27th Street over Trench on West Alameda St.	2 Lane Road on Precast Concrete Girders with Cast in Place Concrete Deck	114-0.80-A	Segment 2 S-400 to S-424	51'-0"	1	162'-7⅛"	City of LA
38th / 41st Street Overpass	38th / 41st Street across the trench adjacent to Alameda Street	2 Lane Road Precast Concrete Girders with Cast in Place Concrete Deck	114-1.20-A	Segment 2 S-300 to S-325	51'-0"	1	251'-6"	City of LA
Vernon Ave. Overpass	Vernon Ave. across the trench adjacent to Alameda Street	4 Lane Road on Precast Concrete Girders with Cast in Place Concrete Deck	114-1.50-A	Segment 2 S-200 to S-220	51'-0"	1	168'-6"	City of LA
55th Street Overpass	55th Street across the trench adjacent to Alameda Street	2 Lane Road on Precast Concrete Girders with Cast in Place Concrete Deck	114-2.20-A	Segment 2 S-100 to S-121	51'-0"	1	158'-6"	City of LA
Slauson Ave. and Railroad Overpass	Slauson Ave. and Railroad track across the trench adjacent to Alameda Street	6 Lanes (4 thru & 2 turn) & Railroad Track on Precast Concrete Girders with Cast in Place Concrete Deck	114-2.50-A 114-2.50-AT	Segment 3 S-201 to S-225	51'-0"	1	143'-8⅝"	Huntington Park
Randolph Street and Railroad Overpass	Randolph Street and Railroad track across the trench adjacent to Alameda Street	4 Lanes & Railroad Track on Precast Concrete Girders with Cast in Place Concrete Deck	114.2.60-A 114-2.60-AT	Segment 3 S-101 to S-123	51'-0"	1	175'-5⅝"	Huntington Park
Gage Ave. Overpass	Gage Ave across the trench adjacent to Alameda Street	5 Lanes (4 thru & 1 turn) on Precast Concrete Girders with Cast in Place Concrete Deck	114-3.00-A	Segment 3 S-501 to S-518	51'-0"	1	104'-0" pp	Huntington Park

Description	Location	Type	Crossing Number	Reference DWG	Length	# of Spans	Width	Surface Maintenance
Zoe Ave. Overpass	Zoe Ave across the trench adjacent to Alameda Street	4 Lanes (1 thru & 3 turn) on Precast Concrete Girders with Cast in Place Concrete Deck	114-3.15-A	Segment 3 S-401 to S-418	51'-0"	1	80'-0"	Huntington Park
Florence Ave. Overpass	Florence Ave across the trench adjacent to Alameda Street	5 Lanes (4 thru & 1 turn) on Precast Concrete Girders with Cast in Place Concrete Deck	114-3.50-A	Segment 3 S-301 to S-318	51'-0"	1	128'-0"	County of LA
74th St / shopping center access	Shopping center access across the trench adjacent to Alameda Street	Access Driveway on Precast Concrete Girders with Cast in Place Concrete Deck. Built by County after Corridor completion	114-3.60-A	LA County contract plans	51'-0"	1	48'-0"	County of LA
76th St / Metro Commercial Overpass	Metro Commercial Access across the trench adjacent to Alameda Street	Access Driveway on Precast Concrete Girders with Cast in Place Concrete Deck	114-3.76-A	Segment 3 S-601 to S-619	51'-0"	1	48'-0"	County of LA
Nadeau Street Overpass	Nadeau St across the trench adjacent to Alameda Street	5 Lanes (4 thru & 1 turn) on Precast Concrete Girders with Cast in Place Concrete Deck	114-4.00-A	Segment 3 S-201 to S-218	51'-0"	1	104'-0"	County of LA
Engle Driveway Overpass	Engle Driveway across Alameda Trench	Driveway Access on Precast Concrete Girders with Cast in Place Concrete Deck	114-4.40-A	Segment 3 S-101 to S-118	51'-0"	1	48'-0"	County of LA
Hon Driveway	Hon Driveway across Alameda Trench	Driveway Access on Precast Concrete Girders with Cast in Place Concrete Deck	114-4.60-A	Segment 4 S-401 to S-419	51'-0"	1	48'-0"	County of LA
Firestone Blvd Overpass	Firestone Blvd across the trench adjacent to Alameda Street	5 Lanes (4 thru & 1 turn) on Precast Concrete Girders with Cast in Place Concrete Deck	114-4.67-A	Segment 4 S-301 to S-319	51'-0"	1	144'-0"	County of LA
92nd St. / Southern Ave. Overpass	92 St / Southern Ave across the trench adjacent to Alameda Street	4 Lanes (3 thru & 1 turn) on Precast Concrete Girders with Cast in Place Concrete Deck	114-5.00-A	Segment 4 S-201 to S-218	51'-0"	1	96'-0"	County of LA

Description	Location	Type	Crossing Number	Reference DWG	Length	# of Spans	Width	Surface Maintenance
Tweedy Blvd Overpass	Tweedy Blvd across the trench adjacent to Alameda Street	4 Lanes (2 thru & 2 turn) on Precast Concrete Girders with Cast in Place Concrete Deck	114-5.50-A	Segment 4 S-101 to S-118	51'-0"	1	104'-0"	County of LA
Martin Luther King Jr Blvd Overpass	Martin Luther King Jr across the trench adjacent to Alameda Street	6 Lanes (2 thru & 4 turn) on Precast Concrete Girders with Cast in Place Concrete Deck	114-6.00-A	Segment 5 S-401 to S-418	51'-0"	1	128'-0"	Lynwood
Santa Ana Blvd / Fernwood Ave Overpass	Santa Ana Blvd / Fernwood Ave across the trench adjacent to Alameda Street	3 Lanes (2 thru & 1 turn) on Precast Concrete Girders with Cast in Place Concrete Deck	114-6.40-A	Segment 5 S-301 to S-318	51'-0"	1	112'-0"	County of LA
Imperial Hwy Overpass	Imperial Hwy across the trench adjacent to Alameda Street	6 Lane Road on Precast Concrete Girders with Cast in Place Concrete Deck	114-6.64-A	Segment 5 S-201 to S-218	51'-0"	1	136'-0"	County of LA
Lynwood Rd. Overpass	Lynwood Rd across the trench adjacent to Alameda Street	4 Lanes (1 thru & 3 turn) on Precast Concrete Girders with Cast in Place Concrete Deck	114-6.90-A	Segment 5 S-101 to S-118	51'-0"	1	88'-0"	Lynwood
124th St / Weber St Overpass	124 St / Weber St across the trench adjacent to Alameda Street	4 Lanes (2 thru & 2 turn) on Precast Concrete Girders with Cast in Place Concrete Deck	114-7.30-A	Segment 6 S-501 to S-517	51'-0"	1	80'-0"	County of LA
El Segundo Blvd Overpass	El Segundo Blvd across the trench adjacent to Alameda Street	6 Lanes (3 thru & 3 turn) on Precast Concrete Girders with Cast in Place Concrete Deck	114-7.60-A	Segment 6 S-401 to S-419	51'-0"	1	128'-0"	County of LA
134th St / Pine St Overpass	134 St / Pine St across the trench adjacent to Alameda Street	4 Lanes (2 thru & 2 turn) on Precast Concrete Girders with Cast in Place Concrete Deck	114-7.90-A	Segment 6 S-301 to S-317	51'-0"	1	96'-0"	County of LA

Description	Location	Type	Crossing Number	Reference DWG	Length	# of Spans	Width	Surface Maintenance
Elm Street Overpass	Elm Street across the trench adjacent to Alameda Street	5 Lanes on Precast Concrete Girders with Cast in Place Concrete Deck	114-8.60-A	Segment 6 S-201 to S-217	51'-0"	1	96'-0"	Compton
Palmer St Overpass & Plaza	Palmer Street and Pedestrian Plaza across the trench adjacent to Alameda Street	4 Lanes and Plaza on Precast Concrete Girders with Cast in Place Concrete Deck	114-8.80-A	Segment 6 S-101 to S-116A	51'-0"	1	208'-0"	Compton
Compton Blvd Overpass & Plaza	Compton Blvd and Pedestrian Plaza across the trench adjacent to Alameda Street	6 Lanes and Plaza on Precast Concrete Girders with Cast in Place Concrete Deck	114-9.00-A	Segment 7 S-401 to S-419	51'-0"	1	272'-0"	Compton
Myrrh Street Overpass & Plaza	Myrrh St and Pedestrian Plaza across the trench adjacent to Alameda Street	5 Lanes and Plaza on Precast Concrete Girders with Cast in Place Concrete Deck	114-9.20-A	Segment 7 S-301 to S-318	51'-0"	1	208'-0"	Compton
Alondra Blvd Overpass	Alondra Blvd across the trench adjacent to Alameda Street	7 Lane Road on Precast Concrete Girders with Cast in Place Concrete Deck	114-9.50-A	Segment 7 S-201 to S-218	51'-0"	1	104'-0"	Compton
Greenleaf Blvd Overpass	Greenleaf Blvd across the trench adjacent to Alameda Street	6 Lanes (4 thru & 2 turn) on Precast Concrete Girders with Cast in Place Concrete Deck	114-10.00-A	Segment 7 S-101 to S-120	51'-0"	1	104'-0"	Compton

Maintenance of Way Services

Appendix H

Roadway/Highway and Railroad Crossing List

Alameda Corridor
Roadway/Highway and Railroad Crossings
(At-grade shaded)

Street Name	Corridor Station	Milepost	Jurisdiction	Type of Crossing
Washington Blvd. Rail Bridge	115+00	0	Los Angeles	Undercrossing
Santa Fe Ave. Bridge	122+45	0.16	Los Angeles	Undercrossing
Santa Fe Ave./Hi-Rail Access	122+00		Los Angeles	Private/At-Grade
25th St. Bridge	149+50	0.7	Vernon	Overcrossing
27th St. Bridge	157+38	0.82	Vernon	Overcrossing
38th/41st St. Bridge	175+44	1.2	Vernon	Overcrossing
Vernon Ave. Bridge	190+50	1.5	Vernon	Overcrossing
55th St. Bridge	230+20	2.2	Vernon	Overcrossing
BNSF Harbor Subdivision Rail Bridge	244+12	2.46	Huntington Park	Overcrossing
Slauson Ave. Bridge	244+13	2.46	Huntington Park	Overcrossing
UPRR La Habra Branch Rail Bridge	253+42	2.64	Huntington Park	Overcrossing
Randolph St. Bridge	253+98	2.64	Huntington Park	Overcrossing
Gage Ave. Bridge	272+00	2.99	Huntington Park	Overcrossing
Zoe Ave. Bridge	280+11	3.14	Huntington Park	Overcrossing
Florence Ave. Bridge	297+69	3.48	Huntington Park	Overcrossing
74th St. Bridge	304+18	3.6	Walnut Park	Overcrossing
Metro Comm. Driveway (76th St) Bridge	312+53	3.76	Walnut Park	Overcrossing
Nadeau St. Bridge	324+47	3.99	Walnut Park	Overcrossing
Engle Entrance Bridge	346+28	4.4	Walnut Park	Overcrossing
Hon Entrance Bridge	355+79	4.58	South Gate	Overcrossing
Firestone Blvd. Bridge	360+52	4.67	South Gate	Overcrossing
92nd St./Southern Ave. Bridge	376+85	4.98	South Gate	Overcrossing
Tweedy Blvd. Bridge	401+76	5.45	South Gate	Overcrossing
Martin Luther King Blvd. Bridge	432+60	6.03	Lynwood	Overcrossing
Santa Ana Blvd./Fernwood Ave. Bridge	453+56	6.43	Lynwood	Overcrossing
Imperial Hwy. Bridge	462+95	6.61	Lynwood	Overcrossing
105 Fwy./Metro Green Line Bridge	464+50	6.64	Lynwood	Overcrossing
Lynwood Rd. Bridge	477+90	6.89	Lynwood	Overcrossing
124th St/Weber Ave. Bridge	500+18	7.31	Compton	Overcrossing
El Segundo Blvd. Bridge	513+44	7.56	Compton	Overcrossing
134th St/Pine St. Bridge	533+28	7.94	Compton	Overcrossing
Rosecrans Ave. Bridge	560+70	8.46	Compton	Overcrossing
Elm St. Bridge	570+35	8.64	Compton	Overcrossing
Palmer St. Bridge	579+80	8.81	Compton	Overcrossing
Compton Blvd. Bridge	587+63	8.97	Compton	Overcrossing
Myrrh St. Bridge	600+85	9.22	Compton	Overcrossing
Alondra Blvd. Bridge	614+91	9.43	Compton	Overcrossing
Greenleaf Blvd. Bridge	641+74	9.99	Compton	Overcrossing
Artesia Blvd.	667+42	10.48	Compton	Overcrossing
Artesia/ Hi-Rail Access	669+00	10.54	Compton	Private/At-Grade
SR91 Fwy. Bridge	670+20	10.54	Compton	Overcrossing
Artesia Fwy. (onramp) Bridge	673+65	10.71	Compton	Overcrossing

Alameda Corridor
Roadway/Highway and Railroad Crossings
(At-grade shaded)

Street Name	Corridor Station	Milepost	Jurisdiction	Type of Crossing
Compton Creek Bridge	673+65	10.71	Compton	Railroad Bridge
MTA Blue Line Bridge	714+00	11.36	Rancho Dominguez	Overcrossing
Alameda St. Bridge	717+80	11.43	Rancho Dominguez	Undercrossing
Del Amo Blvd. Bridge	770+63	12.43	Rancho Dominguez	Overcrossing
Carson St. Bridge	825+90	13.48	Carson	Overcrossing
Dolores Yard Ped Tunnel	837+14	13.7	Carson	Undercrossing
San Diego Fwy. Bridge	851+35	13.95	Carson	Overcrossing
223rd St. Bridge	855+25	14.04	Carson	Overcrossing
Dominguez Channel Rail Bridge	888+80	14.68	Carson	Railroad Bridge
Sepulveda Blvd. Bridge	916+80	15.2	Carson	Overcrossing
Watson At-Grade Private Crossing	950+00	15.84	Carson	Private/At-Grade
UPRR San Pedro Branch Diamonds	966+70	16.15	Carson	Rail to Rail Crossing
Thenard Wye At-Grade Crossing	N/A		Los Angeles	At Alameda Street
Alameda St. Rail Bridge	967+60	16.16	Los Angeles	Undercrossing
Pacific Coast Hwy Bridge	982+43	16.4	Los Angeles	Overcrossing
Pacific Coast Hwy Private Crossing	982+29	16.44	Los Angeles	Private/At-Grade
Long Beach Lead Diamonds	1002+50	16.83A	Los Angeles	Rail to Rail Crossing
Private Crossing		16.93	Los Angeles	Private/At-Grade
POLB Lead Rail Bridge (Dominguez Channel)	1009+50	16.96B	Los Angeles	Railroad Bridge
Manuel Subdivision Diamonds		17.1	Los Angeles	Rail to Rail Crossing
Terminal Island Fwy Bridge (LB Lead)	1036+14	17.45B	Los Angeles County	Overcrossing
Anaheim St. Bridge (LB Lead)	1045+65	17.63B	Los Angeles County	Overcrossing
Opp St. At-Grade Private Crossing	1009+80	16.97A	Los Angeles	Private/At-Grade
Anaheim St. Bridge	1019+60	17.15A	Los Angeles	Overcrossing
Henry Ford Viaduct/End of Corridor Rail Bridge	1031+00	17.35A	Los Angeles	Undercrossing
Henry Ford Ave Grade Crossing	1030+00		Los Angeles	3 Sets of Gates
Henry Ford Ave Hwy Bridge Over Dominguez Channel	1037+00	17.49	Los Angeles	
				rev. 7/25/2024

Alameda Corridor
Roadway/Highway and Railroad Crossings
(At-grade shaded)

ID #	Street Name	Corridor Station	Milepost	Jurisdiction	Type of Crossing
16	Washington Blvd. Rail Bridge	115+00	0	Los Angeles	Undercrossing
17	Santa Fe Ave. Bridge	122+45	0.16	Los Angeles	Undercrossing
	Santa Fe Ave./Hi-Rail Access	122+00		Los Angeles	At-Grade
18	25th St. Bridge	149+50	0.67	Vernon	Overcrossing
19	27th St. Bridge	157+38.12	0.82	Vernon	Overcrossing
20	38th/41st St. Bridge	175+48.79	1.16	Vernon	Overcrossing
21	Vernon Ave. Bridge	190+38.99	1.45	Vernon	Overcrossing
22	55th St. Bridge	230+31.18	2.2	Vernon	Overcrossing
	BNSF Harbor Subdivision Rail Bridge	244+12	2.46	Huntington Park	Overcrossing
23	Slauson Ave. Bridge	244+12.51	2.46	Huntington Park	Overcrossing
	UPRR La Habra Branch Rail Bridge	253+41.53	2.64	Huntington Park	Overcrossing
24	Randolph St. Bridge	253+41.53	2.64	Huntington Park	Overcrossing
25	Gage Ave. Bridge	271+98.81	2.99	Huntington Park	Overcrossing
26	Zoe Ave. Bridge	280+11.00	3.14	Huntington Park	Overcrossing
27	Florence Ave. Bridge	297+68.56	3.48	Huntington Park	Overcrossing
28a	74st St. Bridge	304+17.66	3.6	Walnut Park	Overcrossing
28	Metro Comm. Driveway (76st St) Bridge	312.56	3.76	Walnut Park	Overcrossing
29	Nadeau St. Bridge	324+47.86	3.99	Walnut Park	Overcrossing
30	Engle Entrance Bridge	346+27.95	4.4	Walnut Park	Overcrossing
31	Hon Entrance Bridge	355+79.05	4.58	South Gate	Overcrossing
32	Firestone Blvd. Bridge	360+52.16	4.67	South Gate	Overcrossing
33	92nd St./Southern Ave. Bridge	376+85.39	4.98	South Gate	Overcrossing
34	Tweedy Blvd. Bridge	401+76.48	5.45	South Gate	Overcrossing
35	Martin Luther King Blvd. Bridge	432+60.75	6.03	Lynwood	Overcrossing
36	Santa Ana Blvd./Fernwood Ave. Bridge	453+56.05	6.43	Lynwood	Overcrossing
37	Imperial Hwy. Bridge	463+11.16	6.61	Lynwood	Overcrossing
38/39	105 Fwy./Metro Green Line Bridge	464+50	6.64	Lynwood	Overcrossing
40	Lynwood Rd. Bridge	477+89.30	6.89	Lynwood	Overcrossing
41	124th St/Weber Ave. Bridge	500+18.39	7.31	Compton	Overcrossing
42	El Segundo Blvd. Bridge	513+44.79	7.56	Compton	Overcrossing
43	134th St/Pine St. Bridge	533+52.00	7.94	Compton	Overcrossing
44	Rosecrans Ave. Bridge	560+70.00	8.46	Compton	Overcrossing
45	Elm St. Bridge	570+33.29	8.64	Compton	Overcrossing
46	Palmer St. Bridge	579+08.44	8.81	Compton	Overcrossing
47	Compton Blvd. Bridge	587+63.26	8.97	Compton	Overcrossing
48	Myrrh St. Bridge	600+86.51	9.22	Compton	Overcrossing
49	Alondra Blvd. Bridge	614+80.49	9.43	Compton	Overcrossing
50	Greenleaf Blvd. Bridge	641+73.83	9.99	Compton	Overcrossing
51	Artesia Blvd.	667+41.13	10.48	Compton	Overcrossing
	Artesia/ Hi-Rail Access	669+00	10.54	Compton	At-Grade
52	SR91 Fwy. Bridge	670+20	10.48	Compton	Overcrossing
53	Artesia Fwy. (onramp) Bridge	673+65	10.71	Compton	Overcrossing
55	Compton Creek Bridge	673+65	10.71	Compton	Railroad Bridge

Alameda Corridor
Roadway/Highway and Railroad Crossings
(At-grade shaded)

54	MTA Blue Line Bridge	714+00	11.36	Rancho Dominguez	Overcrossing
56	Alameda St. Bridge	717+80	11.43	Rancho Dominguez	Undercrossing
57	Del Amo Blvd. Bridge	770+30	12.43	Rancho Dominguez	Overcrossing
58	Carson St. Bridge	825+90	13.48	Carson	Overcrossing
59	San Diego Fwy. Bridge	851+35	13.95	Carson	Overcrossing
60	223rd St. Bridge	855+25	14.04	Carson	Overcrossing
61	Dominguez Channel Rail Bridge	888+80	14.68	Carson	Overcrossing
63	Sepulveda Blvd. Bridge	916+80	15.2	Carson	Overcrossing
	Watson At-Grade Private Crossing	950+00	15.84	Carson	At-Grade/Private
	UPRR San Pedro Branch Diamonds	966+70	16.15	Carson	Rail to Rail Crossing
	Thenard Wye At-Grade Crossing	N/A		Los Angeles	At Alameda Street
64	Alameda St. Rail Bridge	967+60	16.16	Los Angeles	Undercrossing
65	Pacific Coast Hwy Bridge	982+43	16.16	los Angeles	Overcrossing
	Pacific Coast Hwy Private Crossing	982+29	16.44	Los Angeles	At-Grade/ HR Access
	Long Beach Lead Diamonds	1002+50	16.83A	Los Angeles	Rail to Rail Crossing
67	POLB Lead Rail Bridge	1009+50	16.96B	Los Angeles	Railroad Bridge
68	Terminal Island Fwy Bridge (LB Lead)	1036+14	17.45B	Los Angeles County	Overcrossing
69	Anaheim St. Bridge (LB Lead)	1045+65	17.63B	Los Angeles County	Overcrossing
	Opp St. At-Grade Private Crossing	1010+10	16.97A	Los Angeles	Private/At-Grade
70	Anaheim St. Bridge	1019+60	17.15A	Los Angeles	Overcrossing
71-74	Henry Ford Viaduct/End of Corridor Rail Bridge	1031+00	17.35A	Los Angeles	Undercrossing
	Henry Ford Ave Grade Crossing	1030+00		Los Angeles	3 Sets of Gates
75	Henry Ford Ave Hwy Bridge Over Dominguez Channel	1037+00	17.49	Los Angeles	
76	Henry Ford Ave Rail Bridge Over Dominguez Channel			Los Angeles	Railroad Bridge
					rev. 12/30/2016

Alameda Corridor
Roadway/Highway and Railroad Crossings
(At-grade shaded)

ID #	Street Name	Corridor Station	Milepost	Jurisdiction	Type of Crossing
	Perrino Place Grade Crossing	0	0	Los Angeles	At-Grade
16	Washington Blvd. Rail Bridge	114+00	0	Los Angeles	Undercrossing
17	Santa Fe Ave. Bridge	122+49.11	0.16	Los Angeles	Undercrossing
	Santa Fe Ave./Hi-Rail Access	0	0	Los Angeles	At-Grade
18	25th St. Bridge	149+53.55	0.67	Vernon	Overcrossing
19	27th St. Bridge	157+38.12	0.82	Vernon	Overcrossing
20	38th/41st St. Bridge	175+48.79	1.16	Vernon	Overcrossing
21	Vernon Ave. Bridge	190+38.99	1.45	Vernon	Overcrossing
22	55th St. Bridge	230+31.18	2.2	Vernon	Overcrossing
23	Slauson Ave. Bridge	244+12.51	2.46	Huntington Park	Overcrossing
	BNSF Harbor Subdivision Rail Bridge	244+12	2.46	Huntington Park	Overcrossing
24	Randolph St. Bridge	253+41.53	2.64	Huntington Park	Overcrossing
	UPRR La Habra Branch Rail Bridge	253+41.53	2.64	Huntington Park	Overcrossing
25	Gage Ave. Bridge	271+98.81	2.99	Huntington Park	Overcrossing
26	Zoe Ave. Bridge	280+11.00	3.14	Huntington Park	Overcrossing
27	Florence Ave. Bridge	297+68.56	3.48	Huntington Park	Overcrossing
28a	74st St. Bridge	304+17.66	3.6	Walnut Park	Overcrossing
28	Metro Comm. Driveway (76st St) Bridge	312.56	3.76	Walnut Park	Overcrossing
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33	92nd St./Southern Ave. Bridge	376+85.39	4.98	South Gate	Overcrossing
34	Tweedy Blvd. Bridge	401+76.48	5.45	South Gate	Overcrossing
35	Martin Luther King Blvd. Bridge	432+60.75	6.03	Lynwood	Overcrossing
36	Santa Ana Blvd./Fernwood Ave. Bridge	453+56.05	6.43	Lynwood	Overcrossing
37	Imperial Hwy. Bridge	463+11.16	6.61	Lynwood	Overcrossing
38/39	105 Fwy./Metro Green Line Bridge	0	6.64	Lynwood	Overcrossing
40	Lynwood Rd. Bridge	477+89.30	6.89	Lynwood	Overcrossing
41	124th St/Weber Ave. Bridge	500+18.39	7.31	Compton	Overcrossing
42	El Segundo Blvd. Bridge	513+44.79	7.56	Compton	Overcrossing
43	134th St/Pine St. Bridge	533+52.00	7.94	Compton	Overcrossing
44	Rosecrans Ave. Bridge	560+70.00	8.46	Compton	Overcrossing
45	Elm St. Bridge	570+33.29	8.64	Compton	Overcrossing
46	Palmer St. Bridge	579+08.44	8.81	Compton	Overcrossing
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49	Alondra Blvd. Bridge	614+80.49	9.43	Compton	Overcrossing
50	Greenleaf Blvd. Bridge	641+73.83	9.99	Compton	Overcrossing
51/52	Artesia Blvd. / SR91 Fwy Bridge	667+41.13	10.48	Compton	Overcrossing
	Artesia/ Hi-Rail Access	0	10.54	Compton	At-Grade
53	Artesia Fwy. (onramp) Bridge	0	10.61	Compton	Overcrossing
55	Compton Creek Bridge	673+65	10.71	Compton	Railroad Bridge
54	MTA Blue Line Bridge	714+00	11.36	Rancho Dominguez	Overcrossing

Alameda Corridor
Roadway/Highway and Railroad Crossings
(At-grade shaded)

56	Alameda St. Bridge	717+80	11.43	Rancho Dominguez	Undercrossing
57	Del Amo Blvd. Bridge	770+30	12.43	Rancho Dominguez	Overcrossing
58	Carson St. Bridge	825+90	13.48	Carson	Overcrossing
59	San Diego Fwy. Bridge	851+35	13.95	Carson	Overcrossing
60	223rd St. Bridge	855+25	14.04	Carson	Overcrossing
61	Dominguez Channel Rail Bridge	888+80	14.68	Carson	Overcrossing
63	Sepulveda Blvd. Bridge	916+80	15.2	Carson	Overcrossing
	Watson At-Grade Private Crossing	0????	0????	Carson	At-Grade/Private
	UPRR San Pedro Branch Diamonds	966+70	16.15	Carson	Rail to Rail Crossing
	Thenard Wye At-Grade Crossing			Los Angeles	At Alameda Street
64	Alameda St. Rail Bridge	967+60	16.16	Los Angeles	Undercrossing
65	Pacific Coast Hwy Bridge	982+15	16.16	los Angeles	Overcrossing
	Pacific Coast Hwy Private Crossing	982+15	16.44	Los Angeles	At-Grade/ HR Access
	Long Beach Lead Diamonds	1002+50	16.83A	Los Angeles	Rail to Rail Crossing
67	POLB Lead Rail Bridge	1009+50	16.96B	Los Angeles	Railroad Bridge
68	Terminal Island Fwy Bridge (LB Lead)	1036+14	17.45B	Los Angeles County	Overcrossing
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	Opp St. At-Grade Private Crossing	1010+10	16.97A	Los Angeles	Private/At-Grade
70	Anaheim St. Bridge	1019+60	17.15A	Los Angeles	Overcrossing
71-74	Henry Ford Viaduct/End of Corridor Rail Bridge	1031+00	17.35A	Los Angeles	Undercrossing
	Henry Ford Ave Grade Crossing	1030+00		Los Angeles	3 Sets of Gates
75	Henry Ford Ave Hwy Bridge Over Dominguez Channel	1037+00	17.49	Los Angeles	
76	Henry Ford Ave Rail Bridge Over Dominguez Channel			Los Angeles	Railroad Bridge
					rev. 12/02/2016

Maintenance of Way Services

Appendix I

Pump Stations-Discharge Sequence and Operation and Maintenance Manual

GREENLEAF AND NADEAU PUMP STATIONS

OPERATION AND MAINTENANCE MANUAL

TABLE OF CONTENTS

Page

1. INTRODUCTION

The Mid-Corridor Trench pump stations are located on the east side of the trench near Nadeau Street and on the west side of the trench near Greenleaf Boulevard and provide flooding protection for the Mid-Corridor Trench. The watershed area drained by the pump stations extends the full width and length of the trench and includes the area between about Santa Fe Avenue to the north and State Route 91 (SR-91) Artesia Freeway to the south. At each end, where the tracks reach the elevation of the adjacent ground, there is a flood barrier. The barrier is intended to prevent the intrusion of runoff and flood waters from outside of the trench into the trench storm water removal systems.

Each pump station contains four sets of pumps that perform different functions. In addition, there is an extensive list of supporting equipment including control systems, power supply, ventilation equipment, control building and related facilities. The two pump stations have a slightly different layout due to their size limitations, but contain the same amount of equipment, and have the same logic for operation.

There are a total of 11 pumps at each pump station and are labeled groundwater pumps, first flush pumps, storm water pumps and sump pumps. These are described below.

Groundwater Pumps - The groundwater pumps are submersible pumps that discharge clean-up/wash-down flows, infiltrating ground waters, and storm water runoff from the initial start of a rain event (<0.10" of rain) into the Los Angeles County Sanitation District (LACSD) sanitary sewer system. There are 2 groundwater pumps in each of the groundwater wet wells with one set as the lead pump and the other set as the lag pump. The discharge from these pumps is regulated by a LACSD industrial waste permit. However, in order to access the LACSD sanitary sewer at the Nadeau Pump Station, the discharge must first flow through a small section of sewer pipe owned by the Los Angeles County Department of Public Works (LACDPW). Therefore, there is a second industrial waste permit from LACDPW regulating the discharge. At both locations, the industrial waste permits regulate the daily discharge volume, flow rate, hours of discharge, and concentrations of compounds. These pumps are linked to a combustible gas sensor and rain gauge to prevent unauthorized discharges into the LACSD sanitary sewer and a flow meter for monitoring purposes. The groundwater wet well was designed to store the volume of one tank car in the event of a serious accident.

First Flush Pumps – The first flush pumps are rotary lobe pumps that discharge between 0.1" and 0.5" of rain (following the shutdown of the groundwater pumps), mechanical failure of the groundwater pumps, or if a large rain event occurs and overcomes the pumping capacity of the groundwater pumps. There are 3 first flush pumps in each of the first flush wet wells with one set as a lead pump, two set as a lag pumps. Their discharge flows into a series of oil/water separators to remove contaminants before discharging into the closest surface water body via the local storm drain system. The discharge from these pumps is regulated by a National Pollutant Discharge Elimination System (NPDES) permit. To support the work of the oil/water separators, there is an alum metering system and an activated carbon drum system.

Storm Water Pumps – The storm water pumps are vertical turbine pumps that discharge greater than 0.5” of rain or if a large rain event occurs and overcomes the pumping capacity of the groundwater and first flush pumps. There are 4 storm water pumps in each of the storm water wet wells with one set as a lead pump, and the other 3 set as lag pumps. Their discharge flows directly into the closest surface water body via the local storm drain system regulated by a NPDES permit.

Clean-out Sump Pumps - The sump pumps are 2 additional submersible pumps with one located in the first flush wet well and a second located in the storm water wet well. These pumps are used at the end of the rainy season to completely empty these 2 wet wells for maintenance purposes and to prevent the breeding of mosquitos and other insects.

The groundwater, first flush and storm water pump systems are connected to their own individual magnetic flow meters which measure and indicate both the instantaneous flow rate and the total flow quantity (to date) for each system. The groundwater pumps are linked to its magnetic flow meter to prevent unauthorized discharges into the LACSD sanitary sewer and through a small portion of the LACDPW sanitary system. If the total daily flow quantity is exceeded per the set volume included in the permits, the programmable logic control (PLC) will shut down the groundwater pumps until the following day. The first flush and storm water pump systems do not have the same restrictions. Service water is available near each of these pumping systems as well as at grade near the alum system to allow for clean-up and hosing down. Additionally, it may be used to fill the wet wells in order to calibrate, and/or operate the pumps for maintenance purposes.

There are many types of valves included throughout each of the pump stations and these are used to isolate pumps and separators, control flow rate and direction, for the purpose of safety and when service or repairs are needed on a specific unit.

There are two different types of fan units, one to provide air changes in the main control building (exhaust fan) and one to facilitate air changes in the wet wells (ventilator).

The following sections identify and describe the above mentioned equipment, purpose of this equipment, relationship to adjacent units, operation, controls, operational problems and maintenance. Refer to the attached as-built mechanical drawings for the location of this equipment at the Greenleaf and Nadeau Pump Stations.

2. GROUNDWATER PUMP

2.1 PURPOSE: To discharge clean-up/wash-down flows, infiltrating ground waters, and storm water runoff from the initial start of a rain event (less than 0.1" of rain) into the Los Angeles County Sanitation District (LACSD) sanitary sewer system.

2.2 EQUIPMENT: Two (2) constant speed submersible pumps (P-101/102 Greenleaf Pump Station [GPS] and P-601/602 Nadeau Pump Station [NPS]) are provided to pump the waste waters, ground waters, and/or storm waters from the groundwater sump into the LACSD sanitary sewer. One pump is placed on lead and the other is on lag. These designations are manually rotated throughout the year to extend the life of each pump.

A mercury float switch system consisting of two (2) floats, LSL-103/LSH-103 GPS and LSL-603/LSH-603 NPS are provided to control pump operation.

2.3 RELATIONSHIP TO ADJACENT UNITS

During wet weather periods, if the water level in the wet well continues to rise and exceeds the high level setting, LSH-103 NPS and LSH-603 GPS, the water will eventually flow over the weir baffle into the adjacent first flush pump wet well while the pumps are pumping. The operating groundwater pump will be stopped by the signal from the level switch LSH-110 GPS and LSH-610 NPS in the first flush pump wet well, which will also activate the operation of first flush pump, or the rain gauge level switch LS-105 GPS and LS-605 NPS, where the rainfall indicator is set at 0.1" level. Note: the rain gauge level switch will be reset 2 hours and 45 minutes after the end of the rain event and the groundwater pumps will resume operation.

A combustible gas sensor, AE-112 GPS and AE-612 NPS, is installed about one foot below the galvanized steel grating, which is directly above the groundwater pumps, to detect the presence of combustible gases in the groundwater pump wet wells.

At any time when the catalytic bead combustible gas sensor detects any combustible gases with a concentration at 15% lower explosive limit (LEL) the sensor switch, ASH-11 GPS and ASH-612 NPS, will actuate an alarm at the PLC cabinet in the control building and at the Alameda Corridor Control Center through the common alarm. The alarm will remain indicating on the PLC cabinet until it is manually reset. Should the combustible gas level reach the upper alarm level (20% LEL), the sensor switch ASSHH-12 GPS and ASHH-612 NPS will shut down the operation of the groundwater pumps and actuate an alarm at the PLC panel and at the Alameda Corridor Control Center through the common alarm. The sensor switch ASHH-112 GPS and

ASHH-612 NPS will also prevent the first flush pumps and ventilator from running until the alarm is manually reset.

Magnetic flow meters, FE-104 GPS and FE-604 NPS, sense the pump discharge and instantly record the flow rate and total flow quantity on the indicator / transmitter device, which is integrally mounted directly on the flow meter. The device also transmits the flow rates to the PLC cabinet in the pump control building for recording. Should the daily flow quantity reached the LACSD permitted limits (36,000 gallons per day [gpd] GPS and 19,200 gpd NPS), the operating groundwater pump will be stopped by the signal from the magnetic flow meters and will also activate the operation of first flush pumps.

2.4 OPERATION

2.4.1 Initial Start-up before Operation

1. Check for proper cleanliness (free of sediment, trash, etc.) of the pump wet well to avoid damage to the pump casing and impeller.
2. If the pumps is being lowered down along guide bars to the discharge head connection, check to be sure that the pump casing nozzle is properly engaged with the discharge head.
3. Check pump discharge valves for proper operation.
4. Verify the level sensors are operational.
5. Check to be sure that the wet well is filled with water before the pumps are run for any period of time.

Each pump should be started by placing the selector switch in the “HAND” position on the control building panel with the operator inspecting for excessive noise, vibration, etc. If it runs smoothly, it should be placed in the normal mode of operation (“AUTO” position), which will be controlled by the settings of the level switches (LSL-105/LSH-105 GPS and LSL-605/LSH-605 NPS). When the pump is in the operation, all of the valves and piping associated with the pump operation should be checked for leaks and proper operation. The magnetic flow meter (FE-104 GPS and FE-604 NPS) on the pump discharge manifold should be checked to verify the readout of the total pumping flow rate.

2.4.2 Normal Operation

Operation of the groundwater pumps include the automatic starting and stopping of the pumps by the level switches, rain gauge or combustible gas sensor. The selector switch should be placed in the “AUTO” position on the control building panel during normal operation. The level switches in the pump wet well will automatically control the pumping operation in response to the water level in the wet well. The wet well water levels at which the float switches automatically start and stop the pumps are as follows:

Level Switches	Activated Elevation	Function
LSH-103 GPS/LSH-603 NPS	3’-0” from floor	Start Pump
LSL-103 GPS/LSL-603 NPS	12” from floor	Stop Pump

2.4.3 Emergency Operation

The groundwater storage provided in the wet well was designed to have sufficient capacity to hold a full tank cargo volume of the freight train in the event of an accident. In the event of a tank cargo spillage, the groundwater pumps should only be operated in “HAND” mode (manual) or turned off. The operator has to be present at the site to make sure there are no pollutants discharged into the LACSD sanitary sewer that exceed discharge limits and should act in accordance with the ACTA Emergency Response Plan. Depending on the analytical results, the spillage may have to be removed by vacuum truck for off-site disposal.

If the combustible gas sensor detects combustible gases in the wet well, and activates the sensor alarm at 20% LEL, the operation of the groundwater pumps will be shut down completely. The operator should investigate the condition in accordance with the ACTA Emergency Response Plan.

If the lead pump breaks down, a visual alarm will be indicated at the PLC panel and at the Alameda Corridor Control Center through the common alarm. The lag pump should be placed into service. The inoperative pump should be taken out of service by turning it off (placing it in the “OFF” mode) and inserting a lock out/tag out tag in the handle to prevent it from being used. The operator should investigate the condition of the pump and determine if it can be repaired or should be replaced. In any case, the inoperative unit should be put back into service as soon as possible.

2.5 CONTROLS

2.5.1 Flow Control

Since the groundwater pumps are of the centrifugal type pump, the flow rates will vary. At a minimum, once a year the flow rate should be checked to ensure that it does not exceed the specified LACSD industrial waste permit peak flow rates (300 gallons per minute [gpm] GPS and 150 gpm NPS). The flow rates are controlled by the pump discharge valves.

Due to the vibration caused by the movement of trains, this discharge valve may be effected by opening or closing a little bit each time thus altering the flow rates. The flow rate is checked on the magnetic flow meters located on the pump discharge piping and should be adjusted accordingly.

2.5.2 Electrical Control

The electrical controls for the groundwater pumps are located on the PLC cabinet and the motor control center in the pump station control building at the street level. The lead and lag pumps are selected by pressing the buttons on the front of the PanelMate unit located on the front of the PLC cabinet. The pump may be placed in the OFF, AUTO (automatic), or HAND (manual) position on the front of the motor control center. Caution: When the pump is manually controlled, care should be taken so that the pump does not continue pumping after the liquid level in the wet well has decreased to the bottom of the pump inlet. Operation of the pump in a dry condition may cause damage to the pump.

2.6 OPERATIONAL PROBLEMS

2.6.1 Mechanical Equipment Problems

Clogging of the pumps and their associated piping may be a problem. The rectangular ditches along the Corridor trench walls are covered with galvanized steel gratings and screens are installed prior to the drop inlet into the underneath detention basin and groundwater wet well. Foreign materials such as vegetation and trash (Styrofoam and plastic materials) are known to enter the detention basin and groundwater wet well. Due to the concerns that some unexpected foreign materials may get into the groundwater pump wet well and cause clogging problems in the pumps and piping, routine checking and cleaning of the ditches along the Corridor trench should be done and recorded.

For additional mechanical equipment problems, the manufacturer’s operation and maintenance manuals for the submersible pumps should be checked.

2.6.2 Trouble Shooting

Refer to the manufacture’s operation and maintenance manuals for the Flygt Pumps or the abs/Sulzer Pumps for trouble shooting. The recommended remedies are provided to solve the possible operational problems on the pumps and motors.

2.7 MAINTENANCE

2.7.1 Preventative Maintenance

Refer to the Operation and Maintenance Manuals for the Flygt Pumps or the abs/Sulzer Pumps for preventative maintenance. Particular attention should be paid on the following:

1. Visual inspection for worn and damaged parts.
2. Check for oil chamber leaks, oil level, and the requirement of oil change.
3. Check for cable entry leaks, damage on the outer jacket, and replace as required.

The recommended schedules and the types of oil should be followed. Also, as a safety precaution, all work on the motors, which are of the explosion-proof type, should be performed by authorized Flygt and abs/Sulzer personnel.

2.7.2 Maintenance During Operation Periods

The pump and motor should be checked for operational problems such as excessive noise, vibration or other abnormal conditions. In addition, check to see that:

1. The level switches respond to the rising and falling water level in the wet well.
2. The unit starts and stops as designated.

3. MAGNETIC FLOWMETER

3.1 PURPOSE: To measure and indicate both the instantaneous flow rate and the total flow quantity (to date) through the magnetic flow meter.

3.2 EQUIPMENT: Separate flow meters (FE-104/-111/-206 GPS and FE-604/-611/-706 NPS) are installed, respectively, to measure the discharges from groundwater, first flush runoff, and storm water pumps.

3.3 RELATIONSHIP TO ADJACENT UNITS

The flow meters are provided to measure the following pump discharges:

Flow Meter FE-104 GPS and FE-604 NPS: Groundwater Pumps P-101/P-102 GPS and P-601/P-602 NPS

Flow Meter FE-111 GPS and FE-611 NPS: First Flush Pumps P-106/P-107/P-108 GPS and P-606/P-607/P-608 NPS

Flow Meter FE-206 GPS and FE-706 NPS: Storm Water Pumps P-201/P-202/P-203/P-204 GPS and P-701/P-702/P-703/P-704 NPS

3.4 OPERATION

3.4.1 Initial Start-up before Operation

1. Check units for proper installation, mounting, and electrical connections.
2. Ensure that the meter readings are accurate only when the power is on and the pipe is in full flow conditions.

3.4.2 Normal Operation

The flow meter senses the pump discharge and has the instantaneous and the total flow quantity at the moment displayed locally on the indicator / transmitter device, which is integrally mounted directly on the flow meter. The device also transmits the flow rates to the PLC cabinet in the pump control building for recording.

The flow meters installed at the pump station have the following flow ranges:

Flow Meter FE-104 GPS and FE-604 NPS: 100 to 400 gallons per minute (gpm)

Flow Meter FE-111 GPS and FE-611 NPS: 1,050 to 2,100 gpm

Flow Meter FE-206 GPS and FE-706 NPS: 6,000 to 12,600 gpm

3.4.3 Emergency Operation

In case of a power failure or equipment breakdown, the flow meter sensor will not operate. The meter will function only after the power is resumed (either from main power or standby power) or the repair is done.

3.5 CONTROLS

3.5.1 Flow Control

Except for the straight runs installed at both upstream and downstream of the meter for accurate operation, no valve is provided for hydraulic flow control.

3.5.2 Electrical Control

No “On/Off” switch is provided for each flow meter. The meter is always ready to measure the flow rates so long as there is no power interruption.

3.6 OPERATIONAL PROBLEMS

In general, very few problems should occur with the meter, since there are no moving parts and obstruction less design through the meter tube. If repetitive erratic meter readings occur, the operator should contact the flow meter manufacturer (Danfoss Instrumark International) for checking, calibration, or repair.

3.7 MAINTENANCE

The magnetic flow meter is considered an almost “maintenance free” instrument. However, the instrument must be hydraulically calibrated annually in accordance with LACSD industrial wastewater discharge flow measurement requirements. Equipment calibration cannot be performed based on the installation configuration.

4. COMBUSTIBLE GAS SENSOR

4.1 PURPOSE: To detect the presence of combustible gases in the groundwater wet wells and prevent these gases from entering the LACSD sanitary sewer system and the storm drain system by shutting down the groundwater and first flush pumping systems and the ventilator.

4.2 EQUIPMENT: A combustible gas sensor, AE-112 GPS and AE-612 NPS, is installed about one foot below the galvanized steel grating, which is directly above the groundwater pumps, to detect the presence of combustible gases in the groundwater pump wet wells.

4.3 RELATIONSHIP TO ADJACENT UNITS

The combustible gas sensor is provided to measure the combustible gases in the groundwater wet well. At any time when the catalytic bead combustible gas sensor detects any combustible gases with a concentration at 15% lower explosive limit (LEL) the sensor switch, ASH-11 GPS and ASH-612 NPS, will actuate an alarm at the PLC cabinet in the control building and at the Alameda Corridor Control Center through the common alarm. The alarm will remain indicating on the PLC cabinet until it is manually reset. Should the combustible gas level reach the upper alarm level (20% LEL), the sensor switch ASSHH-12 GPS and ASHH-612 NPS will shut down the operation of the groundwater pumps and actuate an alarm at the PLC panel and at the Alameda Corridor Control Center through the common alarm. The sensor switch ASHH-112 GPS and ASHH-612 NPS will also prevent the first flush pumps and ventilator from running until the alarm is manually reset.

4.4 OPERATION

4.4.1 Initial Start-up before Operation

Prior to system start-up, the entire system should be visually inspected to ensure proper installation.

The combustible gas sensor settings must be set and utilizes a visual menu system operated by means of a magnet. A magnet stick is supplied for this purpose. The menu system is used to configure alarm set-points, calibrate the sensor module, and for maintenance procedures and alarms acknowledge. The module menu system is operated by means of directing the magnet stick toward each of four independent hall-effect magnetic switches. Each switch functions as if it is a manually activated key. The keys are located above and below the faceplate display and are labeled “M”, “E”, and up and down arrows. The low alarm (15%), high alarm (20%), and methane concentration (50%) to be used for calibration need to be set. Once these are set, the combustible gas sensor should be calibrated to verify this setting and operation.

4.4.2 Normal Operation

During normal operation, the combustible gas sensor readings will fluctuate slightly. As required by the LACSD, the span check/adjustment shall be performed on a regular basis (no less than twice per month) and the zero check/adjustment shall be done on a more frequent basis than the span check/adjustment (i.e., once per week versus twice per month). A calibration kit is maintained in the main control building for this purpose. The calibration readings shall be recorded on the Combustible Gas Detection Meter Calibration Check Record form maintained in the main control building. These forms shall be kept and retained for a period of four years.

The combustible gas sensor utilizes a visual menu system operated by means of a magnet. A magnet stick is supplied for this purpose. The menu system is used to configure alarm set-points, calibrate the sensor module, and for maintenance procedures and alarms acknowledge. The module menu system is operated by means of directing the magnet stick toward each of four independent hall-effect magnetic switches. Each switch functions as if it is a manually activated key. The keys are located above and below the faceplate display and are labeled “M”, “E”, and up and down arrows. The SMC Instruction Manual on Table 6-1 shows the step by step process of the calibration procedures.

4.4.3 Emergency Operation

If the combustible gas sensor detects combustible gases in the wet well, and activates the sensor alarm at 20% LEL, the operation of the groundwater pumps will be shut down completely. The operator should investigate the condition in accordance with the ACTA Emergency Response Plan.

In addition to the regular calibration schedule, and as required by the LACSD, the span check/adjustment shall be performed if the upper alarm level (20%) is reached. This is to ensure the continued proper operation of the unit. A calibration kit is maintained in the main control building for this purpose. The calibration readings shall be recorded on the Combustible Gas Detection Meter Calibration Check Record form maintained in the main control building. These forms shall be kept and retained for a period of four years.

4.5 OPERATIONAL PROBLEMS

The inspection and troubleshooting guide located in the SMC Instruction Manual can be used to determine the corrective action if a fault occurs. Examples of a fault include if the unit is unreliable, noisy, or cannot be calibrated.

4.6 MAINTENANCE

Operator should refer to the SMC Instruction Manual for maintenance procedures. A separate on/off switch has been installed adjacent to the unit to remove the system power.

5. RAIN GAUGE

5.1 PURPOSE: The rain gauge is installed in accordance with the discharge permit requirements of the LACSD. When the rainfall at the pump station area exceeds 0.1 inch, the level switch in the rain gage will send an electrical signal to the PLC cabinet to shutoff the operation of groundwater pumps. If the rainfall continues, the groundwater sump becomes full and the water spills over the weir wall into the first flush sump, where the water will be pumped to the oil/water separators for treatment prior to being discharged to the storm drain system.

5.2 EQUIPMENT: One (1) rain gauge, ME-105 GPS and ME-605 NPS, is provided to stop the pumping of the groundwater into the LACSD sanitary sewer system during rain events. The installation of the rain gauge is done in accordance with the discharge permit requirements of the LACSD.

5.3 RELATIONSHIP TO ADJACENT UNITS

The rain gauge is linked to the groundwater pumps by the PLC as described below.

5.4 OPERATION

Rain will fall in the 14" diameter funnel on the top of the rain gauge. As the rain collects in the float chamber, which is right below the funnel, a float ball will detect the level of the water. As the water level rises, the float will lift a magnetic piston into the operating zone of the level switch, LS-105 GPS and LS-605 NPS, which is installed with the float chamber. The switch will be actuated after approximately 0.1 inch of rain has fallen and will send an electrical signal to the PLC cabinet to shutoff the operation of the groundwater pumps. The following will also occur in accordance with the discharge permit requirements of the LACSD:

- The switch will turn on the green light on the front of the PLC cabinet. The green light will stay lit while the groundwater pumps are deactivated.
- There is a 60 second delay from when the rain gauge has been activated and when the water will drain from it (solenoid valve SV-105 GPS and SV-605 NPS).
- Once the rain gauge has deactivated the groundwater pumps, they will remain deactivated for 2 hours and 45 minutes.
- This timer will be reset every time the rain gauge is filled up again (after emptying every 60 seconds). This is to acknowledge that it is still raining outside.

5.5 OPERATIONAL PROBLEMS

The operator should maintain the cleanliness of the rainfall collection funnel. Any debris, such as tree litter, paper, plastic, and accumulation of dust in the funnel will clog the entrance to the float chamber and cause the gauge read to erroneously.

5.6 MAINTENANCE

Since a long period of dry weather season is predictable in Southern California, covering the top of the funnel may minimize the clogging problem during the dry season.

6. FIRST FLUSH PUMP

6.1 PURPOSE: To pump the first flush water, which are waters from the groundwater wet well, including rain waters between 0.1 inch and 0.5 inch during rainy periods, into the oil/water separators for oil and solids removal. The treated first flush water is then discharge into the 42” diameter storm drain line underneath West Alameda Street and then eventually disposed of into Compton Creek at GPS and 27” diameter storm drain line underneath Leota Street and then eventually disposed of into the Los Angeles River at NPS.

6.2 EQUIPMENT: Three (3) constant speed rotary lobe pumps (P-106/107/108 GPS and P-606/607/608 NPS) are provided to pump the water that flows over the weir from the groundwater wet well into the first flush wet well. These waters are pumped from the first flush wet well into the treatment equipment prior to discharge into the local storm drain system. One pump is placed on lead and the other two are placed on lag. These designations are manually rotated throughout the year to extend the life of each pump.

A mercury float switch system consisting of three (3) floats, LSL-110/LSH-110/LSHH-110 GPS and LSL-610/LSH-610/LSHH-610 NPS are provided to control pump operation.

6.3 RELATIONSHIP TO ADJACENT UNITS

The first flush pumps are provided to pump between 0.1” and 0.5” of rainfall collected from the Corridor trench to the oil/water separators for treatment during rainy periods. If the water level in the wet well continues to rise and exceed the high level setting, LSHH-110 GPS and LSHH-610 NPS, the water will eventually flow over the weir baffle separating the first flush wet well and the storm water wet well. The first flush pumps will be stopped by the signal from the level switch LSM-205 GPS and LSM-705 NPS in the storm water wet well, which is to activate the operation of the storm water pumps.

The first flush pumps will also be started again by the signal from the level switch LSL-205 GPS and LSL-705 in the storm water wet well, which is to stop the operation of the storm water after each storm event. The first flush pumps will continue pumping until the water level in their wet well reaches the pre-set lowest elevation and will be stopped by LSL-110 GPS and LSL-610 NPS.

At any time when the catalytic bead combustible gas sensor detects any combustible gases with a concentration at 15% LEL the sensor switch, ASH-11 GPS and ASH-612 NPS, will actuate an alarm at the PLC cabinet in the control building and at the Alameda Corridor Control Center through the common alarm. The alarm will remain indicating on the PLC cabinet until it is manually reset. Should the combustible gas level reach the upper alarm level (20% LEL), the sensor switch ASSHH-112 GPS and ASHH-612 NPS will shut down the operation of the groundwater pumps and actuate an alarm at the PLC panel and at the Alameda Corridor Control Center through the common alarm. The sensor switch ASHH-112 GPS and ASHH-612 NPS will also prevent the groundwater pumps and ventilator from running until the alarm is manually reset.

6.4 OPERATION

6.4.1 Initial Start-up before Operation

1. Check for proper cleanliness (free of large size rocks, wood residues, trash, etc.) of the pump wet well to avoid damage to the pump casing and rotary lobes.
2. Check to be sure that the pump casing cover plate is properly bolted in place and the pump and motor drive shafts and driven belt are covered with safety guard. Safety guards are to prevent access to the rotating parts.
3. Check to ensure that the discharge pipe from rotary pups all the way to the oil/water separators is not blocked and valves are not closed to prevent damage to the pump by excessively high pressures.

   Note: Should the excessive discharge pressure occur, a 2" pressure relief valve installed on the pump discharge manifold will be activated and a portion of the pump discharge will be released back into the wet well through the grating opening directly above the wet well clean-out sump pump.
4. Check to ensure that the pump has no suction difficulties. If such a problem exists, fill either the suction or discharge nozzles with water and remove the plug from breather.
5. Check to ensure that the hydraulic oil canister installed on the top of the pump casing is filled adequately for the periods of operation.
6. Check to make sure all equipment items (pumps, motors, and valves) are properly lubricated.
7. Check pump discharge valves for proper operation.
8. Verify the level sensors are operational.
9. Check to be sure that the wet well is filled with water before the pumps are turned on and run for any length of time.

Each pump should be started by placing the selector switch in the "HAND" position on the control building panel with the operator inspecting for excessive heat, noise, vibration, etc. If it runs smoothly, it should be placed in the normal mode of operation ("AUTO" position), which will be controlled by the settings of the level switches (LSL-110/LSH-110/LSHH-110 GPS and LSL-610/LSH-610/LSHH-610 NPS). When the pump is in the operation, all of the valves and piping associated with the pump operation should be checked for leaks and proper operation. The magnetic flow meter (FE-111 GPS and FE-611 NPS) on the pump discharge manifold should be checked to verify the readout of the total pumping flow rate.

6.4.2 Normal Operation

Operation of the first flush pumps include the automatic starting and stopping of the pumps by the level switches, rain gauge or combustible gas sensor. The selector switch should be placed in the "AUTO" position on the control building panel during normal operation. The level switches in the pump wet well will automatically control the pumping operation in response to the water level in the wet well. The wet well water levels at which the float switches automatically start and stop the pumps are as follows:

Level Switches	Activated Elevation	Function
LSHH-110 GPS/LSHH-610 NP	5'-4" from floor	Start Pump
LSL-110 GPS/LSL-610 NPS	1'-4" from floor	Stop Pump

6.4.3 Emergency Operation

If the lead pump breaks down, a visual alarm will be indicated at the PLC panel and at the Alameda Corridor Control Center through the common alarm. One of the lag pumps should be placed into service. The inoperative pump should be taken out of service by turning it off (placing it in the "OFF" mode) and inserting a lock out/tag out tag in the handle to prevent it from being used. The operator should investigate the condition of the pump and determine if it can be repaired or should be replaced. In any case, the inoperative unit should be put back into service as soon as possible.

If the combustible gas sensor detects combustible gases in the groundwater wet well, and activates the sensor alarm at 20% LEL, the operation of the groundwater and first flush pumps and the ventilator will be shut down completely. The operator should investigate the condition in accordance with the ACTA Emergency Response Plan.

6.5 CONTROLS

6.5.1 Flow Control

Since the first flush pumps are a positive displacement type pump, their pumping flow rates remain constant regardless of the pumping heads incurred, therefore, any flow controls are not recommended. No isolation valves are allowed to be in the “CLOSED” positions in the pump discharge line. Closed pump discharge will ruin the pump unit in no time. The butterfly valve is an isolation valve for each pump and should be left in the fully “OPEN” position during normal operation.

6.5.2 Electrical Control

The electrical controls for the first flush pumps are located on the PLC cabinet and the motor control center in the pump station control building at the street level. The lead and lag pumps are selected by pressing the buttons on the front of the PanelMate unit located on the front of the PLC cabinet. The pump may be placed in the OFF, AUTO (automatic), or HAND (manual) position on the front of the motor control center. Caution: When the pump is manually controlled, care should be taken so that the pump does not continue pumping after the liquid level in the wet well has decreased to the bottom of the pump inlet. Operation of the pump in a dry condition may cause damage to the pump.

6.6 OPERATIONAL PROBLEMS

6.6.1 Mechanical Equipment Problems

1. Clogging of the pumps and their associated piping may be a problem, though this should not occur. Due to the concerns that some unexpected foreign materials may get into the first flush pump wet well and cause clogging problems in the pumps and piping, routine checking and cleaning of the ditches along the Corridor trench should be done and recorded.
2. Quenching oil contamination may occur and the condition of the oil should be checked. If contamination is visible after the first 50 hours or every 200 operating hours thereafter, the quenching oil should be changed with oil recommended in the manufacture’s operation and maintenance manual.
3. If the pump housing shells wear out, re-adjust the segments per procedures described in the manufacture’s operation and maintenance manual.

For additional mechanical equipment problems, the manufacture's operation and maintenance manuals for the submersible pumps should be checked.

6.6.2 Trouble Shooting

Refer to Vogelsang Pumps' Installation, Operation and Maintenance Instructions for trouble shooting. The recommended remedies are provided to solve the possible operational problems on the pumps and motors.

6.7 MAINTENANCE

6.7.1 Preventative Maintenance

Refer to the Vogelsang Pumps' Installation, Operation and Maintenance Instructions for the preventative maintenance schedule for pumps and preventative maintenance. Particular attention should be on changing the pump quenching oil and gear oil and the lubrication of the motor. The recommended schedules and the types of oil and lubricants should be followed.

In addition, the first flush pumps are normally operated during rain events. Operators should be aware of the forecasted weather conditions and conduct the necessary maintenance to have the pumping units ready for full operation prior to the start of the storm season.

6.7.2 Maintenance During Operation Periods

The pump and motor should be checked for operational problems such as excessive noise, vibration or other abnormal conditions. In addition, check to see that:

1. The level switches respond to the rising and falling water level in the wet well.
2. The units start and stop as designated.
3. The motor speed comes up quickly and is maintained.
4. The motors do not spark excessively when starting or running.

7. ALUM FEED METERING PUMP

7.1 PURPOSE: To inject the aluminum sulfate (alum), which is used as a coagulant, into the oil/water separator influent to enhance oil/water/solids separation. The injection point is located directly on the first flush discharge manifold at the location very close to the storm water discharge box.

7.2 EQUIPMENT: Two (2) positive displacement hydraulically balanced diaphragm pumps (P-401/402 GPS and P-901/902 NPS) are provided. One pump is on duty and the other is used as a standby unit. The control panel, UCP-400 GPS and UCP-900 NPS, is installed near the pumps. A calibration chamber is provided on the pump suction header for checking the pump outputs.

A float switch, LSL-405 GPS and LSL-905 NPS, is provided to shut down the pumps when the liquid level in the alum storage tank reaches the preset low level.

7.3 RELATIONSHIP TO ADJACENT UNITS

The operation of the slum feed pump is interlocked with the first flush runoff pumps. The alum solution is injected to the storm water only when the first flush pumps are operating.

A vertical fiberglass chemical storage tank is provided near the pumps to supply the alum solution to the pumps. The tank is equipped with a float switch, LSL-405 GPS and LSL-905 NPS, to shut down the pump when the liquid level in the tank drops to the preset low level, and to actuate an alarm on the PLC cabinet in the pump control building.

7.4 OPERATION

7.4.1 Initial Start-up before Operation

1. Check to be sure that the gear and hydraulic reservoir oil has been filled.
2. Check to see that the coupling guard is in place to prevent access to moving parts.
3. Check to see that the pumping rates have been calibrated.
4. Check to be sure that there is adequate alum solution in the storage tank for the expected periods of operation.

Each pump should be started by placing the selector switch in the “HAND” position with the operator inspecting for abnormal noise, vibration, etc. If it runs smoothly, it should be placed in the normal mode of operation

("AUTO" position), which will be controlled by the operation of the first flush pumps. When the pump operation should be checked for leaks and proper operation.

7.4.2 Normal Operation

During normal operation, the operator selects the lead pump at the PLC control cabinet in the pump station control room and places the "HAND-OFF-AUTO" switch in "AUTO" position. Thereon, the pump will be started and stopped with the operation of the first flush pumps.

7.4.3 Emergency Operation

Breakdown of a pumping unit is not considered an emergency situation; however, the oil/water/solids separation performance will deteriorate. Pump failure will actuate an alarm at the PLC cabinet in the pump control building and at Alameda Corridor Control Center through the common alarm.

The inoperative pump should be taken out of service by closing its suction and discharge valves. The lag pump should be put into service. The operator should investigate the condition of the pump and determine if it can be repaired or should be replaced. In any case, the inoperative unit should be put back into service as soon as possible.

7.5 CONTROLS

7.5.1 Flow Control

Alum feed rates should be adjusted periodically in accordance with the water quality of the storm water being pumped to the oil/water separators. Each pump is provided with a lock-in place micrometer knob adjustment for changing length of stroke, while in operation or idle, and thus changing the pump output. In addition, at the initial start-up operation, check to be sure that the pumping output is accurate by timing the solution level changes in the calibration cylinder, which is installed in the pump suction header. Refer to Pulsafeeder Pumps' Installation, Operation, and Maintenance Instructions for calibration.

7.5.2 Electrical Control

The electrical controls for the alum feed metering pumps are located at the local control panel, UCP-400 GPS and UCP-900 NPS. The pumps are selected by the selector switch HS-403 GPS and HS-903 NPS on the UCP. The alternator in the panel will automatically alternate the pumps after each pumping event. Each pump is controlled by its "HAND-OFF-

AUTO" switch. Normally, the "HAND-OFF-AUTO" switch for each pump is in the "AUTO" position to automatically start/stop with the operation of the first flush pumps.

The "HAND" and "OFF" positions of the "HAND-OFF-AUTO" selector switch are provided for the manual starting and stopping of the auger. <u>Caution: When the pump is manually controlled, care should be taken so that the pump does not continue pumping after the liquid level in the storage tank has decreased to the pump inlet. Operation of the pump in a dry condition will damage the pump.</u>

All pumps running status, OL-401/402 GPS and OL-801/802 NPS, will be indicated on the UCP. Pump operational failure will also actuate an alarm at the PLC cabinet and at the Alameda Corridor Control Center through the common alarm.

7.6 OPERATIONAL PROBLEMS

7.6.1 Mechanical Equipment Problems

The operator should investigate the problem and determine if he can repair it or if a trained serviceman or a manufacturer's representative is needed. In any case, the inoperative unit should be repaired and put back into service as soon as possible. Unless it is absolutely necessary, do not take the alum feed metering pumps out of service during rain events (arrange for the repair to be done during dry weather periods).

For additional mechanical equipment problems, the manufacture's operation and maintenance manuals for the alum feed metering pumps should be checked.

7.6.2 Trouble Shooting

Refer to Pulsafeeder Pumps' Installation, Operation and Maintenance Instructions manual for trouble shooting. The recommended remedies are provided to solve the possible operational problems on the pumps and motors.

7.7 MAINTENANCE

7.7.1 Preventative Maintenance

Refer to Pulsafeeder Pumps' Installation, Operation and Maintenance Instructions manual for the preventative maintenance schedule for alum pumps and motors. Particular attention should be on the following:

1. Periodic inspection of the hydraulic diaphragm.
2. Periodic checking of hydraulic oil in the gear and oil reservoir.
3. Periodic checking of check valves in the pump head.
4. Periodic calibration of the pumping output.

In addition, the alum feed metering pumps are normally operated during rain events. Operators should perform general inspections on the interior of the tank and conduct the necessary maintenance on the auger drives to have the units ready for full operation prior to the start of the storm season.

7.7.2 Maintenance During Operation Periods

The alum feed metering pumps and motors should be checked for operational problems such as excessive noise, heat, vibration or other abnormal conditions. In addition, check to see that the pump starts and stops in response to the operation of the first flush pumps.

8. OIL/WATER SEPARATORS

8.1 PURPOSE: To remove the oil and settleable solids from the first flush storm water runoff prior to being discharged into the Los Angeles County Sanitation District (LACSD) sanitary sewer line.

8.2 EQUIPMENT: Three (3) corrugated plate interceptor oil/water separators (T-301/T-302/T-303 GPS and T-801/T-802/T-803 NPS) are provided to treat the storm water pumped from the first flush pumps. Each separator is complete with a separation chamber, oil chamber, effluent chamber and sludge chamber. A sludge auger assembly, complete with gear motor drive, is installed adjacent to each sludge hopper to convey the sludge from the hopper into the underground sludge holding tank. A total of six (6) sludge augers are provided. The operations of the auger assemblies are controlled by control panel (UCP-300 GPS and UCP-800 NPS) located near the storm water discharge box.

8.3 RELATIONSHIP TO ADJACENT UNITS

The inlet valve of each oil/water separator is always in the “OPEN” position to receive the storm water from the first flush pumps. After oil/water separation, the oil removed in the separator is accumulated in the oil chamber until it is disposed of by a collection truck. The effluent water continuously overflows into a below-grade 16” diameter manifold line and then flows into the storm water discharge box. The solids settling in the separator hoppers are periodically removed in accordance with the timer settings in the control panel and dumped into the underground sludge holding tank. The sludge in the holding tank will need to be periodically hauled away by truck for off-site disposal.

Prior to being discharged to the atmosphere, the vapors collected from the each of the covered oil/water separators are conveyed through a 4” diameter header to an activated carbon drum for removal of volatile organic compounds (VOCs).

8.4 OPERATION

8.4.1 Initial Start-up before Operation

1. Check to see that the inlet valve of each oil/water separator is in the “OPEN” position and the oil withdrawal valve is closed.
2. Check that the oil and effluent weir levels are properly set.
3. Check that the separators are filled with the clean water prior to receiving the flow from first flush pumps.
4. Check that the gear unit of sludge auger has adequate oil level and safety guard is in place to cover up the rotating shafts.

5. Check that the separator covers/lids are properly bolted with gaskets in place.
6. Check that the timer in the control panel is properly set for sludge removal intervals.
7. Verify that the carbon absorption drum has adequate capacity remaining.

Each sludge auger should be started by placing its selector switch in the “HAND” position with the operator inspecting for abnormal noise, vibration, etc. If it runs smoothly, it should be placed in the normal mode of operation (“AUTO” position), which is thereon controlled by the timer of the unit control panel (UCP-300 GPS and UCP-800 NPS).

8.4.2 Normal Operation

During normal operation, the operator should put all of the augers in the “AUTO” position on the unit control panel. Sludge removal will be done in accordance with the timer settings on each of the augers. When the augers are in operation, all the valves and piping associated with the auger operation should be checked for leaks and proper operation. The flow control valves (FCV-301/FCV-302/FCV-303 GPS and FCV-801/FCV-802/FCV-803 NPS), which are provided in each of the sludge lines, and are also controlled by the same panel. The valves will “OPEN” and “CLOSE” the operation of the augers.

8.4.3 Alternative Operation

Alternative methods of operation include the manual starting and stopping of the augers and shutting down the augers for maintenance or repairs. The operated auger should have its selector switch placed in the “HAND” or “OFF” position. (Refer to Section 1.5.1 Caution).

8.4.4 Emergency Operation

Breakdown of a sludge auger unit is not considered an emergency situation, since the sludge will be continuously accumulated in the hopper until it is withdrawn by manually opening the flow control valve. Without running of the auger, sludge will not be withdrawn evenly and completely out of the hopper. The electric motor actuated flow control valves, FCV-301/FCV-302/FCV-303 GPS and FCV-801/FCV-802/FCV-803 NPS, are of the Fail to Close type (i.e., the valve will remain in “CLOSED” position when it fails.

8.5 CONTROL

8.5.1 Electrical Control

The electrical control for the oil/water separators are located at the local control panel close to the storm water discharge box. Each sludge auger drive is controlled by its “HAND-OFF-AUTO” selector switch on the panel. Normally, the “HAND-OFF-AUTO” selector switch for each auger drive is in the “AUTO” position to provide automatic sludge removal through the timer controller of the panel.

The “HAND” and “OFF” positions of the “HAND-OFF-AUTO” selector switch are provided for the manual starting and stopping of the auger. Caution: When the auger is manually controlled, care should be taken so that the auger does not continue to withdraw the sludge after the first flush pumps are stopped to feed the storm water into the separator. Operation of the augers for a long period of time, while no feed is coming from the first flush pumps, will drain the liquids out of the separator tank and well below its weir crest level. This may create a vacuum condition in the tank and create other maintenance problems afterwards, such as forming of oil and solids crusts on corrugate plates and weir plates (if liquid level is not resumed to the weir crest level), intake of fresh air into the vapor space, etc.

Note: A 4” diameter pressure/vacuum relief valve is installed on the top of each separator to prevent the tank shell from excessive pressure/vacuum conditions.

All auger running status, OL-301AB/OL-302AB/OL-303AB GPS and OL-801AB/OL-802AB/OL-803AB NPS, and failure alarms, OA-301AB/OA-302AB/OA-303AB GPS and OA-801AB/OA-802AB/OA-803AB NPS, are all indicated on the separator control panel.

8.6 OPERATIONAL PROBLEMS

8.6.1 Mechanical Equipment Problems

1. Overload of the auger drive.
2. Breakdown of the flow control valve.
3. Clogging of the sludge withdrawal pipe due to a long period of inoperative auger or control valve.

The operator should investigate the problem and determine if it can be repaired or if a trained serviceman is needed. In any case, the inoperative unit should be repaired and put back into service as soon as possible.

Unless it is absolutely necessary, do not take the separator out of service during rain events (arrange for the repair to be done during dry weather periods).

8.6.2 Trouble Shooting

Refer to Hydro-Flo Technologies' Installation, Operation & Maintenance Instructions manual for trouble shooting. A list of trouble indicators include the following:

1. Effluent quality is deteriorating.
2. Offensive vapor is being generated.
3. Problem in removing the sludge.
4. Problem in removing the oil.

Refer to the manual for individual trouble shooting guides and techniques to solve the possible operational problems.

8.7 MAINTENANCE

8.7.1 Preventive Maintenance

Refer to Hydro-Flo Technologies' Installation, Operation & Maintenance Instructions manual for preventive maintenance schedule for auger motors and gear drives. Particular attention should be on the motor and gear drive lubrications. The recommended schedules and the types of lubricants should be followed.

In addition, the oil/water separators are normally to operate during rain evens. Operators should perform general inspections on the interior of the tank and conduct the necessary maintenance on the auger drives to have the units ready for full operation prior to the start of the storm season.

Safety Precautions:

1. Keep all flammable materials away from tanks.
2. Do not enter the tank until the atmosphere has been tested and it has been shown to be safe to enter.

8.7.2 Maintenance During Operation Periods

The auger motors and gear drives should be checked for operational problems such as excessive noise, heat, vibration, or other abnormal conditions.

In addition, check to see if any leaks are occurring at the point where the auger shaft enters the tank. Adjust the packing gland as required.

9. ACTIVATED CARBON DRUM

9.1 PURPOSE: A 200 pound activated carbon drum is installed at the oil/water separator area to capture the volatile organic compounds (VOCs) in the vapor, which is emitted and collected from the gas space above the liquid surfaces of the oil/water separators.

9.2 EQUIPMENT: One (1) activated carbon drum with a dimension of approximately 24” diameter by 36” high is provided with a 2-inch inlet assembly kit, a 2-inch outlet assembly kit, and a 2-inch flexible hose connector. The hose connector is to connect the inlet of the activated carbon drum to the vent header on the oil/water separators. A ¼-inch shutoff sampling cock is installed on each of the tee fittings of the inlet and outlet assemblies. The entire activated carbon drum is placed on a concrete slab for easy maintenance.

9.3 RELATIONSHIP TO ADJACENT UNITS

The activated carbon drum is connected to the oil/water separators to remove VOCs from the vapor.

9.4 OPERATION

The activated carbon drum has to be replaced after the activated carbon inside the drum has captured or absorbed excessive VOCs and becomes saturated (i.e., the VOCs in the inlet and outlet of the drum have the same concentration).

Based on the design data, it calculated that the air/vapor flow rate from the oil/water separators to the activated carbon drum is very slow, and the pressure drop through the activated carbon drum is negligible. Therefore, the 200 pound activated carbon drum may last up to two (2) years without replacement. However, to take some unexpected factors into consideration, such as higher oil concentration, it is recommended that the activated carbon drum be replaced once a year, unless periodic sampling confirms that the activated carbon drum is not exhausted.

Sampling the VOC concentrations in the activated carbon in the drum should be performed by a trained individual.

9.5 OPERATIONAL PROBLEMS AND MAINTENANCE

1. Check to see that all piping, fittings, and hose connectors are properly connected, and no vapor leaks.
2. Check the last date that the activated carbon drum was replaced, and a test to confirm that the current drum is not exhausted.

10. STORM WATER PUMP

10.1PURPOSE: To pump the storm water runoff, which are waters from the first flush wet well, including rain waters greater than 0.5 inch during rainy periods. The water is discharge into the 42” diameter storm drain line underneath West Alameda Street and then eventually disposed of into Compton Creek at GPS and 27” diameter storm drain line underneath Leota Street and then eventually disposed of into the Los Angeles River at NPS.

10.2 EQUIPMENT: Four (4) constant speed vertical turbine pumps (P-201/202/203/204 GPS and P-701/702/703/704 NPS) are provided to pump the water that flows over the weir from the first flush wet well into the storm water wet well. One pump is placed on lead and the other three are placed on lag. These designations are manually rotated throughout the year to extend the life of each pump.

A mercury float switch system consisting of three (3) floats, LSL-205/LSM-205/LSH-205 GPS and LSL-705/LSM-705/LSH-705 NPS are provided to control pump operation. An additional float switch, LSHH-205 GPS and LSHH-705 NPS is also provided to actuate the high-high level alarm at the Control Room PLC cabinet and the common alarm at the Alameda Corridor Control Center, when the water level in the wet well is at the alarming level.

A one-gallon oil reservoir is provided with each pump for automatic pump line shaft lubrication. The solenoid valve of the oiler assembly is interlocked with the storm water pump and will open to inject the oil to lubricate the line shaft bearings whenever the pump operates.

A pressure switch (PSL-201/PSL-202/PSL-203/PSL-204 GPS and PSL-701/PSL-702/PSL-703/PSL-704 NPS) is provided with each pump to shut down the pumping unit, if the pump fails to achieve the operating pressure as sensed by the switch. In this case, the pumping pressure may not be adequate to fully open the check valve on the pump discharge.

10.3 RELATIONSHIP TO ADJACENT UNITS

The storm water pumps are provided to pump greater than 0.5” of rainfall collected from the Corridor trench during rainy periods. The storm water pumps have a pumping capacity corresponding to the 10-year peak rainfall. When a 50-year storm occurs, the balance of the runoff from this event will be stored in the wet well where it will be pumped out continuously until the water level reaches the pump shut-off level.

10.4 OPERATION

10.4.1 Initial Start-up before Operation

1. Check for proper cleanliness to avoid damage to the pump impellers and bowls.
2. Check to be sure the oil reservoir is full of the proper oil. If necessary, refer to Johnston Pump's Operation and Maintenance Instructions.
3. Adjust the sight feed valve of the oiler assembly to have one drop per second.
4. Check to make sure the pump shaft turns freely.
5. Check pump discharge valves for proper operation.
6. Check to make sure all equipment items (pumps, motors, and valves) are lubricated.
7. Verify the level sensors are operational.
8. Check to be sure that the wet well is filled with water before the pumps are turned on and run for any length of time.

Each pump should be started by placing the selector switch in the "HAND" position on the control building panel with the operator inspecting for excessive heat, noise, vibration, etc. If it runs smoothly, it should be placed in the normal mode of operation ("AUTO" position), which will be controlled by the settings of the level switches (LSL-205/LSM-205/LSH-205 GPS and LSL-705/LSM-705/LSH-705 NPS). When the pump is in the operation, all of the valves and piping associated with the pump operation should be checked for leaks and proper operation. The magnetic flow meter (FE-206 GPS and FE-706 NPS) on the pump discharge manifold should be checked to verify the readout of the total pumping flow rate.

10.4.2 Normal Operation

Operation of the storm water pumps include the automatic starting and stopping of the pumps by the level switches, rain gauge or combustible gas sensor. The selector switch should be placed in the "AUTO" position on the control building panel during normal operation. The level switches in the pump wet well will automatically control the pumping operation in response to the water level in the wet well. The wet well water levels at which the float switches automatically start and stop the pumps are as follows:

Level Switches	Activated Elevation	Function
LSM-205 GPS/LSM-705 NPS	7'-4" from floor	Start Pump
LSL-205 GPS/LSL-705 NPS	5'-0" from floor	Stop Pump
LSHH-205 GPS/LSHH-705 NPS	10'-2" from floor	Sound High-High Water Alarm

10.4.3 Emergency Operation

If the lead pump breaks down, a visual alarm will be indicated at the PLC panel and at the Alameda Corridor Control Center through the common alarm. One of the lag pumps should be placed into service. The inoperative pump should be taken out of service by turning it off (placing it in the “OFF” mode) and inserting a lock out/tag out tag in the handle to prevent it from being used. The operator should investigate the condition of the pump and determine if it can be repaired or should be replaced. In any case, the inoperative unit should be put back into service as soon as possible.

When the water level in the wet well exceeds the maximum preset level, it will actuate the level switch LSHH-205 GPS and LSHH-705 NPS and the high-high level alarm at the PLC cabinet in the pump control building and the common alarm at the Alameda Corridor Control Center through the common alarm.

10.5CONTROLS

10.5.1 Flow Control

Each pump is provided with a discharge check valve and butterfly valve. The check will swing open and close with the on and off operation of the pump. The butterfly valve is an isolation and control valve for each pump and shall be locked in the appropriate position during normal operation.

10.5.2 Electrical Control

The electrical controls for the storm water pumps are located on the PLC cabinet and the motor control center in the pump station control building at the street level. The lead and lag pumps are selected by pressing the buttons on the front of the PanelMate unit located on the front of the PLC cabinet. The pump may be placed in the OFF, AUTO (automatic), or HAND (manual) position on the front of the motor control center. Caution: When the pump is manually controlled, care should be taken so that the pump does not continue pumping after the liquid level in the wet well has decreased to the bottom of the pump inlet. Operation of the pump in a dry condition may cause damage to the pump.

10.6 OPERATIONAL PROBLEMS

10.6.1 Mechanical Equipment Problems

Clogging of the pumps and their associated piping may be a problem, though this should not occur. The rectangular ditches along the Corridor trench walls are covered with galvanized steel gratings and screens are installed at the drop inlet into the wet wells. The ditches are provided to convey the storm water or groundwater seepage from the Corridor trench into the underneath detention basin and storm water pump wet well. Foreign materials, such as large size gravel/rocks or trash are not expected. However, in the event unexpected foreign materials enter the wet well, routine checking and cleaning of the ditches along the Corridor trench should be done and recorded.

For additional mechanical equipment problems, the manufacture's operation and maintenance manuals for the submersible pumps should be checked.

10.6.2 Trouble Shooting

Refer to Johnston Pumps' Installation, Operation and Maintenance Instructions for trouble shooting. The recommended remedies are provided to solve the possible operational problems on the pumps. For the motors, refer to U.S. Electrical Motors Vertical High Thrust Motors Installation, Operation and Maintenance Manual.

10.7 MAINTENANCE

10.7.1 Preventative Maintenance

Refer to the Johnston Pumps' Installation, Operation and Maintenance Instructions for the preventative maintenance schedule for pumps and refer to U.S. Electrical Motors Vertical High Thrust Motors Installation, Operation and Maintenance Manual for the preventative maintenance schedule for motors. The recommended schedules and the types of oil and lubricants should be followed.

In addition, the storm water pumps are normally operated during rain events. Operators should be aware of the forecasted weather conditions and conduct the necessary maintenance to have the pumping units ready for full operation prior to the start of the storm season.

10.7.2 Maintenance During Operation Periods

The pumps and motors should be checked for operational problems such as excessive noise, heat, vibration or other abnormal conditions. In addition, check to see that:

1. The level switches respond to the rising and falling water level in the wet well.
2. The units start and stop as designated.

3. The motor speed comes up quickly and is maintained.
4. The motors do not spark excessively when starting or running.

11. CLEAN-OUT SUMP PUMP

11.1 PURPOSE: The clean-out sump pumps are used to drain the residual water remaining in the detention basin and both the first flush pump and storm water pump wet wells. The pumping operation is normally done during dry weather periods or preferably during summer time when the inspection on the interiors of the detention basin and wet wells is necessary or to prevent the breeding of insects.

11.2 EQUIPMENT: Two (2) constant speed submersible pumps (P-121/211 GPS and P-621/711 NPS) are provided, one in each individual wet well, to pump the residual water to the oil/water separators for solids removal prior to discharge into the storm drain system. A level switch, LSL-121/211 GPS and LSL-621/711 NPS, each equipped with one float, is provided in each sump to stop the pump operation.

11.3 RELATIONSHIP TO ADJACENT UNITS

Each clean-out sump pump is operated independently. The clean-out or drainage water is pumped into the oil/water separators for solids removal. Make sure that the separators are ready to receive the clean-out water.

The potable water from the hose bibs installed above the wet well openings should be used to hose down the interiors of the detention basin and wet wells.

11.4 OPERATION

11.4.1 Initial Start-up before Operation

1. Check for proper cleanliness (free of trash and debris) of the wet well to avoid damage to the pump casing and impeller
2. If the pump is being lowered down along guide bars to the discharge head connection, check to be sure that the pump nozzle is properly engaged with the discharge head.
3. Check pump discharge valves for proper operation.
4. Verify the level sensors are operational.
5. Check to be sure that the wet well is filled with water before the pumps are run for any period of time.

Each pump should be started by pushing the “START” pushbutton with the operator inspecting for abnormal noise, vibration, etc. If it runs smoothly, it should be able to be stopped by releasing the hand from the pushbutton. Thereon, it will be stopped by the low level switch (LSL) in the sump.

When the pump is in operation, all valves and piping associated with the pump operation should be checked for leaks and proper operation.

11.4.2 Normal Operation

Once the “START” pushbutton is pushed, the operating pump will automatically stop when the liquid level in the sump drops to the level controlled by the low level switch LSL-121/LSL-211 GPS and LSL-621/LSL-711 NPS. The frequencies of the operations will be based on the inspection and maintenance schedule of the detention basin and pump wet wells.

11.4.3 Emergency Operation

If one of the pumps breaks down, the inoperative pump should be taken out of service by closing the discharge plug valve and lifting the pump up and out of the wet well for inspection. The operator should investigate the condition of the pump and determine if he can repair it or if a trained serviceman or a pump manufacturer’s serviceman is needed.

Since the two clean-out sump pumps are identical in their fabrication and performance, the pumps are interchangeable. The operable pup can be lifted up from one sump and lowered into the other sump and operated. In any case, the inoperative unit should be repaired and put back into service as soon as possible.

11.5 CONTROLS

11.5.1 Flow Control

No flow control is required. All valves in the pump discharge line should be in full open position.

11.5.2 Electrical Control

The electrical controls for the clean-out sump pumps are located at the unit control panel, UCP-120 GPS and UCP-620 NPS, near the sump openings. Though each pump is to operate independently, the two pumps share one common panel. Each pump is started by its local manual ‘START” pushbutton and stopped by the associated level switch (LSL) in the pump.

The pumps running status, OL-121/211 GPS and OL-621/711 NPS, and failure alarms, OA-121/211 GPS and OA-621/711 NPS, will be indicated at the UCP-120 GPS and UCP-620 NPS.

11.6 OPERATIONAL PROBLEMS

11.6.1 Mechanical Equipment Problems

1. Should clogging in pump casing, valves, or piping, it should be cleaned as soon as detected. Note: Submersible pumps as manufactured by Flygt Pumps, model CP 3127 are capable of passing a 3” diameter solid sphere.
2. Water enters into the pump oil chamber. Should this occur, the sensor in the oil chamber will activate an operational failure alarm on the UCP. The inoperative pump should be taken out of service by lifting it up out of the wet well. The operator should contact the Flygt serviceman for repair.

For additional mechanical equipment problems, the manufacture’s operation and maintenance manuals for the clean-out sump pumps should be checked.

11.6.2 Trouble Shooting

Refer to Flygt Pumps’ Installation, Care and Maintenance Instructions manual for trouble shooting. The recommended remedies are provided to solve the possible operational problems on the pumps and motors.

11.7 MAINTENANCE

11.7.1 Preventative Maintenance

Refer to Flygt Pumps’ Installation, Care and Maintenance Instructions manual for the preventative maintenance for pumps and electric motors. Particular attention should be on the following:

1. Visual inspection for worn and damaged parts.
2. Check for oil chamber leaks, oil level, and the requirement/frequency for oil change.
3. Check for cable entry leaks, damage on outer jacket, and replace as required.

The recommended schedules and the types of oil should be followed. Also, as a safety precaution, all work on the motors, which are of the explosion-proof type, should be performed by authorized Flygt personnel or personnel authorized by Flygt.

11.7.2 Maintenance During Operation Periods

The pump and motor should be checked for operational problems such as excessive noise, heat, vibration or other abnormal conditions. In addition, check to see that the level switch responds to the water level in the sump. Clean, and adjust as required.

12. SERVICE WATER

12.1 PURPOSE: A 1-1/2 inch potable water line is provided at the pump stations for cleaning up and hosing down the alum feed facility area, oil/water separator area, and the pumping facility area in the trench. Additionally, it may be used to fill the wet wells in order to calibrate, and/or operate the pumps for maintenance purposes.

12.2 EQUIPMENT: A 1-1/2 inch water line is connected to the City's potable water supply line by a 1 inch water meter and a 1 inch reduced pressure type backflow preventer. The meter is installed in a below-grade meter box and backflow preventer, together with its two 1 inch isolation valves installed above ground in accordance with City Water Department requirements. The meter and backflow preventer are located outside of the barrier wall and south of alum storage tank at GPS and inside the vehicular gate and northeast of the main control building.

A total of four (4) hose bibs are provided including two (2) hose bibbs of the wall mounted type are at the pumping facility areas – one near the access opening to the groundwater pumps and one near the access opening to the clean-up sump pumps opening and two (2) hose bibbs of the post mounted type are at the oil/water separators area – one near the oil/water separators and one near the alum storage tanks.

12.3 RELATIONSHIP TO ADJACENT UNITS

Service water is independent of other units.

12.4 OPERATION

Pumping facility area – When required for inspection, clean-up, calibration and maintenance, operator should use a hose of proper length. Connect hose to the hose bibb, and hose down the interiors of the wet wells and the basin and other areas as needed. If the wet wells/basins are entered, OSHA requirements shall be followed.

Oil/water separator area – Since the oil/water is in an enclosed tank with an overflow outlet pipe connected to the below-grade manifold to the storm runoff discharge box, there should be no leakage or drips from the oil/water separator during normal operation. However, while the oil in the separator is withdrawn for truck hauling and disposal, oil may spill at the quick-coupler hose connection joint. If this occurs, a spill kit is available and stored in the main control building.

Alum feed facility area – If there is leakage at the hose coupling joint or spillage from the tank overflow pipe during tank fill, a spill kit is available and stored in the main control building.

12.5 MAINTENANCE

Check for leaks in the service water system and repair as soon as possible.

13. VALVES (BUTTERFLY VALVES, CHECK VALVES, PLUG VALVES, BALL VALVES, PRV, PCV, SHEAR GATE)

13.1 PURPOSE:

Butterfly Valves: Butterfly valves are installed at the pump discharges of the first flush pumps (P-106/P-107/P-108 GPS and P-606/P-607/P-608 NPS) and storm water pumps (P-201/P-202/P-203/P-204 GPS and P-701/P-702/P-703/P-704 NPS) and at the inlets of the oil/water separators (T-301/T-302/T-303 GPS and T-801/T-802/T-803 NPS), are used to isolate the pump(s) and the separator(s), when service or repair on the unit is required. A 4” butterfly valve is also installed at each outlet of the oil withdrawal pipe of the oil/water separator to open/close for the truck connection.

Swing Check Valve: Swing check valves are installed at the pump discharges of the first flush and storm water pumps to prevent the reversal of flow back into the pump impellers.

Ball Check Valves: Ball check valves are installed at the pump discharges for the groundwater pumps (P-101/P-102 GPS and P-601/P-602 NPS) and clean- out sump pumps to prevent the reversal of flow back into the pump impellers.

Plug Valves: Eccentric plug valves, equipped with motorized actuators, are installed at each outlet of oil/water separator sludge pipe for automatic sludge withdrawal. Manually operated eccentric plug valves are also installed on the discharge lines of each clean-out pump for isolation of the pump unit.

Ball Valves: The PVC ball valves are installed throughout the alum feed lines for isolation of the alum liquid solution when the unit needs to be shut down for maintenance or repair.

Pressure Reducing Valves (PRV): PRVs are installed at the discharge lines of the positive displacement type pumps, i.e., first flush pups (rotary lobes) and alum feed metering pumps (hydraulic diaphragm), to prevent overpressure on the pump casings and associated piping.

Pressure Control Valves: A pressure control valve is installed on the discharge header of alum feed pumps for accurate operation of the pumps.

Shear Gate Valve: A 4” shear gate valve is installed at the floor level on the wall between the groundwater pump wet well and the first flush pump wet well for cleaning and maintenance.

13.2 EQUIPMENT

Refer to PURPOSE section above for description.

13.3 RELATIONSHIP TO ADJACENT UNITS

Refer to PURPOSE section above for description.

13.4OPERATION

13.4.1 Initial Start-up before Operation

All valves, regardless of type and function, require checking before being put into operation.

1. Visually inspect valve to insure it has been properly installed.
2. Are gaskets and/or packings properly installed?
3. Does valve move smoothly during operation?
4. No fluid leakage should be visible.

13.4.2 Normal Operation

All valves at the pump station are generally in Open or Close positions. Visual inspection for wear, corrosion, or hindered valve movement should be done regularly.

Prior to storm seasons, all valves should be inspected, lubricated, and operated throughout their entire operating range to ensure that they have not become frozen or jammed in position and can achieve full shutoff in any circumstances.

13.5 CONTROLS

Except for the motorized eccentric plug valves (FCV-301/FV-302/FCV-303 GPS and FCV-801/FV-802/FCV-803 NPS) installed at the sludge outlet lines of oil/water separators, and the spring-loaded pressure valves, all other valves are manually operated to open or close as required.

The operation of each motorized eccentric plug valve is controlled by the settings of the master timer KS-300 GPS and KS-800 NPS, which is in the local unit control panel (UCP-300 GPS and UCP-800 NPS) of the oil/water separators.

The spring-loaded pressure relief valves will automatically pop open to release excessive pressure in the pump discharge lines of the positive displacement pumps, such as first flush pumps and alum feed metering pumps. The setting of the spring is mechanically adjustable as required.

13.6 OPERATIONAL PROBLEMS

The most common operational problems with valves are the following:

1. Leakage from stem packing (butterfly valves, eccentric plug valves).
2. Leakage from diaphragm seal (pressure reducing valves).
3. Leakage from O-ring seals (PVC ball valves).
4. Leakage from valve seat (swing check valves).

If leakage occurs, operator should refer to the valve manufacturer's instruction manual for repair. The timing for repair should be scheduled to have minimum interference to the pumping operation.

13.7 MAINTENANCE

Except for the valves installed with the groundwater pumps, which require regular maintenance during both the dry and wet weather conditions, all other valves are operated only during rain events. These valves should be thoroughly inspected for wear, corrosion, jamming, gasket replacement, and etc. or repaired, lubricated, replaced as necessary before the storm season comes.

Operator should refer to the valve manufacturer's catalogue sheets and installation and maintenance instructions for procedures for disassembly and re-assembly of valves.

14. VENTILATOR

14.1 PURPOSE: The ventilator is provided to facilitate air changes in the wet wells and associated underground detention basin. (NOTE: Refer to OSHA requirements for supplemental air supply for other sources, such as portable air blowers, and other safety devices should be put into use while working in the confined or enclosed space.)

14.2 EQUIPMENT: Ventilator (F-131 GPS and F-631 NPS) is installed at the south end of the storm water pumps to ventilate the air space above the liquid level in the wet wells.

A local hand switch, HS-131 GPS and HS-631 NPS, and the timer switch, KS-131 GPS and KS-631 NPS, at the PLC cabinet of the pump control building are used to control the operation of ventilator.

14.3 RELATIONSHIP TO ADJACENT UNITS

At any time when the catalytic bead combustible gas sensor detects some combustible gases with a concentration at 15% LEL the sensor switch, ASH-112 GPS and ASH-612 NPS, will actuate an alarm at the PLC cabinet in the pump control building and at the Alameda Corridor Control Center through the common alarm. The alarm will remain indicating on the PLC cabinet until reset pushbutton switch is pushed. Should the combustible gas level reach the upper alarm level (20% LEL), the sensor switch ASHH-112 GPS and ASHH-612 NPS will shut down the operation of the ventilator and actuate an alarm at the PLC cabinet in the pump control building and at the Alameda Corridor Control Center through the common alarm. The sensor switch ASHH-112 GPS and ASHH-612 NPS will also prevent the groundwater pumps and first flush pumps from running until the alarm is reset.

14.4 OPERATION

14.4.1 Initial Start-up before Operation

All valves, regardless of type and function, require checking before being put into operation.

1. Check to see that ventilator stack cap, safety guard, and motor base plate are properly secured. Check and tighten all bolts, fasteners, and set crews as necessary.
2. Switch to the “HAND” position from the local hand switch, HS-131 GPS and HS-631 NPS, at the ventilator and allow the ventilator to run at full speed. Check for excessive vibration, unusual noise, proper belt tension, and proper lubrication. If any problem is indicated, switch off immediately, repeat the checking procedure in accordance with

ventilator manufacturer's (Hartzell Fan, Inc.) installation, operation, and maintenance manual.

3. If the ventilator seems to be operating satisfactorily, switch to "OFF" position and let it completely stop, and then switch to "AUTO" position.

14.4.2 Normal Operation

During normal operation, the operator should have the local selector switch, HS-131 GPS and HS-631 NPS, in the "AUTO" position. Thereon, the ventilator will be controlled by the timer switch at the PLC cabinet in the pump control interlocked with the combustible gas sensor.

14.5 OPERATIONAL PROBLEMS

14.5.1 Mechanical Problems

The most common operational problems are excessive vibration and unusual noise due to improper driven belt tension and/or under-lubricated impeller and/or motor bearings.

Check belt tension often. Ideal tension is the tension at which the belt will not slip under normal operating conditions. Also check sheave alignment. Sheaves that are not properly aligned cause belt wear and sheave wear. Motor bearings and ventilator impeller bearing should be greased at regular intervals in accordance with the manufacturer's recommended schedule.

See Hartzell's Installation, Operation, and Maintenance Manual for proper type and amount of lubricants to be used and guidelines for checking belt tension.

14.5.2 Trouble Shooting

Refer to Hartzell's Installation, Operation and Maintenance Instructions manual for trouble shooting chart. The possible causes and related problems are indicated in the chart.

The operator should investigate the problems and determine if he can repair it or if a ventilator manufacturer's serviceman is needed. In any case, the unit should be repaired and put back into service as soon as possible.

14.6 MAINTENANCE

The ventilator should be on the regular maintenance list regardless of dry or wet weather conditions. Properly lubricate the impeller and motor bearings and check the V-belt drive for proper alignment, tension, and excessive wear are the major tasks for good maintenance and minimum trouble operation. Also, check impeller for any buildup of foreign material or wear from abrasion. Clean the impeller of any foreign material. Replace the belt and/or the impeller if excessive vibration and wear occur.

15. EXHAUST FAN

15.1 PURPOSE: The exhaust fan is provided to have air changes in the main control building and dissipate the heat generated from the motor control center and other equipment.

15.2 EQUIPMENT: One (1) wall mounted exhaust fan is installed on the north wall of the main control buildings.

15.3 RELATIONSHIP TO ADJACENT UNITS

The exhaust fan is independent of other units.

15.4 OPERATION

15.4.1 Initial Start-up before Operation

1. Check to see that mounting plate, fan hood, and motor are properly secured. Check and tighten all bolts, fasteners, and set crews as necessary.
2. Switch on the electrical supply and allow the fan to run at full speed. Check for excessive vibration, unusual noise, and proper lubrication. If any problem is indicated, switch off immediately, repeat the checking procedure in accordance with the fan manufacturer's (CFM Company/Greenheck) installation, operation, and maintenance manual.
3. If the fan seems to be operating satisfactorily, switch off and let it completely stop, and then switch on again to make sure it will operate smoothly from now on.

15.4.2 Normal Operation

During normal operation, the operator should let the exhaust fan continuously run to have proper ventilation in the main control building.

15.5 OPERATIONAL PROBLEMS

15.5.1 Mechanical Problems

The most common operational problems are excessive vibration and unusual noise due to under-lubricated fan and/or motor bearings. Motor bearing and fan bearings should be greased at regular intervals in accordance with the manufacturer's recommended schedule.

15.5.2 Trouble Shooting

Refer to CFM Company's Installation, Operation and Maintenance Instructions manual for trouble shooting table. The possible causes, related problems and corrective actions are indicated in the table.

The operator should investigate the problems and determine if he can repair it or if a ventilator manufacturer's serviceman is needed. In any case, the unit should be repaired and put back into service as soon as possible.

15.6 MAINTENANCE

The exhaust fan should be on the regular maintenance list regardless of dry or wet weather conditions. Properly lubricate the fan and motor bearings and check for excessive noise and wear are the major tasks for good maintenance and trouble-free operation. Check fan impeller for any buildup of foreign material and clean up as necessary.

Maintenance of Way Services

Appendix J

Track and Signal Inspection Forms

ALAMEDA CORRIDOR TRANSPORTATION AUTHORITY
Track Inspection Report

Inspected By: ______________________ Signature: ______________________ Date: ______________

Assisted By: ______________________

Inspection Type: ______________ Vehicle: ______________ Walk: ______________

Station/MP: ______________ Start: ______________ End: ______________

ITEM	Location, Track or SW Number	Class of Track	EXCEPTION (Description, FRA Defect Code)	CORRECTIVE ACTION	DATE CORRECTED	CORRECTED BY

NOTES:

Rev. 08-16-2006

MONTHLY TURNOUT INSPECTION REPORT

Sub Division:													Month/Year:					Inspector Name:							
				SWITCH POINT		CONDITION							FROG		GUARD RAILS			CONDITION							
DATE	SWITCH LOCATION	Switch Number	TURNOUT="T" SIDING="S" MT="M"	POINT THROW OPENING	CON-DITION	SW RODS	RAIL BRACES & FAS-TENERS	STOCK RAIL	SWITCH TIMBERS	COTTER PINS	SUR-FACE OF SWITCH	MAX GAUGE	CON-DITION	TRACK GAUGE	CON-DITION	GUARD CHECK GAUGE	GUARD FACE GAUGE	GUARD RAIL BOLTS	FROG BOLTS	ALL JOINTS INSPECTED IN TURNOUT	SUR-FACE	FROG TIMBERS	HOLD DOWN DEVICES	SPRING HOU-SING	REMARKS OR REMEDIAL ACTION
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			T																						
			M																						
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Inspector's Signature	Date	Inspector's Signature	Date	Inspector's Signature	Date	Inspector's Signature	Date	Inspector's Signature	Date	"G" FOR GOOD "F" FOR FAIR "P" FOR POOR

ALAMEDA CORRIDOR TRANSPORTATION AUTHORITY
ANNUAL SWITCH INSPECTION REPORT

LOCATION AND DESCRIPTION OF SWITCH					o POWER OPERATED
					o HAND THROW
TURNOUT NUMBER		FROG TYPE		GUARD RAIL TYPE	
				M.L. SIDE	T.O. SIDE

INDICATE CONDITION OF

STOCK RAILS	RH		LH			
SWITCH POINTS	RH		LH			
HEEL BLOCKS						
RAIL JOINTS AND BOLTS AT HEEL OF SWITCH POINTS		RH			LH	
HEAD BLOCK TIES			SWITCH STAND			
SWITCH LOCK			TRANSIT CLIPS & BOLTS			
SWITCH TIES			SWITCH PLATES			
GAUGE PLATES			SWITCH POINT THROW AT No. 1 ROD			
No. 20 T.O. SWITCH POINT THROW	P.S.	No. 1 ROD	No. 2 ROD	No. 3 ROD	No. 4 ROD	No. 5 ROD
FROG				FROG BOLTS		
FROG PLATES				RETARDER		
RAIL JOINTS & BOLTS ON FROG	TOE			HEEL		
HOLD DOWN BRACKETS ON WING RAIL						
GUARD RAILS	ML SIDE			T.O. SIDE		
SETTING OF GUARD RAILS	ML SIDE			T.O. SIDE		
INSULATED JOINTS						
RAIL JOINTS & BOLTS						
LINE, SURFACE & GAUGE OF MAIN TRACK THRU SWITCH						
LINE, SURFACE & GAUGE THRU T.O. SIDE OF SWITCH						

REMARKS

DATE OF INSPECTION	
DATE EXCEPTIONS FURNISHED TO SECTION FOREMAN	
DATE EXCEPTIONS CORRECTED	

Contract Manager

Rev. 08-16-2006

ALAMEDA CORRIDOR TRANSPORTATION AUTHORITY
YEARLY TEST OF HAZARD DETECTORS

Date Submitted: ______________________

Sheet #: ______________________

Inspected by: ______________________

READING MARK

C - Test complete. Equipment in satisfactory condition.
A - Adjustment made and test complete.
R - Repairs or replacement needed.
S - Repairs or replacement made. Equipment in satisfactory condition.
* - Explain on back of form.

DATE OF TEST (mm/dd/yy)	MILE POST LOCATION	TYPE OF DETECTOR (High, Wide, & Hot Box)	DETECTOR CAUSE PROPER SIGNAL TO BE DISPLAYED (Yes or No)	RESULTS	Line Number
					1
					2
					3
					4
					5
					6
					7
					8
					9
					10
					11
					12
					13
					14
					15
					16
					17
					18
					19
					20

 Rev. 08-16-2006

ALAMEDA CORRIDOR TRANSPORATION AUTHORITY
HOT BOX DETECTOR TESTS D.E.D.

Location: ____________________

Track #: ____________________

	Bi-Weekly							Monthly																									Semi-Annual											
Date (mm/dd/yy)	**Clean Mirrors**	**Clean Lenses**	**DED Alarm Both Directions**	**View Axel Data**	**Transducers Tight**	**Transducers Clean**	**Scanner Heaters**	**AC Voltage**	**AC Inverter Voltage**	**Ambient Temperature**	**DC Voltages Board Self-Test**	**Board Self-Test**	**Gauge Plates & Rods**	**Surge Protection**	**Correct Anchor Pattern**	**Anchor or Plate vs Transducer**	**Rail Gauge Correct**	**Non-Metallic Transducer Test**	**Transducer Height & Level**	**Transducer Damage**	**Scanner Hardware Tight**	**Scanner Guard Damage**	**Rail 1 Average Temperature**	**Rail 2 Average Temperature**	**Heat Test Rail 1**	**Heat Test Rail 2**	**Rail 1 is North/East**	**Chart Recorder Working Properly**	**Electronic Recorder-Print Train List**	**DED Harware Tight**	**DED Damage**	**DED Impact-Type, All Sections Operating**	**Blow Water From Conduit**	**All Wiring Connections**	**Scanner Height/Alignment**	**Carrier Levels**	**Ground Resistance**	**Transducer Resistance**	**DED 8°** Deflection Test	**2-Man Simulated Train Test**	**Correct Prints**	**Current & Correct Instructions**	**Current Radion License**	**Lubricate All Hinges**

Rev. 08-16-2006

ACTA

ALAMEDA CORRIDOR TRANSPORATION AUTHORITY
INSULATION RESISTANCE TEST
RULE 236.108 AND RULE 234.267

Recording Mark

C - Test complete. Equipment in satisfactory condition.
A - Adjustment made and test complete.
Equipment in satisfactory condition.
R - Repairs or replacement needed.
S - Repairs or replacement made.
Equipment in satisfactory condition.
* - Explain on back of form.

SIGNATURE ____________
M.P. TO M.P. ____________
SHEET ______ OF ______ SHEETS

In no case shall a circuit be permitted to function when resistance is less than 200,000 ohms.

DATE OF TEST	LOCATION	CABLE IDENTIFICATION	IF RESISTANCE READING OF ANY CONDUCTOR WITHIN A CABLE IS LESS THAN 500,000 OHMS, LIST EACH WIRE IDENTIFICATION AND RESISTANCE VALUE WITHIN THAT CABLE.		TEST RESULTS	LINE NO. REMARKS	DATE OF TEST	LOCATION	CABLE IDENTIFICATION	IF RESISTANCE READING OF ANY CONDUCTOR WITHIN A CABLE IS LESS THAN 500,000 OHMS, LIST EACH WIRE IDENTIFICATION AND RESISTANCE VALUE WITHIN THAT CABLE.		TEST RESULTS	LINE NO. REMARKS
			WIRES IDENTIFICATION	RESISTANCE						WIRES IDENTIFICATION	RESISTANCE		
						1							16
						2							17
						3							18
						4							19
						5							20
						6							21
						7							22
						8							23
						9							24
						10							25
						11							26
						12							27
						13							28
						14							29
						15							30

ALAMEDA CORRIDOR TRANSPORTATION AUTHORITY
SIGNAL DEPT. D.O.T. - RS & I TEST

Recording Mark

C - Test complete. Equipment in satisfactory condition.
A - Adjustment made & test complete.
Equipment in satisfactory condition.
R - Repairs or replacement needed
S - Repairs or replacement made.
Equipment in satisfactory condition.
* - Explain on back of form.

VITAL RELAY TEST RULE 236.106 AND RULE 234.263

Each relay shall be tested once every 4 years except: "AC" centrifugal relays shall be tested every 12 months. "AC" vane relays and "DC" polar relays shall be tested every 2 years, and all relays with soft iron magnets structure shall be tested every 2 years.

RELAY NAME		MANUFACTURER & MODEL		COIL OHMS	SERIAL NUMBER			SUBDIVISION		RESULTS OF TEST	M.P.
DATE OF TEST	TAG READINGS	PICKUP		WORKING		DROP-AWAY		POLAR PICKUP			
MM/DD/YY	SIGNATURE OF INSPECTOR										
		VOLTS	AMPS	VOLTS	AMPS	VOLTS	AMPS	VOLTS	AMPS		

ACTA
Alameda Corridor Transportation Authority

Maintenance of Way Services

Appendix K

Training Requirements

ALAMEDA CORRIDOR TRANSPORTION AUTHORITY
MAINTENANCE OF WAY SERVICES
TRAINING REQUIREMENTS FOR MOW PERSONNEL

Course No.	Type of Training	Frequency of Training	Craft
1 .	General Code of Operating Rules for Maintenance of Way Employees	Annually	All maintenance of way
2.	Roadway Worker - CFR49 Section 214.3 On-Track Safety program	Annually	All maintenance of way
3.	1. EIC	Annually	Inspectors, flaggers, supervisors (track, bridge, signals & comm), and contract manager
	2. Lone Worker	Annually	Inspectors, flaggers, supervisors (track, bridge, signals & comm), and contract manager
4.	First Responder/ Hazardous Material (40 hours)	Annually	Supervisors (track, bridge, signals & comm, and contract manager
5.	Hazardous Material (40 hours)	3 years	Supervisors (track, bridge, signals & comm), and contract manager
6.	CFR49 Section 213/7	Once	Inspectors, rail repair leaders, supervisors (track, bridge, signals & comm), and flaggers
7.	Fall Protection/ Rescue 214 (Annual Recertification)	Annually	Supervisors (track, bridge, signals & comm), contract manager, and as required
8.	Confined Space OSHA	Annually	As required
9.	CWR Maintenance	Annually	Inspector, rail repair leaders, welders, track supervisor and contract manager
10.	Track Welding	Current Certification	Welders, welder helpers, supervisors
11 .	Emergency Ladder Inspection and Maintenance	Annually	Supervisors (track, bridge, signals & comm), contract manager, and others as required.

COURSE SPECIFICATIONS

The training to be provided by the Contractor to its employees listed above will contain the course material, require the duration, and will be expected to meet the course objectives listed in the following sections.

The Contractor shall furnish a schedule of training classes to be given as a part of the proposed Maintenance of Way and Structures Service Plan. For the period between the start date and the first annual budget cycle, the Contractor shall furnish a schedule of training within 30 days of the start date. ACTA will review the schedule and reserves the right to alter the schedule to avoid depletion of the work force or to avoid conflicts with scheduled maintenance activities.

ACTA may monitor the Contractor's classes for content and effectiveness of presentation and will be provided the results of tests of the students. In the event that ACTA believes that course content or presentation is not meeting the objectives of the specifications identified below, the Contractor and ACTA representatives will meet to review the current training schedule and make changes, as necessary.

General Code of Operating Rules for Maintenance of Way Employees

(5-Day Class for persons not previously qualified on the GCOR)

1. Introduction and Safety Briefing of the Facility

2. Course Content

   A. Overview of documents and how they work together:

   - GCOR
   - Employee Timetable, Special Instructions, and Modifications to GCOR
   - General Orders
   - Track Bulletins

   B. Rules

   - Rule 1, General Responsibilities • Rule 2, Railroad Radio
   - Rule 3, Standard Time
   - Rule 4, Timetables • Rule 5, Signals
   - Rule 6, Fouling and Working on Tracks
   - Rule 7, Moving Equipment Safely
   - Rule 8, Switches
   - Rule 9, Block System Rules
   - Rule 10, Centralized Traffic Control
   - Rule 14, Track Warrant Control
   - Rule 15, Track Bulletin Rules
   - 1/2 day out on the field

   C. Examination

Roadway Worker Class Outline
(4-hour class)

1. Introduction and Safety Briefing of the Facility

2. Background of the Rule Making
   A. 2 years in the making
   B. Group of peers/FRA/Training officers each RR
   C. Reason for rule

3. Definition of
   A. On-Track Safety
   B. Training

4. Hierarchy of On-Track Safety

5. Definitions of:
   A. Roadway Worker; Who is a Roadway Worker?
   B. Fouling a track
   C. Job Briefing
   D. Employee In Charge
   E. Lone Worker
   F. Watchman
   G. Exclusive Track
   H. Non-Controlled Track
   I. Inaccessible Track

6. Types of Protection
   A. Track and Time
   B. Watchman
   C. Lone Worker, Individual Train Detection

7. Right to Challenge

8. On-Track Equipment

9. Test - Question and Answers

Roadway Worker
Employee-in-Charge, Lone Worker, Watchmen Class Outline
(8-hour class)

1. Introduction and Safety Briefing of the Facility

2. Background of the rule making
    - A. 2 years in the making
    - B. Group of peers/FRA/Training officers each RR
    - C. Reason for rule

3. Definition of
    - A. On-Track Safety
    - B. Training

4. Hierarchy of On-Track Safety

5. Definitions of:
    - A. Roadway Worker; Who is a Roadway Worker?
    - B. Fouling a track
    - C. Job Briefing
    - D. Employee In Charge
    - E. Lone Worker
    - F. Watchman
    - G. Bridge Worker; Fall Protection

6. Responsibilities of:
    - A. EIC
    - B. Lone Worker
    - C. Watchman
    - D. Machine Operator
    - E. Bridge Worker

7. Review the following Definitions
    - A. Exclusive Track
    - B. Non-Controlled Track
    - C. Inaccessible Track

8. Types of Protection
    - A. Track and Time

B. Watchman
C. Lone Worker, Individual Train Detection

9. Types of Protective Equipment
   A. Concentrating on Fall Protection

10. Right to Challenge

First Response Awareness Level Outline

(8-hour class)

1. Introduction

   Provides the essential information for individuals who are likely to witness, discover, or respond to an incident of a hazardous substance release and who have been trained to initiate and emergency response sequence by notifying the proper authorities of the release.

2. Review of hazard communication (Right-to-Know).

   At the completion of this training course, the participant will be acquainted with the following information:

   A. Understanding of hazardous substances and risks associated with them in an incident
   B. Understanding of potential outcome associated with an emergency created when hazardous substances are present.
      - Ability to recognize the presence of hazardous substances in an emergency.
      - Ability to identify the hazardous substance, if possible
      - Understanding of the role of the first responder awareness individual in the employer's emergency response plan. (Including site security and control) and the US department of transportation's Emergency Response Guidebook.
      - The ability to realize the need for additional resources, and to make appropriate notification to the communication center.

Hazardous Material Course EIC
(40 hours) Outline (5-day 8 hour/day)
12 participants per class

A comprehensive technical course designed to provide a thorough introduction to regulations covering personnel involved in investigation and remediation of hazardous waste sites.
Topics include:

- Classes of hazardous materials
- Site safety
- Levels of protection
- Personal equipment programs
- Medical and emergency considerations
- Site Safety plans sources of information
- Decontamination procedures and instructions commonly used on-site.

Track Safety Standards Class
FRA part 213 sections A to F
Basic Course for First-Time Qualification
(4-Day Class)

1. Introduction and Safety Briefing of the Facility
   A. Foundation of the railroads physical plant
   B. Determination of acceptable variation in track

2. Technical Discussion

3. Course Description

   This course will allow the student to understand the FRA 213 Track Safety Standards and to make track evaluations based on the minimum safety requirements.

   A. General Information
      - Application
      - Excepted track
      - Responsibility of track owners
      - Designation of qualified persons to supervise certain renewals and inspect track
      - Class of track operating speed
      - Civil penalty
      - Exemptions

B. Roadbed

- Drainage
- Vegetations

C. Track Geometry

- Gage
- Alignment
- Curves
- Elevation
- Surface

D. Track Structure

- Ballast; general
- Crossties
- Defective rails
- Rail end mismatch
- Railjoints
- Rail fasteners
- Turnouts, switches and frogs

E. Track Appliances

- Scope
- Derails

F. Inspections

- Track inspection
- Crosstie inspection
- Rail inspection
- Special inspections
- Inspection records

Fall Protection and Rescue (4-hours)

1. Introduction and Safety Briefing
2. Background: 49 CFR 214 (Roadway Worker)
3. Fall Protection
   A. When is it required?
   B. Inspection
   C. Exceptions
4. Fall Protection Equipment
   A. Intended Use
   B. Certification
   C. Inspection before use
   D. Training
5. Working over Water
6. Scaffolding
7. Rescue Plan
   A. Communications
   B. Assignment of personnel to roles for rescue
   C. Equipment

Confined Space Outline
(8-hour classroom)

1 . Introduction and Safety Briefing

2. Equipment Knowledge
   A. Oxygen
   B. Hazardous Gas

3. Proper dress for levels
   A. Clean
   B. Chemical

4. Proper ventilation

5. Vertical rescue

6. Record Keeping
   A. Gas monitoring

CWR Maintenance Class Outline (8-hour class)
Given on an Annual Basis

1. Introduction and Safety Briefing

Maintenance of Continuously Welded Rail was prepared to focus on reducing the problems that tend to occur in CWR track. In order to give participants a firm understanding of the problem and the solutions, the following main points must be covered:

A. The theory of thermal expansion
B. Understanding the cause of track buckles and pull apart
C. Inspection techniques to locate and identify possible buckle/pull apart sites
D. Proper diagnostic and preventative maintenance methods to be used
E. Step-by step procedures for the repair and reinstatement of thermally defective track
F. Requirements of 49CFR213.119

2. Technical Discussion

A. Course Description

The aim of the course is to provide a training program that will be taught to all track maintenance forces that have responsibility for the inspection, maintenance and destressing of CWR B. Objectives

At the end of the course the participant will:

- Understand the theory of thermal expansion.
- Identify and demonstrate the inspection techniques and identifiers used to determine rail stress conditions.
- Calculate the length of an unrestrained rail at different temperatures.
- Calculate track rail stress at different temperatures.
- Define stress free temperatures, preferred rail laying temperatures, preferred rail laying temperatures range.
- Calculate the adjustment required to return rail to its stress-free condition at any temperature.
- Identify when distressing can be performed.
- Understand the proper steps for destressing rail.
- Identify precautions to be taken when destressing rail.

List all maintenance work that must only be performed within the preferred rail laying temperature range, working zone, and joint inspections limits.

Satisfy the requirement for training under 49CFR213.1 19.

Track Welding Class Outline (4-hour Classroom)
(4-hour Shooting Welds)

Introduction and Safety Briefing

A. Discussion of:
   1. Welding Safety
   2. Approved Welding Procedures
   3. Prohibited Welding

B. Welding of frogs and switches
   1. Types

C. Thermite Welds
   1. Welding Process
   2. Adjusting CWR Temperature
   3. Making the weld

Maintenance of Way Services

Appendix L

Utility Types and Placement

ALAMEDA CORRIDOR TRANSPORTATION AUTHORITY

UTILITIES ON AND ADJACENT TO RAIL CORRIDOR

Types of Utilities (not all inclusive)

Aerial and Underground Electrical
Aerial and Underground Telephone Communications
Above and Below Ground Fiber Optic
Chemicals
Communication Towers and Antennas
Concrete Box Storm Drains
Drainage Culverts
Gas
Groundwater and Other Observation Wells
North End Trench Lighting
Oil
Open Storm Drains in Trench wit Gratings
PVC and Other Type Plastic Track Drains
Railroad and Traffic Signal
Refined Petroleum Product
Sanitary Sewer
Storm Drains
Storm Water Storage/Collection and Pump Stations
Street Lighting
Water

Carrier Methods and Housings

Communication Cable & Vaults
Direct Burial Cables
Electrical Conduits
Fiber Optic Fiberglass Communication Conduit on Trench Wall
Grade Crossing Control Cabinets
Guy Wires
Highway Traffic Signal Cabinets
Open Drainage Channels
RR Signal and Communication Control Houses
RR Signal Bridges
Signal Boxes and Vaults
Steel Casings Over Corridor Trench
Steel Casings Along and Crossing Rail Corridor
Street Light Conduit
Trench Pump Station Equipment, Treatment, and Storage
Telephone Conduits
Wood and Steel Poles

Maintenance of Way Services

Appendix M

Emergency Ladders

&

Fixed Stairways in Trench

Emergency Phone System

At each emergency ladder and control point there are emergency phones with direct dial to the dispatcher. The phones are managed by one main and one backup server with a conferencing software solution by Asteria Solutions Group of Huntsville AL. All the networking equipment that tie the emergency phone and ladder system are on the ACTA owned single mode fiber optic network that runs the length of the corridor. The link from the corridor to the dispatcher at San Bernardino is thru a wide area network connection. The system is managed and monitored with a SCADA system.

Alameda Corridor
Inspection, Lubrication and Testing Plan
for
Emergency Mechanical Ladders in Trench

July 2024

Table of Contents

1.0 Introduction

The Alameda Corridor Trench is a ten-mile-long below ground structure that contains three operating tracks. It runs parallel to Alameda Street through various municipalities. There are approximately 30 perpendicular bridges (28 roadway and 2 railroad) that cross the trench at street level. The open trench is approximately 30 feet deep and is fully protected along its entire length and at the bridges by a six-foot high fence that sits atop a short concrete parapet wall.

Access into and egress from the trench is provided by:

- fixed stairways at three locations consisting of concrete stairs on the J-Yard embankment at the north-end, and steel staircases at each of the two intermediate trench pump stations;
- a fixed steel ladder at one location at the south-end; and
- aluminum and steel mechanical ladders at 46 locations approximately 1,000 feet apart, which are raised and lowered by hand-cranks from both street level and track level. (Seep Appendix A for ladder locations.)

The purpose of this document is to establish an inspection and lubrication plan for the third category above – the mechanical ladders - to ensure safe and reliable operation. (In this document the term “ladder(s)” shall refer to the mechanical ladder(s). These mechanical ladders were installed as part of the original Alameda Corridor trench construction to provide emergency access by police, fire departments and other authorized personnel, and to provide emergency egress by railroad, maintenance and other authorized personnel. They have been available for service since the opening of the corridor April 2002.

2.0 Ladder Types and Components

There are two basic types of ladders in the trench, as determined by the spacing of the perpendicular concrete support struts, which brace the top of the trench walls. Each of the ladder types is shown below.

The spacing of the struts are typically betwee 25 and 15 feet. Because the ladders are longer than the clear distance between the struts, a somewhat complex mechanical system exists that causes the ladders to move both horizontally and vertically as they are lowered and raised. Accordingly, there are numerous moving parts and joints requiring periodic inspection and lubrication to ensure proper alignment and smooth operation.

Ladder Type 1 (#1-7, 9-36)

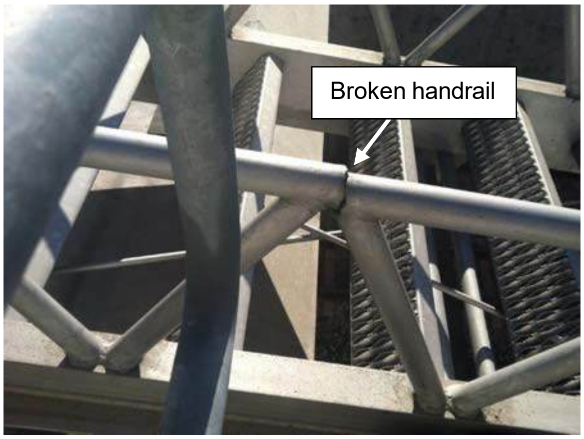
Ladder Type 2 (#37-47)

Major ladder mechanism components and specific issues are as follows:

a) Ladder

Each of the ladders is built of aluminum and includes channel stringers, stair tread gratings, a landing grating, and pipe railings. Each ladder weights about 900 pounds.

Issues: A crack was found at one location in the pipe railing (#2). A crack was found at another location in the stringer where the riser stringer is joined to the landing stringer (#41).



Ladder #2
(Repair later completed)

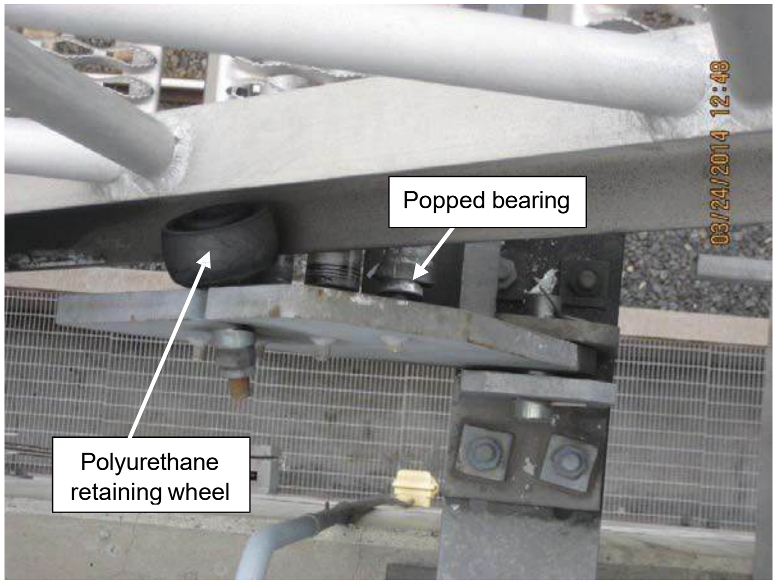
Ladder #41
(Repair pending)

b) Pivot Stand

The ladders rotate and roll on a steel pivot stand attached to the trench wall. There are four conveyor rollers on each ladder stand that make direct contact with and support the ladder stringers. The rollers are attached to two side plates that pivot on pins as the ladder changes its angle during operation. A polyurethane wheel guides and ensures stringer contact with the rollers.

Pivot Stand

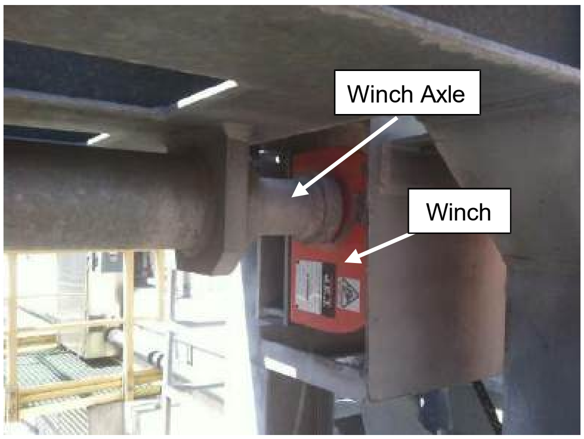
Issues: The stringers do not remain in contact with all four rollers throughout deployment. Popped bearings were noted at three locations (#2, 41, and 44) and the conveyor axle was also bent at one of those popped bearing locations (#41).



Ladder #41
(Repair pending)

c) ***Upper Crank Stand***

The crank stand is another steel frame attached to the trench wall, which contains a hand-crank winch incorporating two spools of cable, one connected to each stringer. The winch controls the lowering and raising of the ladder. The cranking effort is less when lowering than lifting, because the weight of the ladder and its counterweights as described below provides gravitational assistance on the descent. It takes about 120 crank turns to lower or raise the ladder.



Crank Stand

Outer Cable Spool

Cranking from Street Level

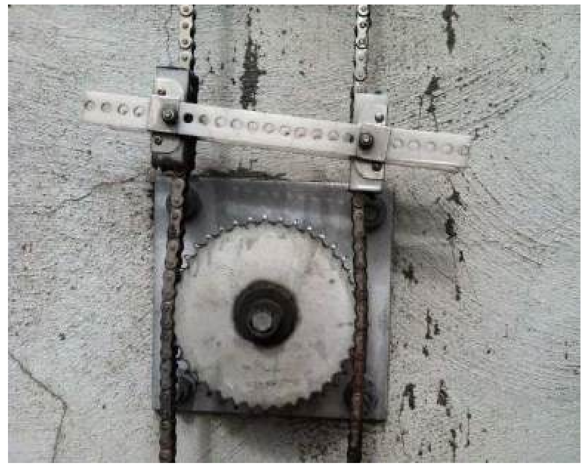
Issues: The winch connection to the spool axle was sheared off at Ladder #37. The two cables are not equally tensioned throughout deployment. The weight appears to shift from one cable to the other at points.

Broken Winch Shaft (#37)
(Repaired and reinstalled)

d) ***Lower Crank Box***

The lower crank box is mounted on the trench wall at track level. It contains a hand-crank and sprocket that is connected to the upper crank stand winch by means of two closed-loop chains, similar to bicycle chains. Two intermediate idler sprockets with tensioners are mounted on the wall to maintain chain alignment. Both the upper and lower crank sprockets turn simultaneously regardless of whether the cranking occurs above or below.

Lower Crank Box and Emergency Telephone



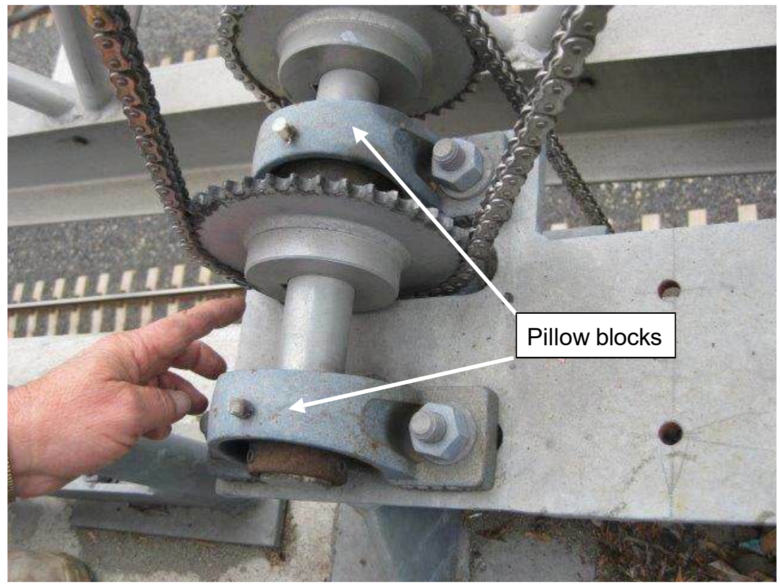
Idler Sprocket and Chain Tensioner

Issues: Corrosion was noted on the crank handles, which are loose and stored in the crank box. This prevents insertion into the winch drive. Also some of the chain tensioners were broken or missing.

e) ***Upper Chain Drive Block***

The upper chain drive block is the intermediate load transfer station for the two drive chains connected to the upper and lower crank sprockets. It is connected to the upper crank stand frame. It contains a rotating pin in two pillow blocks with two sprockets that transfer the direction of the two closed-loop chains.

Chain Drive Block with Cover



Chain Drive Block without Cover

Issues: It was noted that the block can shift due to play in the bolt mounting holes. This can cause the chain to grind against the slot in the mounting beam and shave the chain. The cover must be removed from the block to observe this condition.

f) ***Counterweight Stand(s)***

There is either one or two steel counterweight stands per ladder depending on the ladder type – at one end for Type 1 and at both ends for Type 2. The purpose of the weights is to provide: 1) additional force to assist ladder lowering and
2) enough cable tension to promote smooth unspooling and spooling on the drums. Absent these weights, the ladder is nearly balanced on the pivot stand like a seesaw with the same weight at both ends.

Lower End Counterweight – Up Position

Lower End Counterweight – Down Position

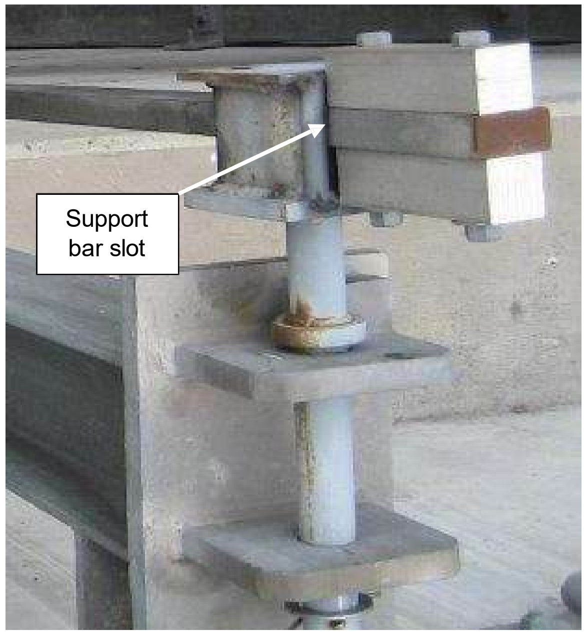
Upper End Counterweight Stand

In order to lower the ladder, the counterweights, which make contact with but are not attached to the ladder, must remain in contact with the ladder and move freely in order for the ladder to operate properly. By design, these counterweights only engage during part of the ladders vertical travel to avoid overstressing the winch.

If the counterweights do not remain in contact with the ladder and move freely, the ladder will not lower and the cable will drape. If cranking continues, an unsafe condition results that can potentially damage the cable, the ladder and its mechanisms when and if the ladder falls due to its own weight or the sudden engagement of the counterweight.

Accordingly, it is important that an operator verify through observation that the cable is not slackening during cranking, that the ladder is descending, and that the counterweight(s) is and remains in contact with the ladder.

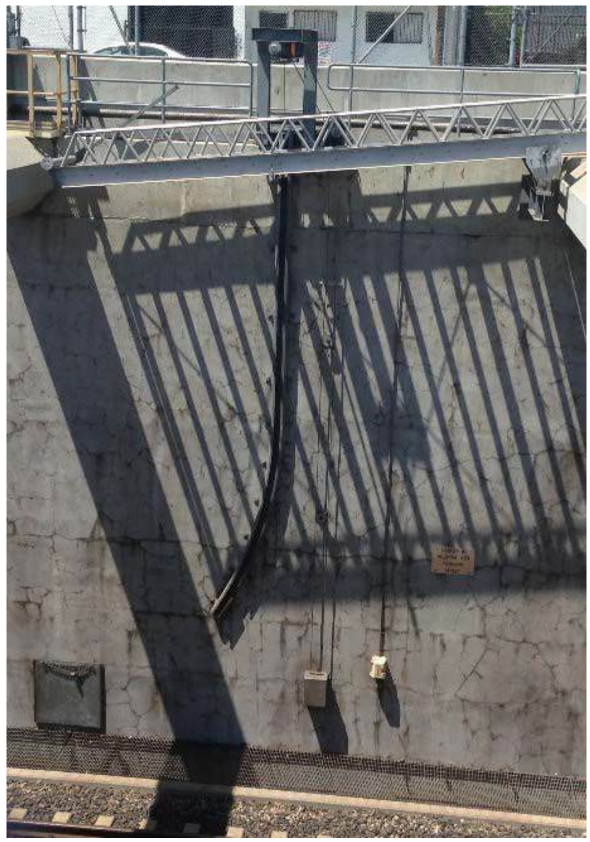
Issues: The counterweight at the foot end of the ladder can bind in the slot through which the support bar must travel, causing the counterweight to be ineffective in lowering the ladder. See above. No problems were noted for the counterweights at the landing end of the Type 2 ladders. Type 1 ladders do not have a landing counterweight.



Lower Counterweight Stand

g) ***Trench Wall Guide Track***

The ladder’s vertical travel is guided by a polyurethane roller on a shaft connected to the ladder stringers. This roller travels in a nearly vertical, open steel channel bolted to the face of the trench wall. It has a flattened “J” shape to account for both horizontal and vertical travel.



Guide Track

Issues: The polyurethane guide wheel can bind in the channel, creating friction during travel.

3.0 Lubrication Points

All the sprockets, pins, chains, and sliding surfaces must be kept lubricated. The points and types of lubrication are shown in the Lubrication Table and photographs below. Lubrication is recommended at least twice a year in conjunction with the semi-annual inspection cycle.

Lubrication Table

Assembly	Parts (#Items)	Lube Type
a) Ladder	• Poly. wheel (sealed bearing) • Shaft through stringer plate (2) • Lower flange face at counterweight contact point	TBD
b) Pivot stand	• 1 1/2" pins (2) • Conveyor rollers (4) • Polyurethane roller (2)	TBD
c) Upper crank stand	• Winch • Winch axle (both ends)	TBD
d) Lower crank box	• Crank shaft (1) • Idler sprockets (2) • Chain tensioner (2)	TBD
f) Upper counterweight stand Lower counterweight stand	• Pins (2) • Under flange stringer (2) • 1"x2" rod slot (1) • Pin (2 plates)	TBD
e) Upper chain drive block	• Pin (2 pillow blocks) • Chains (2)	TBD
g) Guide track	• Inside channel faces (2)	TBD

4.0 Inspection Checklist

During the semi-annual inspection and lubrication cycle, all the moving parts should be inspected in accordance with the Inspection Checklist and photographs below.

Inspection Checklist

a) Ladder	☐ Railing and welds ☐ Stringer welds ☐ Grating connections ☐ Stringer shaft ☐ Cable connections to stringer shaft ☐ Guide wheel and bearings
b) Pivot Stand	☐ Poly wheel and connections ☐ Conveyor rollers (loose bearings) ☐ Pins ☐ Channel spacer welds ☐ Bracket bolts ☐ Support beam welds and bolts
c) Upper Crank Stand	☐ Winch cover and lock ☐ Winch handle ☐ Winch winding ☐ Winch axle ☐ Outer spool and winding ☐ Cable condition ☐ Axle casing and neoprene insert ☐ Frame welds and connections
d) Lower Crank Box	☐ Cover lock ☐ Handle and fit ☐ Cotter pin ☐ Chain on sprocket ☐ Idler sprockets and tensioners
e) Upper Chain Drive Block	☐ Cover and bolts ☐ Pillow blocks and bolts ☐ Chain clearance at slot ☐ Chain condition ☐ Sprocket alignment ☐ Frame bolts and welds
f) Counterweight Stand Lower	☐ Counterweight plate bolts ☐ Bar slot ☐ Pin condition
Counterweight Stand Upper	☐ Counterweight plate connections ☐ Frame welds and bolts ☐ Pins ☐ Support frame welds and connections ☐ Evidence of ladder binding
g) Guide track	☐ Channel wall bolts ☐ Upper closure plate weld ☐ Edge guard (cable protectors)

5.0 Semi-Annual Deployment

Ladders should be fully deployed twice a year – once from street level and once from track level. This deployment should not include the deployment that occurs during Annual Emergency Drill. Those specific ladders to be operated during the annual drill should be deployed within 60 days prior to the drill. Therefore, the ladders at the emergency drill locations will be deployed three times a year.

6.0 Future Improvements

The ladders are undergoing a design review to determine where improvements can be made to better ensure reliability. Once the Operating Committee approves the proposed improvements, the improvements will be installed at a prototype location for verification testing. If the tests are successful, a program and schedule will be established to install the improvements system-wide.

In general, the inspection and lubrication plan will remain in effect for both the old and improved ladder systems during the improvement installation phase. Select changes may be made as needed to the plan after the improvements are installed.

7.0 Summary/Conclusions

The mechanical ladders have been in service since 2002. Due to design requirements, the ladder mechanisms are a complex organization of moveable parts that must all work in concert for the ladders to operate properly. Recent experience with ladder deployment has indicated the need for a standardized schedule of inspection and lubrication. In addition, some of the ladder mechanisms are being reviewed from a design standpoint to determine if they can be improved for increased reliability.

In mid-2014, most all the ladders were deployed for the purpose of identifying and correcting problems common to all ladders and specific problems to some. Many of the problems were immediately corrected and others are being evaluated. This comprehensive review exercise was very beneficial and was used as input into the inspection and lubrication plan.

Therefore, the reliability and safe operation of the ladders will be ensured by the combination of bi-annual inspection, lubrication and testing; future installation of certain design improvements; and issuance of instructions and training to potential users, addressing proper operation and how to spot and correct trouble conditions.

Ladder Locations

Alameda Corridor Mid-Corridor Trench
Emergency Access Ladder & Fixed Stairs Locations

Ladder No.	Station	Mile Post	Geographic Location	Comments
Vertical Ladder	649+75	10.15	west side of trench, s/o Auto Drive North - Compton	Vertical Ladder
Greenleaf Pump Station Stairway	635+40	9.88	west side of trench, n/o Bennet Street - Compton	Fixed Stairs
1	627+40	9.73	west side of trench, s/o Tichenor Street - Compton	
2	617+40	9.54	west side of trench, s/o Alondra Blvd. - Compton	
3	607+40	9.35	west side of trench, s/o Cypress Street - Compton	
4	598+10	9.17	west side of trench, n/o Myrrh Street - Compton	
4F	594+10	9.11	west side of trench, n/o Myrrh Street - Compton	Fixed Stairs
5	589+50	9.01	west side of trench, s/o Compton Blvd. - Compton	
Caged Ladder	584+68	8.93	west side of trench, 60 yds n/o Compton Blvd. - Compton	Caged Ladder for Signal Niche
6	581+10	8.83	west side of trench, 400 yds s/o Palmer Street - Compton	
7	571+17	8.67	west side of trench, 400 yds s/o Elm Street - Compton	
8	461+35	8.49	west side of trench, 400 yds s/o Rosecrans Ave - Compton	Fixed Stairs replaced Drop Ladder
9F	551+40	8.29	east side of trench, 270 yds n/o Mealy Street - Compton	Fixed Stairs
9	551+35	8.29	west side of trench, 270 yds n/o Mealy Street - Compton	
10	541+46	8.10	west side of trench, 230 yds s/o Oris Street - Compton	
11	531+76	7.92	west side of trench, 570 yds n/o 134th Street/Pine St. - Compton	
12	521+40	7.73	west side of trench, 500 yds s/o 130th Street - Compton	
Control Point Weber Access Stairway	517+54	7.67	west side of trench, 110 yds s/o El Segundo Blvd.	Fixed Stairs
13	511+74	7.54	west side of trench, 470 yds n/o El Segundo Blvd. - Compton	
14	501+61	7.36	west side of trench, 530 yds s/o 124th Street/Weber Ave. - Compton	
15	491+38	7.16	west side of trench, 1970 yds s/o Industry Way - Lynwood	
16F	481+55	6.97	east side of trench, 290 yds n/o Industry Way - Lynwood	Fixed Stairs
16	481+50	6.97	west side of trench, 290 yds n/o Industry Way - Lynwood	
17	470+94	6.78	west side of trench, 470 yds s/o Imperial Hwy- Lynwood	
18	461+05	6.59	west side of trench, 500 yds n/o Imperial Hwy - Lynwood	
19	451+79	6.41	west side of trench, 600 yds n/o Santa Ana Blvd. - South Gate	
20F	441+15	6.20	east side of trench, 350 yds n/o 110th Street. - South Gate	Fixed Stairs
20	441+23	6.21	west side of trench, 330 yds n/o 110th Street - South Gate	
21	431+35	6.01	west side of trench, 400 yds \n/o Martin Luther King Blvd. - South Gate	
22	421+45	5.83	west side of trench, 460 yds s/o 103rd Street - South Gate	
23	410+95	5.64	west side of trench, 240 yds n/o 103rd Street - South Gate	
24	403+08	5.47	west side of trench, 470 yds s/o Tweedy Blvd. - South Gate	
25	392+23	5.28	west side of trench, 470 yds n/o 96th Place - LA County	
26	382+35	5.09	west side of trench, 470 yds n/o 94th Street - LA County	
27	371+78	4.90	west side of trench, 45 yds n/o 90th Street - LA County	
28	362+54	4.71	Compton - west side of trench, 700 yds s/o Firestone Ave. - LA County	

Alameda Corridor Mid-Corridor Trench
Emergency Access Ladder & Fixed Stairs Locations

Ladder No.	Station	Mile Post	Geographic Location	Comments
29	352+56	4.52	Compton - west side of trench, 330 yds s/o Manchester Ave. LA County	
30	341+50	4.31	west side of trench, 170 yds s/o 83rd Street - LA County	
Nadeau Control Point Access Stairway	331+90	4.13	east side of trench, 400 yds s/o Center Street - LA County	Fixed Stairs.
Nadeau Pump Station Access stairway	322+60	3.95	east side of trench, 175 yds s/o Leota Street - LA County	Fixed Stairs.
31	311+50	3.74	west side of trench, 125 yds s/o 76th Street - LA County	
32	301+07	3.56	west side of trench, 130 yds s/o Florence Ave - Huntington Park	
33F	290+90	3.37	east side of trench, 35 yds s/o Saturn Avenue - Huntington Park	Fixed Stairs.
33	291+11	3.37	west side of trench, 90 yds n/o Hawkins Circle - Huntington Park	
34	281+44	3.18	west side of trench, 50 yds s/o Zoe Ave. Huntington Park	
35	272+92	3.02	west side of trench, 50 yds s/o Gage Ave - Huntington Park	
36	262+28	2.82	west side of trench, 310 yds s/o Randolph Street - Huntington Park	
Caged Ladder	259+20	2.79	east side of trench, 168 yds s/o Randolph Street - Huntington Park	Caged Ladder for Signal Niche
37	251+67	2.62	east side of trench, 70 yds n/o Randolph Street - Huntington Park	
38	241+85	2.43	east side of trench, 70 yds n/o Slauson Ave. Huntington Park	
39	231+66	2.24	east side of trench, s/o 55th Street - Vernon	
40	221+90	2.05	east side of trench, n/o 52nd Street - Vernon	
41	211+85	1.86	east side of trench, s/o 49th Street - Vernon	
42	201+85	1.67	east side of trench, n/o 48th Street - Vernon	
43	191+85	1.48	east side of trench, s/o Vernon Ave - Vernon	
44	182+41	1.3	east side of trench, n/o Vernon Ave - Vernon	
45	177+81	1.20	east side of trench, s/o 38th Street - Vernon	
46	167+26	1.01	east side of trench, n/o Martin Luther King Blvd. - Vernon	
47	155+31	0.79	west side of trench, n/o 27th Street - City opf Los Angeles	
Fixed Access Stairway	138+38	0.4	east Side of J-Yard Slope - Acces for CP 25th St.	Fixed Access Staiway

ACTA

Alameda Corridor Transportation Authority

Maintenance of Way Services

Appendix N

Qualifications of Key Personnel

MAINTENANCE CONTRACT MANAGER

Duties:

- Plan, direct, manage, and coordinate the activities of the Contractor (including subcontractors) in the performance of Services to ensure compliance with contract requirements, applicable regulations, ACTA standards, and approved budgets.

- Coordinate activities, as necessary, with other ACTA contractors, third-party contractors, and other public and private entities.

- Serve as the point of contact for ACTA for all matters relating to the contract and attend consultation and planning meetings with ACTA.

- Coordinate preparation of documents including annual budget and work plan; training schedule and curriculums; inspection and safety plans; Contract Task Orders (CTOs); required records and reports; ACTA contract invoices; subcontracts; and vendor purchase orders.

- Supervise and manage subcontractors and Contractor staff and arrange for replacement personnel in the event of vacancies.

- Respond immediately to emergency events and initiate inspection and/or repair to track, signal and communications systems, and other facilities as required to safely support railroad operations.

Requirements: (Note: ACTA reserves the right to reduce required years-of-experience based on evaluation of individual resume.)

1. 8-10 years of progressively responsible experience in railroad track maintenance and/or construction on a signalized operating railroad, including at least 3 years in a similar contract manager role supervising and managing employees engaged in such activities, and 3 years managing construction and/or maintenance contracts.

2. Knowledge of the safe and proper procedures for operating railroad maintenance hand/power tools and railroad maintenance equipment.

3. Ability to communicate both verbally and in writing in the English language and have prior record keeping and invoicing experience.

4. Must possess strong interpersonal skills, experience dealing directly with clients, and experience managing administrative and accounting staff.

5. Knowledge of FTSS and FRWS and the ability to be qualified for part 213.7 of FTSS and the GCOR related to these regulations at the Start Date.

6. Previously qualified with a railroad to provide workplace protection under FRWS and to inspect track and supervise restoration of track under FTSS.

7. Basic knowledge of the physical layout and operation of the ACTA Rail Corridor.

8. Knowledge of time to complete and cost to repair track and right-of-way facilities, and ability to make value judgments regarding efficient and economical repair and/or replacement of these facilities.

9. Knowledge of the adjustment of thermal stress in continuously welded rail per part 213.119 of the FTSS.

10. Ability to read and interpret drawings, plans, and specifications for railroad track and civil construction.

11. Knowledge of track and signal inspection procedures and experience supervising the work of others for compliance with these procedures.

12. Ability to complete work under time constraints and to maintain composure under the stress of emergency situations.

13. Ability to perform scheduled and emergency repair or construction work at any time on any day of the week.

14. Possess or obtain within six weeks of the Start Date, a valid California driver's license and have no more than three moving violations and no DUIs within the last three years.

15. Pass a pre-employment physical examination including a drug and alcohol test.

16. Ability to work outdoors in all weather conditions, lift objects weighing up to 50 lbs., distinguish colors, and hear warning signals and radio and telephone devices.

RAILROAD BRIDGE SUPERVISOR

Duties:

- Supervise and coordinate the activities of crews that inspect, repair, maintain, and construct railroad bridges, tunnels, culverts, and embankments.
- Arrange for the materials, tools, and equipment required for these tasks.
- Arrange protection of work activities per FRWS, including temporary speed restrictions while performing duties in accordance with the FTSS and operating on-track inspection equipment.
- Coordinate with other maintenance activities of the Contractor, railroad dispatchers, third-party contractors, and other impacted public and private entities.
- Train employees in safe and proper work methods, dispatcher communications, and efficient use of labor and material.
- Prepare documentation of inspections performed and resources (labor, material, equipment, and supplies) used.
- Assist Maintenance Contract Manager in overall supervision of the Services.
- Initiate inspections and/or repairs of structures in response to emergency conditions at any time of any day.
- Arrange schedule, material procurement, equipment availability, and transportation for inspection and repair crews.

Requirements: (Note: ACTA reserves the right to reduce required years-of-experience based on evaluation of individual resume.)

1. 6-8 years of progressively responsible experience in railroad structure maintenance and/or construction on a signalized operating railroad, including at least 4 years supervising or directing the work of others engaged in such activities.
2. Familiarity with the inspection, construction, and repair of structures comprised of pre-stressed and cast-in-place concrete, steel, timber, and combinations thereof.
3. Familiarity with the railroad bridge rating system using Cooper E-80 Load.
4. Knowledge of the safe and proper procedures for operating railroad maintenance hand/power tools and railroad maintenance equipment.
5. Ability to communicate verbally and in writing in the English language with prior record keeping experience.

6. Must possess strong interpersonal skills.

7. Knowledge of the FRWS (including fall protection and rescue measures) GCOR related to these regulations at the Start Date.

8. Knowledge of Confined Space regulations of OSHA and CalOSHA.

9. Previously qualified with a railroad to provide worker protection under FRWS.

10. Basic knowledge of the physical layout and operation of the ACTA Rail Corridor.

11. Knowledge of time to complete and cost to repair bridge and right-of-way facilities, and ability to make value judgments regarding efficient and economic repair and/or replacement of these facilities.

12. Ability to read and interpret drawings, plans, and specifications for railroad structural and civil construction.

13. Ability to complete work under time constraints and to maintain composure under the stress of emergency situations.

14. Ability to perform scheduled and emergency repair or construction work at any time on any day of the week.

15. Possess or obtain within six weeks of Start Date, a valid California Class “A” driver’s license with no more than three moving violations and no DUIs within the last 3 years.

16. Pass a pre-employment physical examination including a drug and alcohol test.

17. Ability to work outdoors in all weather conditions, lift objects up to 50 lbs., distinguish colors, and hear warning signals and radio and telephone devices.

RAILROAD TRACK SUPERVISOR

Duties:

- Supervise and coordinate day-to-day activities of crews that inspect, test, repair, maintain, and construct railroad track, special trackwork, embankments, and right-of-way.

- Perform visual inspections of the track and right-of-way, and arrange for necessary materials, tools, and equipment required to keep facilities in good repair.

- Arrange worker protection for crews per FRWS. Control and operate on-track inspection trucks and machinery.

- Coordinate individual and concurrent maintenance and repair activities with railroad dispatchers, third-party contractors, and other impacted public and private entities.

- Training employees in safe and proper inspection, maintenance, and construction methods, how to communicate and coordinate with dispatchers.

- Apply efficiently and economical use of labor, material, and equipment.

- Prepare documentation of inspections, maintenance, repairs, and replacements performed as well as resources (labor, material, equipment, and supplies) used.

- Assist Maintenance Contract Manager in overall supervision of the Services.
- Initiates inspections and/or repairs of track in response to emergency conditions at any time of any day.

Requirements: (Note: ACTA reserves the right to reduce required years-of-experience based on evaluation of individual resume.)

1. 6-8 years of progressively responsible experience in railroad track maintenance and/or construction on a signalized operating railroad, including at least 4 years supervising and/or directing the work of others engaged in such activities.

2. Knowledge of the safe and proper procedures for operating railroad maintenance hand/power tools and railroad maintenance equipment.

3. Ability to communicate verbally and in writing in the English language with record keeping experience.

4. Must possess strong interpersonal skills.

5. Knowledge of FTSS and FRWS and the ability to be qualified for part 21 3.7 of FTSS and the GCOR related to these regulations at the Start Date.

6. Previously qualified with a railroad to provide workplace protection under FRWS and to inspect track and supervise restoration of track under FTSS.

7. Basic knowledge of the physical layout and operation of the ACTA Rail Corridor.

8. Knowledge of the time to complete and cost to repair track, special trackwork, and right-of-way facilities, and the ability to make value judgments regarding efficient and economic repair and/or replacement of these facilities.

9. Knowledge of the adjustment of thermal stress in continuously welded rail per part 213.119 of the FTSS.

10. Knowledge of techniques to maintain, repair, and replace special trackwork items such as turnouts, crossovers, diamonds, and crossing panels.

11. Ability to read and interpret drawings, plans, and specifications for railroad track and civil construction.

12. Ability to complete work under time constraints and maintain composure under the stress of emergency situations.

13. Ability to perform scheduled and emergency repair or construction work at any time on any day of the week.

14. Possess or obtain within six weeks of the Start Date, a valid California driver's license with no more than three moving violations and no DUIs within the last 3 years.

15. Pass a pre-employment physical examination including a drug and alcohol test.

16. Ability to work outdoors in all weather conditions, lift objects up to 50 lbs., distinguish colors and hear warning signals and radio and telephone devices.

RAILROAD SIGNAL AND COMMUNICATIONS SUPERVISOR

Duties:

- Supervise and coordinate the day-to-day activities of crews that inspect, test, repair, maintain, and construct railroad signal and communication systems, including grade crossing warning devices.
- Arrange for worker protection per CFR 49.
- Coordinate with other maintenance activities of the Contractor, dispatchers, third-party contractors, and impacted public and private entities.
- Train employees in safe and proper inspection, testing, installation and repair methods, how to communicate with dispatchers regarding activities to be performed, and the efficient use of labor and material.
- Prepare documentation of inspections, tests and installations performed and resources (labor, material, equipment, and supplies) used.
- Assist Maintenance Contract Manager in overall supervision of the Services.
- Initiate inspections, tests and repairs of signal & communications systems in response to emergency conditions at any time of any day.
- Arrange scheduling, material procurements, equipment availability, and transportation for signal and communications crews.

Requirements: (Note: ACTA reserves the right to reduce required years-of-experience based on evaluation of individual resume.)

1. 6-8 years of progressively responsible experience in railroad signal and communications maintenance and/or construction in an operating railroad environment, including at least 4 years supervising or directing the work of others engaged in such activities.
2. Ability to read and understand complex signal and electrical circuits and possess knowledge of standard signal practices.
3. Knowledge of hot box detectors, high-wide detectors, dragging equipment detectors, grade crossing warning devices, and radio communications elements.
4. Demonstrate understanding of the VHLC (Vital Harmon Logic Controller) and have the ability to reprogram the VHLC at any given time. Ability to modify or make changes to the VHLC program, changes to basic signal circuits such as highway grade crossing systems, switch control circuits etc. Knowledge of Safetrain or Harmon Grade Crossing

Predictors.

5. Familiarity with and capability to perform all tests and inspections set forth in FRA, CFR 49 parts 234 and 236.

6. Knowledge of the safe and proper procedures for operating railroad maintenance hand/power tools and railroad maintenance equipment.

7. Ability to communicate verbally and in writing in the English language with prior record keeping experience.

8. Must possess strong interpersonal skills.

9. Knowledge of the time to complete and cost to repair railroad signal & communication systems and how to address failures, and ability to make value judgments regarding economic repair and/or replacement of these facilities.

10. Ability to complete work under time pressures and to maintain composure under the stress of emergency situations.

11. Ability to perform scheduled and emergency repair or construction work at any time on any day of the week.

12. Possess or obtain within six weeks of the Start Date, a valid California driver's license with no more than three moving violations and no DUIs within the last 3 years.

13. Pass a pre-employment physical examination including a drug and alcohol test.

14. Ability to work outdoors in all weather conditions, lift objects up to 50 lbs., distinguish colors, and hear warning signals and radio and telephone devices.

SAFETY SUPERVISOR

Duties:

- Manages and coordinates all aspects ACTA and Railroad safety programs, ensuring that all safety programs are correctly administered as set forth in the Special conditions, as well as knowledge of FRA standards and qualified under FRA Track Safety Standards, Part 213, Railroad Workplace Safety, Part 214, applicable CPUC General Orders, Right-of-Way, and Structures Engineering instructions, and Roadway Worker Protection rules and regulations.

- Implements and manages safety policies and procedures in compliance with local, state, and federal OSHA rules and regulations.

- Manages the administration of project safety, accident, and hazard communication programs to maintain safe work environments.

- Corrects unsafe employee activities, procedures, and practices.

- Inspect work locations to detect existing or potential accidents and health hazards.

- Documents unsafe conditions, safety hazards, determines corrective or preventative measures where indicated, and follows up to ensure measures have been implemented.

- Evaluates contractors' safety programs and policies; recommends changes and manages implementation of changes.

- Conducts investigations of accidents and injuries through employee interviews, equipment inspections and site inspections, carefully reviewing the integrity of personal protective equipment, materials, and job-site specific gear.

- Provides regular worksite safety training for all employees; provides training for hourly labor, foremen, supervisors and local managers in work site safety practices, fire prevention and correct handling techniques for toxins, equipment and other materials.

- Recommends appropriate disciplinary action when safety policies are violated.

- Manages administration of contractor safety training.

- Requires that all required records and reports be complete, accurate and correctly submitted to comply with all internal processes and comply with all state and federal regulations.

- Provides informational signs, posters, barriers, and other materials to warn of potential and actual safety hazards and to prevent access to hazardous conditions.

Requirements: (Note: ACTA reserves the right to reduce required years-of-experience based on evaluation of individual resume.)

1. A minimum of 5 years of experience in safety positions in the railroad industry.
2. A bachelor's degree in occupational safety or a related science field.
3. Knowledge of and experience with OSHA rules, and regulations and reporting processes and procedures.
4. Knowledge of FRA standards and qualified under FRA Track Safety Standards, Part 213, Railroad Workplace Safety, Part 214, and applicable CPUC General Orders.
5. Possess or obtain within six weeks of the Start Date, a valid California driver's license with no more than three moving violations and no DUIs within the last 3 years.
6. Ability to effectively communicate, train and manage staff.
7. Strong verbal and written communication skills: ability to interact with all levels of individuals and regulatory agencies.

RAILROAD MACHINE OPERATORS

Duties:

- The MOW contractor shall provide qualified Railroad Machine Operators and will not be allowed to operate any equipment within the Authority Right-of-Way until the following requirements are met:

Requirements: (Note: ACTA reserves the right to reduce required years-of-experience based on evaluation of individual resume.)

1. Knowledge of railroad methods of track construction and maintenance.

2. Equipment operators with at least two years of experience operating the make and model of the equipment assigned to operate.

3. Certification from MOW Safety Supervisor that operator has successfully completed any and all training on equipment or machine assigned to operate.

4. Must have a valid California driver’s license with no more than three moving violations and no DUI’s in any state in the last three years.

5. Must pass a pre-employment physical examination including a drug and alcohol test.

6. Ability to work outdoors in al weather conditions, to lift objects weighing a minimum of 50 lbs. and must be able to distinguish colors and hear warning signs and radio and telephone devices.

Maintenance of Way Services

Appendix O

Small Business Enterprises (SBE) Forms

SBE Participation

Subcontracting Opportunities List

It is ACTA's objective to provide SBE subcontracting opportunities for all subcontracted activity, as well as to encourage contractors to subcontract activities which might have otherwise been performed by the contractor itself to meet and exceed the 15% minimum participation level.

During the term of the Maintenance of Way Agreement, there may be subcontracting opportunities in the following areas. While this list is not all inclusive, the Proposer is encouraged to consider any and all opportunities where appropriate.

- Crane service
- Damaged bridge and structure repairs
- Debris removal
- Emergency ladder repairs
- Fence installation and repair
- Graffiti removal
- Maintenance facility security
- Maintenance facility cleaning and repair
- Painting of structures
- Pump station repair and maintenance – electrical, plumbing, mechanical
- Rail grinding
- Rail flaw detection
- Traffic control
- Weed abatement/vegetation control

Alameda Corridor Transportation Authority
Small Business Enterprise (SBE) Participation Requirements

1.0 SBE Participation

ACTA promotes using Small Business Enterprises (SBEs) and has established a minimum participation level of 15% for the Maintenance of Way Services Agreement. However, Proposers are encouraged to maximize SBE participation above that amount to the extent possible.

2.0 Definitions

Contractor - an individual, partnership, corporation or other legal entity that is submitting a bid or proposal to perform construction related work. A Contractor must have a valid State of California Contractor's License to the extent required by law.

Department of General Services (DGS) - serves as the business manager for the State of California.

Good Faith Effort (GFE) - a prescribed set of actions conducted by Proposers to identify SBEs to meet the established SBE participation 15% SBE minimum participation level for this procurement. See Good Faith Effort Evaluation Criteria.

National Institute of Governmental Purchasing (NIGP) - a professional association for public procurement that seeks to develop, support and promote the public procurement profession through educational and research programs, professional support, technical services and advocacy initiatives that benefit members and constituents.

NIGP Codes - standardized commodity/service codes developed by the NIGP.

North American Industrial Classification System (NAICS) - classifies business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. economy. The NAICS industry codes define establishments based on activities in which they are primarily engaged.

NAICS Codes - used as the certification codes for Small Business Certifications.

Small Business Enterprise (SBE) - eligibility may be determined by either using U.S. Small Business Administration (SBA) size standards which are matched to the NAICS codes, or by the SBE standards set by the DGS.

Subcontractor - an individual, firm, or entity having a direct contract with the prime Contractor or with any other Subcontractor to perform a portion of the subject contract. A Subcontractor must have a valid State of California Contractor's License to the extent required by law.

Vendor/Supplier - an individual, firm or entity providing materials or supplies directly to the subject contract. For a prime Contractor to receive participation credit for using an SBE Vendor or Supplier, the materials/supplies must be directly applicable to the subject contract.

3.0 Application

3.1 Non-SBE prime Contractors are encouraged to the extent possible to use SBE subcontractors. Non-SBE prime Contractors shall meet the 15% SBE minimum participation level or document and submit an acceptable GFE, for their proposal to be deemed responsive. SBE prime Contractors, certified through online SBE databases and/or the DGS database or certified through local agencies and verified by ACTA, are deemed to have met the SBE component of the 15% SBE minimum participation level.

3.2 All prime Contractors are encouraged to use SBE Subcontractors, whether at a first tier or lower tier level, as well as small business Vendors and Suppliers. Lower tier subcontractors, Vendors and Suppliers must provide services/materials directly related to the contract to be counted toward meeting the 15% SBE minimum participation level.

4.0 SBE Databases: Vendor Registration and SBE Certification

4.1 In order to be counted toward meeting the 15% SBE minimum participation level, an SBE firm shall be certified through any local agency or State program, and must be certified by the due date of the prime Contractor's Proposal.

4.2 Prior to contract award, SBE status shall be verified and may be audited by ACTA.

5.0 Commitment

5.1 The Proposal shall include a completed SBE Commitment Plan Form (CPF) indicating the estimated percentage of SBE participation to be achieved.

5.2 If the Proposal does meet the 15% SBE minimum participation level, the Proposer shall submit GFE documentation with the Proposal. The Proposer must achieve a GFE minimum score of 70 out of 100 points for a Proposal to be deemed responsive.

5.3 A Proposer that does not meet the 15% SBE minimum participation level and does not submit GFE documentation with the Proposal, or submits GFE documentation that does not achieve the minimum passing score of 70 shall be deemed non-responsive.

5.4 If an SBE firm listed on a prime Contractor's CPF loses its SBE status or certification prior to contract award, the firm will not count toward meeting the 15% SBE minimum participation level unless:

- The firm becomes eligible for recertification and is recertified; or
- If the firm is not eligible for recertification, the prime Contractor replaces the firm and submits a revised CPF for approval.

5.5 After negotiations have been completed and the Agreement is executed, achieving the 15% SBE minimum participation level or the GFE reduced commitment is a contractual commitment and can only be altered with written approval of ACTA. During the Annual Maintenance Budget approval process, SBE participation will be negotiated and maximized based on the planned activity for the upcoming year.

5.6 See RFP Appendix A, Draft Maintenance Agreement for information concerning substitutions after award, reporting, compliance, monitoring, violations, and remedies.

6.0 Good Faith Effort Evaluation Criteria

A Proposer submitting a proposal that does not meet the 15% SBE minimum participation level may be deemed responsive if the Proposer submits documentation showing it made an acceptable Good Faith Effort (GFE) to meet the 15% SBE minimum participation level. There are 9 criteria that will be used to evaluate a GFE, and a score of 70 or more of a possible 100 points must be achieved for a proposal to be declared responsive. The following are the weighted GFE criteria:

6.1 **Attend Pre-Proposal Meeting (5 points):** The Proposer submitted written evidence that it attended the pre-proposal meeting.

6.2 **Subdivide the Work (10 points):** The Proposer identified the services (work category) to be performed by its own workforces and those to be subcontracted or supplied by others in an effort to meet the 15% SBE minimum participation level. The services shall be identified using NAICS and/or NIGP codes with dollar values clearly identifying the level of SBE participation sought.

6.3 **Advertise (10 points):** The Proposer submitted written evidence of commercial advertising for SBE participation at least 14 calendar days prior to the Proposal deadline. The advertisement shall identify the list of services identified for SBE participation. Proof of advertising shall include the name of the advertiser(s); a copy of the advertisement(s) showing the date(s) published; and an affidavit from advertiser(s) attesting to the placement of the advertisement(s).

6.4 **Use of Vendor Databases (15 points):** The Proposer submitted written evidence of using local agency and/or DGS online SBE databases.

6.5 **Directly Solicit SBEs (15 points):** The Proposer submitted written evidence of directly soliciting an adequate number of SBE potential participants certified in available databases at least 14 calendar days prior to Proposal submission. The evidence shall contain names, contact persons, addresses, phone numbers and dates of all SBE firms contacted; services requested; and how more specific service requirements were communicated or provided.

The Proposer shall contact an adequate number of SBE firms for each category of work that was identified for SBE participation. The number of contacts depends on the total number of SBE firms certified in the database within the category of work. If the database contains 5 or less, then the bidder or proposer shall contact all SBE firms in that database. If the database contains 6 to 10, at least 5 shall be contacted. If the database contains 11 to 50, at least half shall be contacted. If the database contains more than 50 at least 25 shall be contacted.

6.6 **Conduct Follow-Up (15 points):** Proposer shall submit a contact log with names, contact persons, phone numbers, dates and methods used for follow-up on initial solicitations. The follow-up log should contain a minimum of 75% of the initial solicitations.

6.7 **Offer Assistance (5 points):** The Proposer shall demonstrate that it has offered to assist SBEs in obtaining bonding, insurance, lines of credit, equipment or other means of support.

6.8 **Negotiate and Document Bid Results (15 points):** The Proposer shall submit written evidence that it negotiated in good faith with interested SBEs. Negotiations include discussions regarding scope of work, materials, equipment, insurance, bonding, personnel, timing of project, etc. For any negotiations that were unsuccessful, the Proposer shall submit the unsuccessful firm's name, telephone number, contact person, price bid (if applicable) and the reason for rejecting the SBE firm. ACTA reserves the right to require the Proposer to submit copies of all SBE and non-SBE bids for each item of work before finalizing the score for this criterion.

6.9 **Proposer Commitment Value (10 points):** The Proposer's SBE commitment percentage in relation to that of other Proposers. Percentage must equal or be greater than the average commitment percentage of the other Proposers.

SBE FORM 01 – Proposer SBE Status

1.0 At the time of submitting a proposal is the Proposer a Certified SBE?

YES ______ NO __

If yes, attached a copy of the SBE certification, indicating the certifying agency.

2.0 Verification/Declarations

I declare under penalty of perjury under the laws of the State of California that the foregoing information is true and correct.

Date: ____________________________________

Signature: ________________________________

Print Name: ______________________________

Title: ___________________________________

Proposer: ________________________________

SBE FORM 02 – SBE Participation Calculation

Cost Item	Total Dollar Amount	SBE Dollar Amount *	Name of SBE Certified Firm **
A. Track, Bridge, Safety Positions (Enter Total from Form AR-I. See App. R Cost Forms)			
B. Signal / Comm ARR Unit Costs (Enter Total from Form AR-II (1 of 2). See App. R Cost Forms)			
Subtotal of A & B			

C. Subcontracting Work Items	Assume Total Value of	SBE Dollar Amount *	Name of SBE Certified Firm **
C1. Crane Service	$ 50,000		
C2. Bridge and Structure Repairs	200,000		
C3. Debris Removal	15,000		
C4. Emergency Ladder Repairs	100,000		
C5. Fence Installation / Repair	70,000		
C6. Graffiti Removal	120,000		
C7. Maintenance Facility Cleaning / Repair	24,000		
C8. Maintenance Facility Security	150,000		
C9. Painting of Structures	100,000		
C10. Pump Station Repair / Maintenance – electrical, plumbing, mechanical	100,000		
C11. Rail Grinding	100,000		
C12. Rail Flaw Detection	30,000		

C13. Traffic Control	30,000		
C14. Weed Abatement / Vegetation Control	30,000		
Subtotal of C	$1,119,000		

D. Special Material Purchase	**Assume Total Value of**	**SBE Dollar Amount ***	**Name of SBE Certified Firm ****
D1. Rail Ties and Ballast	$ 240,000		
D2. Switch Ties and Ballast	260,000		
Subtotal of D	$ 500,000		

Grand Total (A+B+C+D)		
	GT1	GT2

SBE % = (GT2/GT1) x 100

* Enter N/A if Not Applicable
** Provide SBE detailed information on SBE Form 03

SBE FORM 03 – SBE Commitment Plan Form (CPF)

This information shall be submitted with Proposal. A Proposal shall be deemed non-responsive and not considered for award of contract, if: (1) the CPF is not received with the Proposal, or (2) the Proposal does not meet the minimum 15% SBE participation level, and does not include GFE documentation with the Proposal that achieves the minimum passing score of 70.

PROPOSER'S NAME:____

Only certified SBE firms are to be listed on this form. Firms must be currently certified on the date of the Proposal. Include all SBE firms from SBE Form 02. Copies of current SBE certifications must be submitted with the Proposal.

	Name of Certified SBE Firm	Certifying Agency *	Certification Number	Services or Materials Supplied **	Contact Information (Telephone # & Email Address)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

Form continues on next page.
Add additional pages if necessary.

*	SBEs must be certified by State or other local agency such as, but not limited to, City of Los Angeles, Los Angeles County Metropolitan Transportation Authority, Port of Long Beach or Port of Los Angeles.
**	If 100% of item is not to be performed or furnished by SBE, provide exact portion of item to be performed or furnished by SBE. The Services or Materials Supplied entry must be sufficiently descriptive to establish whether the work is to be performed by a Subcontractor, Supplier/Vendor, or Manufacturer. Credit for a SBE Supplier/Vendor, who is not a Manufacturer is limited to 60% of the amount paid to the Supplier/Vendor.
IMPORTANT: Names of SBE certified firms listed above should be consistent with the name and items of work listed on the DIR Form (Appendix D) submitted with the Proposal.	

____ ____

Signature of Proposer Date (Area Code) Phone No. Person to Contact (Type or Print)

Note: If any of the SBE certified firms also have other certifications such as but not limited to MBE, WBE, DBE, DVBE, or LBE, please include such on separate SBE Form 04 .

SBE FORM 04 – Other Certifications of SBE Firms

Supplemental SBE Form

If any of the SBE certified firms listed on SBE Form 03 also have other certifications such as but not limited to MBE, WBE, DBE, DVBE, or LBE, please include below. Copies of the certifications listed below should be submitted with the Proposal.

	Name of Certified SBE Firm from SBE Form 03	Additional Certification Type	Certifcation Number	Certifying Agency
1				
2				
3				
4				
5				

Add additional pages if necessary.

SBE FORM 05 – SBE Good Faith Effort Evaluation Form (GFE)

This information shall be submitted with Proposal. A Proposal shall be deemed non-responsive and not considered for award of contract, if: (1) the GFE is not received with the Proposal, or (2) the Proposal does not meet the minimum 15% SBE participation level, and does not include GFE documentation with the Proposal that achieves the minimum passing score of 70.

PROPOSER'S NAME:____

Only certified SBE firms are to be listed on this form. Firms must be currently certified on the date of the Proposal. Include all SBE firms from SBE Form 02. Copies of current SBE certifications must be submitted with the Proposal.

	Evaluation Criteria	Comments	Yes	No	Points
1	Did the Proposer Attend the Pre-Proposal Meeting? (5 Points)				
2	Did the Proposer Subdivide the Work? (10 Points)				
3	Did the Proposer Advertise. (10 Points)				
4	Did the Proposer use the Vendor Database? (15 Points)				
5	Did the Proposer Directly Solicit SBE's. (15 Points)				
6	Did the Proposer Conduct Follow-up. (15 Points)				
7	Did the Proposer Offer Assistance. (5 Points)				
8	Did the Proposer Negotiate and Document Bid Results? (15 Points)				
9	What is the Proposer Commitment Value .(10 Points)				
	TOTAL VALUE				

Maintenance of Way Services

Appendix P

Cost Proposal Forms

SECTION I. Value 16 points

I. TRACK, PUMP STATION, BRIDGE & SAFETY LABOR POSITIONS [1]	Firm(s)	Number of Positions	Straight-time Hours Per Year Per Position	Hourly Rate	Subtotal	Est. OT Hours	OT Rate	Subtotal	Total Annual Cost
I-A. MANAGEMENT POSITIONS - Salaried or Hourly									
Contract Manager									
Track Supervisor									
Bridge Supervisor									
Safety Supervisor									
Office Manager									
Other									
I-B. STAFF POSITIONS - Hourly									
Foreman									
Asst. Foreman									
Track Inspector									
Laborers									
Equipment Operators									
Welder									
Welder Helper									
Flagger (RWIC)									
Other									
			Sub-Totals						
I-C. MAINTENANCE YARD SECURITY [2]									
				Grand Total Annual Labor Costs (1-A, 1-B, 1-C)					

[1] All quoted hourly rates are to be fully burdened, including but not limited to: salary paid to employee; overhead markups including fringe benefits, etc.; insurance; profit; Local Administrative and Office Support Costs (See Appendix A, Article 1 Definitions); and Safety Equipment Costs (See Appendix A, Article 1 Definitions) for contractor and subcontractor. If position is through a subcontractor so indicate, and include general contractor markup as applicable in rate.

[2] Including markups, if applicable.

Section I is worth 16 points. The lowest Proposer's Grand Total for Section I receives 16 points. A Proposer with an overall total 40% or higher than the lowest Proposer's overall total receives zero points. Those between, receive 16 - ((%/40) x 16) points. For example, an overall total that is 10% higher than the lowest Proposer's overall total receive 16 - ((10/40) x 16) or 12 points.

SECTION II. Value 8 points

II. SIGNAL & COMMUNICATION (S&C) LABOR POSITIONS [1]	Firm(s)	Number of Positions	Straight-time Hours Per Year Per Position	Hourly Rate	Subtotal	Est. OT Hours	OT Rate	Subtotal	Total Annual Cost
II-A. MANAGEMENT POSITIONS - Salaried or Hourly									
Signal/Comm Supervisor									
Signal Engineer									
Safety Supervisor									
Other									
II-B. STAFF POSITIONS - Hourly									
Test Maintainer									
Signal Maintainers									
AEI/Comm Technician									
Other									
II-C. VEHICLES [2] (from Table 1A)									
II-D. EQUIPMENT [2] (from Table 1B)									
II-E. MATERIALS [3]									
II-F. MAINTENANCE YARD SECURITY [3]									
II-G. OTHER [3]									
								Grand Total S&C Costs	

[1] All quoted hourly rates are to be fully burdened, including but not limited to: salary paid to employee; overhead markups including fringe benefits, etc.; insurance; profit; Local Administrative and Office Support Costs (See Appendix A, Article 1 Definitions); and Safety Equipment Costs (See Appendix A, Article 1 Definitions) for contractor and subcontractor. If position is through a subcontractor so indicate, and include general contractor markup as applicable in rate.

[2] No contractor or subchontractor markup allowed. See Appendix A - Article 1, Definitions - Allowed Markup.

[3] Including markups, if applicable.

Section II is worth 8 points. The lowest Proposer's Grand Total for Section II receives 8 points. A Proposer with an overall total 40% or higher than lowest Proposer's overall total receives zero points. Those between, receive 8 - ((%/40) x 8) points. For example, an overall total that is 10% higher than the lowest Proposer's overall total receive 8 - ((10/40) x 8) or 6 points.

Section II - Signal Vehicles & Equipment

Table 1A - Signal & Communications Vehicles

Signal & Comm. Position	Type	Hi-Rail Yes/No	Monthly Rate*	Annual Cost **
Total Annual Cost (enter this amount on Line II-C)				

* All-in cost including insurance, registration, fuel, maintenance, and small tools/supplies. No contractor or subcontractor markup allowed. See Appendix A - Article 1, Definitions - Allowed Markup.

** If a vehicle will be used only a fraction of the year, list the total annual cost for that fraction only. For example, if a monthly rate is $100 and it will be used for only six months, list $600.

Table 1B-Signal & Communications Equipment

Equipment by Type	Hi-Rail Yes/No	Leased	Owned	Rented	Unit Rate*	Estimated Annual Cost **
Total Annual Cost (enter this amount on Line II-D)						

* All-in cost including insurance, registration, fuel, maintenance, and small tools/supplies. Indicate hourly, daily, weekly, or monthly rate, as may apply. No contractor or subcontractor markup allowed. See Appendix A - Article 1, Definitions - Allowed Markup.

** If equipment will be used only a fraction of the year, list the total annual cost for that fraction only. For example, if a monthly rate is $100 and it will be used for only six months, list $600.

SECTION III. Value 2 points

PROPOSED CONTRACTOR MARKUP FOR ALL SUBCONTRACTORS, MATERIALS, AND OTHER PROCUREMENTS.
LIST SEPARATELY
(These markups are to be included in all costs in I, II, & V where applicable)

A - Subcontractor	________%
B - Materials	________%
Average of A & B: ((A+B)/2)	________%
Other if any (do not use in computing average above) ________________________________ **(description)**	________%

Section III is worth up to 2 points. Lowest Proposer's average receives 2 points. A Proposer with an average that is 50% or higher than the lowest Proposer's average receives zero points. Others receive partial points based on the following formula: 2-((%/50)x2). For example, an average that is 25% higher than the lowest Proposer's average receives 2-((25/50)x2) or 1 point.

Section IV - Track, Bridge & Safety (TB&S) Vehicles & Equipment

SECTION IV. Value 3 points

Table 2A - Vehicles

TB&S Vehicle	Hi-Rail Yes/No	Indicate Owned or Leased	Monthly Rate*
Full Size Pickup Truck, 3/4 Ton with Hi-Rails	Yes		
Hi-Rail Crew Cab Truck Supervisors	No		
Compact SUV, 4 x 4	No		
Full size Pickup Truck, 1/2 Ton	No		
Full size Pickup Truck, 6 Passenger Cab with Hi-Rails	Yes		
Hi-Rail Truck Track Inspector	Yes		
Pump Station/Graffiti Vehicle	No		
		Total	

* All-in cost including insurance, registration, fuel, maintenance, and small tools/supplies. No contractor or subcontractor markup allowed. See Appendix A - Article 1, Definitions - Allowed Markup.

Table 2B - Equipment

Description	Indicate Owned or Leased	Daily Rate *
5-Yard Hi-Rail Rotary Dump Truck		
Surfacing Unit(tamper, regulator, truck, & operators)		
Hi-Rail Crane Truck		
Prentice Loader/Grapple Truck		
Backhoe		
Speedswing		
Ballast Car		
Welding Truck and Welder with Hi-Rails		
Spot Tamper		
Bucket Truck, Hi-Rail		
Hi-Rail Vac Truck w/Operator		
	Total	

* All-in cost including insurance, registration, fuel, maintenance, and small tools/supplies. No contractor or subcontractor markup allowed. See Appendix A - Article 1, Definitions - Allowed Markup.

Section IV is worth up to 3 points. Vehicles are worth 1 point and Equipment is worth 2 points. Lowest Proposer's total for each receives maximum points. A Proposer with a total that is 50% or higher than the lowest Proposer's total for each category receives partial points based on the following formula:

- for vehicles, 1-((%/50)x1). For example, a vehicle total that is 25% higher than the lowest Proposer's total receives 1-((25/50)x1) or 0.5 points.
- for equipment, 2-((%/50)x2). For example, an equipment total that is 25% higher than the lowest Proposer's total receives 2-((25/50)x2) or 1 point.

Form AR - V

Additional Estimated Cost Items

SECTION V. Value 6 points

Item No.	Item	Units	Unit Cost *
Track			
	Remove and Replace Switch Point:		
1	16’-6”	EA	
2	19’-6”	EA	
3	30’-0”	EA	
4	39’-0”	EA	
	Remove and Replace Frog:		
5	No. 10	EA	
6	No. 14	EA	
7	No. 20	EA	
8	Remove and Replace Cross Tie	EA	
9	Remove and Replace Switch Tie	EA	
10	Thermite Weld (without rail cost)	EA	
		Total	

11	Tamping (use 1,000 continuous LF as basis)	1,000 Feet	
12	Relay Curve Rail (use 500 continuous LF as basis - new rail, not transposed rail)	500 Feet	
		Total	

Signal			
13	Remove and Replace Switch Machine	EA	
14	Remove and Replace VHLC Module	EA	
15	Remove and Replace Dragging Sensor	EA	
16	Remove and Replace Hot Box Sensor	EA	
17	Remove and Replace High/Wide Sensor	EA	
18	Remove and Replace AEI Reader	EA	
19	Remove and Replace Two Headed Ground Signal	EA	
20	Remove and Replace Typical Dwarf Signal	EA	
21	Remove and Replace Typical Crossing Mechanisms	EA	
22	Remove and Replace Typical HXP or GCP	EA	
23	Remove and Replace Typical Battery Rectifier	EA	
		Total	

* To include fully burdened labor, material, equipment, and markups

Section V is worth up to 6 points: 2 points for 1 - 10 total, 2 points for 11 and 12 total, and 2 points for 13 - 23 total. Lowest Proposer's total for each category receives maximum points. A Proposer with a total that is 50% or higher than the lowest Proposer's total for each category receives zero points. Others receive partial points based on the following formula: 2-((%/50)x2). For example, a total that is 25% higher than the lowest Proposer's total receives 2-((25/50)x2) or 1 point.

Maintenance of Way Services

Appendix Q

CY2024 Operations and Maintenance

&

Maintenance of Way Budgets

Alameda Corridor - Approved Amended CY2023 Operations & Maintenance (O&M) Budget

		Calendar Year 2023						Amended Calendar Year 2022				Variance	
		Basis of Apportionment: GR Ton MI	Basis of Apportionment: Train MI	R.R. M & O Rail Cost (A)	Reserve Account Non-Rail Cost (B)	ACTA Operating Budget Cost (C)	Total	R.R. M & O Rail Cost (A)	Reserve Account Non-Rail Cost (B)	ACTA Operating Budget Cost (C)	Total	CY23-CY22	% Change
I. Labor & Operations Maintenance: (1. Labor, 2. Operations Maintenance)													
1.a.i	**Contract Manager**		TM	227,486.00	64,996.00	32,498.00	324,980.00	220,863.97	63,103.99	31,552.00	315,519.95	$ 9,460	3.0%
1.a.ii	**Track Supervisor**	GTM		205,248.00	51,312.00	-	256,560.00	199,275.76	49,818.94	-	249,094.70	$ 7,465	3.0%
1.a.iii	**Safety Supervisor**	GTM		205,248.00	51,312.00	-	256,560.00	199,275.76	49,818.94	-	249,094.70	$ 7,465	3.0%
1.a.iv	**Office Manager**		TM	59,870.00	59,870.00	-	119,740.00	58,122.10	58,122.10	-	116,244.19	$ 3,496	3.0%
1.a.v	**Office Assistant**		TM	**48,870.00**	**55,370.00**	-	**104,240.00**	58,122.10	58,122.10	-	116,244.19	$ (12,004)	-10.3%
1.b	**Track Inspector**	GTM		**222,541.68**	-	-	**222,541.68**	202,312.96	-	-	202,312.96	$ 20,229	10.0%
1.b.i	**Track Foreman**	GTM		**401,083.36**	-	-	**401,083.36**	202,312.96	-	-	202,312.96	$ 198,770	98.2%
1.b.ii	**Assistant Foreman**	GTM		-	-	-	-	199,076.73	-	-	199,076.73	$ (199,077)	-100.0%
1.b.iii	**Track Laborers**	GTM		761,899.87	19,535.89	-	781,435.76	725,914.11	18,613.18	-	744,527.29	$ 36,908	5.0%
1.b.iv	**Equipment Operators**		TM	**350,874.22**	**14,466.01**	-	**365,340.23**	363,631.52	9,323.89	-	372,955.41	$ (7,615)	-2.0%
1.b.v	**Welder**	GTM		410,144.86	-	-	410,144.86	391,681.01	-	-	391,681.01	$ 18,464	4.7%
1.b.vi	**Welder Helper**	GTM		195,358.94	-	-	195,358.94	186,131.82	-	-	186,131.82	$ 9,227	5.0%
1.b.vii	**Laborer (Non-Rail)**		TM	-	195,358.94	-	195,358.94	-	186,131.82	-	186,131.82	$ 9,227	5.0%
1.b.viii	**Foreman (Non-Rail)**		TM	-	211,541.68	-	211,541.68	-	202,312.96	-	202,312.96	$ 9,229	4.6%
1.b.ix	**Track Superintendent**	GTM		134,166.70	134,166.71	-	268,333.41	139,530.03	139,530.03	-	279,060.05	$ (10,727)	-3.8%
2.b	**Pump Station Maintenance**		TM	-	15,480.00	-	15,480.00	-	13,416.00	-	13,416.00	$ 2,064	15.4%
2.b.i	**Pump Station Repairs and Supplies (Subcontractor)**		TM	-	34,815.00	-	34,815.00	-	31,650.00	-	31,650.00	$ 3,165	10.0%
2.c	**AEI & Other Communications Maintenance**		TM	244,287.00	-	147,952.89	392,239.89	202,587.42	-	122,697.45	325,284.87	$ 66,955	20.6%
2.d	**Rail Flaw Detection (Subcontractor)**	GTM		63,000.00	-	-	63,000.00	56,700.00	-	-	56,700.00	$ 6,300	11.1%
2.e	**Graffiti Control**		TM	-	30,726.00	-	30,726.00	-	27,276.00	-	27,276.00	$ 3,450	12.6%
2.f	**Weed Abatement (Subcontractor)**		TM	56,390.40	14,097.60	-	70,488.00	53,568.00	13,392.00	-	66,960.00	$ 3,528	5.3%
2.g	**Safety Training (Subcontractor)**		TM	29,006.25	5,118.75	-	34,125.00	27,221.25	4,803.75	-	32,025.00	$ 2,100	6.6%
2.h	**Safety Management**		TM	20,750.63	3,661.87	-	24,412.50	20,750.63	3,661.88	-	24,412.50	$ -	0.0%
2.i	**Vehicles**	GTM		273,996.00	91,332.00	-	365,328.00	249,198.00	60,290.40	2,115.60	311,604.00	$ 53,724	17.2%
2.l	**Full-Time Equipment**	GTM		288,960.00	-	-	288,960.00	262,128.00	-	-	262,128.00	$ 26,832	10.2%
2.m	**Maintenance Program Rail Grinding - (50% of Total Cost)**	GTM		347,415.45	-	-	347,415.45	304,062.49	-	-	304,062.49	$ 43,353	14.3%
2.n	**Track Materials / Supplies / Rentals**	GTM		303,600.00	-	-	303,600.00	264,000.00	-	-	264,000.00	$ 39,600	15.0%
2.o	**Signal Maintenance (Subcontractor)**		TM	2,233,564.58	-	-	2,233,564.58	1,553,671.90	-	-	1,553,671.90	$ 679,893	43.8%
2.p	**Ladder / Fence / Traffic Support (Subcontractor)**		TM	-	**367,461.00**	-	**367,461.00**	-	279,510.00	-	279,510.00	$ 87,951	31.5%
2.q	**Security - Trench Cameras**		TM	14,322.00	5,115.00	1,023.00	20,460.00	14,322.00	5,115.00	1,023.00	20,460.00	$ -	0.0%
2.r	**Security / Yard & Office Maintenance & Support (Subcontractor)**		TM	259,182.00	-	-	259,182.00	233,415.00	-	-	233,415.00	$ 25,767	11.0%
2.s	**Underwater Bridge Inspection (Not until 2023)**		TM	**73,187.50**	-	-	**73,187.50**	-	-	-	-	$ 73,188	
2.t	**Trench Ditch Cleaning**		TM	-	73,500.00	-	73,500.00	-	46,200.00	-	46,200.00	$ 27,300	59.1%
2.v	**Replace Signal Wire on the Corridor (Subcontractor)**		TM	-	-	-	-	-	-	-	-	$ -	
2.w	**Railroad Reporting and Record Keeping Software System (Subcontractor)**		TM	46,620.00	-	-	46,620.00	44,100.00	-	-	44,100.00	$ 2,520	5.7%
2.x	**Railroad Emergency Drill Exercise**		TM	29,808.04	-	-	29,808.04	27,342.80	-	-	27,342.80	$ 2,465	9.0%
2.dd	**Bridge Inspections (Subcontractor)**	GTM		**37,800.00**	-	-	**37,800.00**	35,700.00	-	-	35,700.00	$ 2,100	5.9%
2.ee	**Communication System Repair**	GTM		4,000,000.00	-	-	4,000,000.00	1,317,530.00	-	-	1,317,530.00	$ 2,682,470	203.6%
	Subtotal Labor & Operations Maintenance			$ 11,544,681.48	$ 1,499,236.45	$ 181,473.89	$ 13,225,391.82	$ 7,812,548.32	$ 1,320,212.97	$ 157,388.05	$ 9,290,149.34	$ 3,935,242.48	42.4%

		Basis of Apportionment		Calendar Year 2023				Amended Calendar Year 2022				Variance	
		GR Ton MI	Train MI	R.R. M & O Rail Cost (A)	Reserve Account Non-Rail Cost (B)	ACTA Operating Budget Cost (C)	Total	R.R. M & O Rail Cost (A)	Reserve Account Non-Rail Cost (B)	ACTA Operating Budget Cost (C)	Total	CY23-CY22	% Change
II. Capital Costs													
3.a	**Surfacing & Mobilization**	GTM		$ -	$ 549,390.90	$ -	$ 549,390.90	$ -	$ 503,065.67	$ -	$ 503,065.67	$ 46,325.23	9.2%
3.c	**Reballast Program - Labor & Equipment**			$ -	$ 347,870.80	$ -	$ 347,870.80	$ -	$ 324,775.97	$ -	$ 324,775.97	$ 23,094.83	7.1%
3.d	**Reballast Program - Ballast**			$ -	$ 63,800.00	$ -	$ 63,800.00	$ -	$ 58,300.00	$ -	$ 58,300.00	$ 5,500.00	9.4%
3.f	**Capital Program Rail Grinding - (50% of Total Cost)**	GTM		$ -	**$ 102,415.45**	**$ -**	**$ 102,415.45**	$ -	$ 304,062.49	$ -	$ 304,062.49	$ (201,647.04)	-66.3%
3.h-2	**Replace 20 Frogs**			$ -	**$ 768,036.80**	**$ -**	**$ 768,036.80**	$ -	$ 728,557.20	$ -	$ 728,557.20	$ 39,479.60	5.4%
3.h-3	**Replace 40 Switch Point and Stock Rail**			$ -	**$ 729,476.80**	**$ -**	**$ 729,476.80**	$ -	$ 458,201.73	$ -	$ 458,201.73	$ 271,275.07	59.2%
3.h-5	**Insulated Joint Replacement**			$ -	$ 286,816.25	$ -	$ 286,816.25	$ -	$ 256,060.44	$ -	$ 256,060.44	$ 30,755.81	12.0%
3.o	**Pump Station Upgrades (Subcontractor)**	GTM		$ -	$ 234,850.00	$ -	$ 234,850.00	$ -	$ 213,500.00	$ -	$ 213,500.00	$ 21,350.00	10.0%
3.r	**Trench Emergency Ladder, Stair Study, & Repairs (Subcontractor)**			$ -	$ 129,000.00	$ -	$ 129,000.00	$ -	$ 129,000.00	$ -	$ 129,000.00	$ -	0.0%
3.w.1	**Rehab Henry Ford Crossing - Near PHL Offices N of Bridge**			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
3.y	**Signal Battery Replacement**			$ -	$ 121,000.00	$ -	$ 121,000.00	$ -	$ 110,000.00	$ -	$ 110,000.00	$ 11,000.00	10.0%
3.aa-1	**Replace Crucero Diamonds**			$ -	$ -	$ -	$ -	$ -	$ 631,773.17	$ -	$ 631,773.17	$ (631,773.17)	-100.0%
3.gg-3	**Curve Rail Replacement**			$ -	$ 1,177,293.85	$ -	$ 1,177,293.85	$ -	$ 657,204.85	$ -	$ 657,204.85	$ 520,089.01	79.1%
3.ll	**Fixed Trench Ladders (Subcontractor)**			$ -	$ 420,000.00	$ -	$ 420,000.00	$ -	$ 420,000.00	$ -	$ 420,000.00	$ -	0.0%
3.mm	**Miscellaneous Trench Structure Repairs (Subcontractor)**			$ -	$ 63,000.00	$ -	$ 63,000.00	$ -	$ 63,000.00	$ -	$ 63,000.00	$ -	0.0%
3.nn	**Compton Bridges - Replace Deck Ties**			$ -	$ 850,273.10	$ -	$ 850,273.10	-	572,913.23	-	$ 572,913.23	$ 277,359.87	48.4%
3.oo	**Replacement of M23A Switches Machines**			$ -	$ 110,000.00	$ -	$ 110,000.00	$ -	$ 30,800.00	$ -	$ 30,800.00	$ 79,200.00	257.1%
3.pp	**Signal Module VHLC Replacements to XLC**			$ -	$ 155,713.95	$ -	$ 155,713.95	$ -	$ 141,699.60	$ -	$ 141,699.60	$ 14,014.35	9.9%
3.qq	**Furnish and Replace Rail Lubricator Systems**			$ -	$ 102,602.00	$ -	$ 102,602.00	-	86,411.66	-	$ 86,411.66	$ 16,190.34	18.7%
	Subtotal Capital Costs			$ -	$ 6,211,539.90	$ -	$ 6,211,539.90	$ -	$ 5,689,326.00	$ -	$ 5,689,326.00	$ 522,213.90	9.2%
	Subtotal of I & II			$ 11,544,681.48	$ 7,710,776.35	$ 181,473.89	$ 19,436,931.72	$ 7,812,548.32	$ 7,009,538.97	$ 157,388.05	$ 14,979,475.33	$ 4,457,456.38	29.8%
Multiple use contingency for 2023, not in MOW Budget but included in O&M Total							$ 440,000.00 *				$ 500,000.00 *	$ (60,000.00)	-12.0%
III. Operating & Other Costs													
	Insurance (annual amount) (8)		TM	$ 1,863,000.00	$ -	$ -	$ 1,863,000.00	$ 1,600,000.00	$ -	$ -	$ 1,600,000.00	$ 263,000.00	16.4%
	Dispatching (1)		(9)	$ 662,385.79	$ -	$ -	$ 662,385.79	$ 662,385.79	$ -	$ -	$ 662,385.79	$ -	0.0%
	Security - Labor (2)		(9)	$ 1,455,116.00	$ -	$ -	$ 1,455,116.00	$ 1,455,116.00	$ -	$ -	$ 1,455,116.00	$ -	0.0%
	Security - Equipment (3)		(9)	$ 281,540.40	$ -	$ -	$ 281,540.40	$ 281,540.40	$ -	$ -	$ 281,540.40	$ -	0.0%
	Utilities (5)		TM	$ 220,000.00	$ -	$ -	$ 220,000.00	$ 214,000.00	$ -	$ -	$ 214,000.00	$ 6,000.00	2.8%
	Storm Water Discharge Permits, Water Testing & Support Services (4)		TM	$ 75,000.00	$ -	$ -	$ 75,000.00	$ 75,000.00	$ -	$ -	$ 75,000.00	$ -	0.0%
	Provide 3rd Party Security Monitoring & Support Services		TM	$ 4,000.00	$ -	$ -	$ 4,000.00	$ 3,500.00	$ -	$ -	$ 3,500.00	$ 500.00	14.3%
	M&O or Capital Reserve Support Service (6)		TM	$ 698,400.00	$ 264,827.00	$ -	$ 963,227.00	$ 426,039.00	$ 142,013.00	$ -	$ 568,052.00	$ 395,175.00	69.6%
	Communications Network and Alarm/Phone Upgrades and Renewals		TM	$ 35,000.00	$ -	$ -	$ 35,000.00	$ 30,000.00	$ -	$ -	$ 30,000.00	$ 5,000.00	16.7%
	Rehab Henry Ford Crossing @ CP Dominguez (Engineering & Permits) (Also see 3.w.)		TM	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
	PRE Signal Plan Updates for Various Control Points		TM	$ 30,000.00	$ -	$ -	$ 30,000.00	$ 50,000.00	$ -	$ -	$ 50,000.00	$ (20,000.00)	-40.0%
	Extraordinary Right-of-Way Cleanup		TM	$ 175,000.00	$ -	$ -	$ 175,000.00	$ 150,000.00	$ -	$ -	$ 150,000.00	$ 25,000.00	16.7%
	AEI Readers Component Replacements	Special Apportionment		$ 15,575.00	$ -	$ 9,425.00	$ 25,000.00	$ 15,575.00	$ -	$ 9,425.00	$ 25,000.00	$ -	0.0%
	Subtotal Operating & Other Costs			$ 5,515,017.19	$ 264,827.00	$ 9,425.00	$ 5,789,269.19	$ 4,963,156.19	$ 142,013.00	$ 9,425.00	$ 5,114,594.19	$ 674,675.00	13.2%
	Total of I, II, & III			$ 17,059,698.67	$ 7,975,603.35	$ 190,898.89	$ 25,666,200.91	$ 12,775,704.51	$ 7,151,551.97	$ 166,813.05	$ 20,594,069.52	$ 5,072,131.38	24.6%

(1,2,3) These costs are for memorandum purposes only & are internal Railroads costs not paid by ACTA
(4) Includes annual fees
(5) Previous Actual Expenditures + 5% increase per year
(6) Split based on work estimates
*** $60k of $500K contingency used for 2.p, approved by ODG in _________ 2024**

(7) Split based upon allocation plan for installation & maintenance agreed to by ACTA and the Railroads
(8) Estimate based on 2022 plus 10 increase
(9) Apportionment between Railroads based upon private agreement between the parties.
FBLR = Fully Burden Labor Rate

(A) Costs paid by Railroads prorated among carriers
(B) Costs paid by ACTA from the Reserve Account
(C) Costs paid by ACTA

Attachment 1

Alameda Corridor - Approved Amended 2023 Maintenance of Way (MOW) Budget

	# of Positions		2023 VALUE	Share	R.R. M & O Rail Cost	Hours	Share	Reserve Account Non-Rail Cost	Hours	Share	ACTA Operating Budget Cost	Hours	2022 Approved Budget
1. LABOR COSTS	19.5	SUBTOTAL A:	$ 4,113,218.86		$ 3,222,791.63	30,325		$ 857,929.23	8,475		$ 32,498.00	200	$ 4,012,700.77
		Approved Amended CY2022 Budget	$ 4,012,700.77		$ 3,146,250.83	30,325		$ 834,897.94	8,475		$ 31,552.00	200	$ 4,012,700.77
		Variance	$ 100,518.08		$ 76,541			$ 23,031			$ 946.00		$ -
		% Change	2.5%		2.4%			2.8%			3.0%		0.0%

2. OPERATIONS MAINTENANCE

		2023	Share	R.R. M&O - Rail Cost	Hours	Share	Res. Acct. Non-Rail Cost	Hours	Share	ACTA Operating Budget Cost	Hours	2022
2.b	Pump Station Maintenance	$ 15,480.00	0.0%	$ -		100.0%	$ 15,480.00		0.0%	$ -		$ 13,416.00
2.b.i	Pump Station Repairs and Supplies (Subcontractor)	$ 34,815.00	0.0%	$ -		100.0%	$ 34,815.00		0.0%	$ -		$ 31,650.00
2.c	AEI & Other Communications Maintenance	$ 392,239.89	62.3%	$ 244,287.00		0.0%	$ -		37.7%	$ 147,952.89		$ 325,284.87
2.d	Rail Flaw Detection (Subcontractor)	$ 63,000.00	100.0%	$ 63,000.00		0.0%	$ -		0.0%	$ -		$ 56,700.00
2.e	Graffiti Control	$ 30,726.00	0.0%	$ -		100.0%	$ 30,726.00		0.0%	$ -		$ 27,276.00
2.f	Weed Abatement (Subcontractor)	$ 70,488.00	80.0%	$ 56,390.40		20.0%	$ 14,097.60		0.0%	$ -		$ 66,960.00
2.g	Safety Training (Subcontractor)	$ 34,125.00	85.0%	$ 29,006.25		15.0%	$ 5,118.75		0.0%	$ -		$ 32,025.00
2.h	Safety Management	$ 24,412.50	85.0%	$ 20,750.63		15.0%	$ 3,661.87		0.0%	$ -		$ 24,412.50
2.i	Vehicles	$ 365,328.00	75.0%	$ 273,996.00		25.0%	$ 91,332.00		0.0%	$ -		$ 311,604.00
2.l	Full-Time Equipment	$ 288,960.00	100.0%	$ 288,960.00		0.0%	$ -		0.0%	$ -		$ 262,128.00
2.m	Maintenance Program Rail Grinding - (50% of Total Cost)	$ 347,415.45	100.0%	$ 347,415.45		0.0%	$ -		0.0%	$ -		$ 304,062.49
2.n	Track Materials / Supplies / Rentals	$ 303,600.00	100.0%	$ 303,600.00		0.0%	$ -		0.0%	$ -		$ 264,000.00
2.o	Signal Maintenance (Subcontractor)	$ 2,233,564.58	100.0%	$ 2,233,564.58		0.0%	$ -		0.0%	$ -		$ 1,553,671.90
2.p	Ladder / Fence / Traffic Support (Subcontractor)	$ 367,461.00	0.0%	$ -		100.0%	$ 367,461.00		0.0%	$ -		$ 279,510.00
2.q	Security - Trench Cameras	$ 20,460.00	70.0%	$ 14,322.00		25.0%	$ 5,115.00		5.0%	$ 1,023.00		$ 20,460.00
2.r	Security / Yard & Office Maintenance & Support (Subcontractor)	$ 259,182.00	100.0%	$ 259,182.00		0.0%	$ -		0.0%	$ -		$ 233,415.00
2.s	Underwater Bridge Inspection (Not until 2023)	$ 73,187.50	100.0%	$ 73,187.50		0.0%	$ -		0.0%	$ -		$ -
2.t	Trench Ditch Cleaning	$ 73,500.00	0.0%	$ -		100.0%	$ 73,500.00		0.0%	$ -		$ 46,200.00
2.w	Railroad Reporting and Record Keeping Software System (Subcontractor)	$ 46,620.00	100.0%	$ 46,620.00		0.0%	$ -		0.0%	$ -		$ 44,100.00
2.x	Railroad Emergency Drill Exercise	$ 29,808.04	100.0%	$ 29,808.04		0.0%	$ -		0.0%	$ -		$ 27,342.80
2.aa	AEI Readers Upgrade - Completed in 2021	$ -	100.0%	$ -		0.0%	$ -		0.0%	$ -		$ -
2.dd	Bridge Inspections (Subcontractor)	$ 37,800.00	100.0%	$ 37,800.00		0.0%	$ -		0.0%	$ -		$ 35,700.00
2.ee	Communication System Repair	$ 4,000,000.00	100.0%	$ 4,000,000.00		0.0%	$ -		0.0%	$ -		$ 1,317,530.00
	SUBTOTAL B:	$ 9,112,172.96		$ 8,321,889.85			$ 641,307.22			$ 148,975.89		$ 5,277,448.56

3. CAPITAL COSTS

		2023	Share	R.R. M&O - Rail Cost	Hours	Share	Res. Acct. Non-Rail Cost	Hours	Share	ACTA Operating Budget Cost	Hours	2022
3.a	Surfacing & Mobilization	$ 549,390.90	0.0%	$ -		100.0%	$ 549,390.90		0.0%	$ -		$ 503,065.67
3.c	Reballast Program - Labor & Equipment	$ 347,870.80	0.0%	$ -		100.0%	$ 347,870.80		0.0%	$ -		$ 324,775.97
3.d	Reballast Program - Ballast	$ 63,800.00	0.0%	$ -		100.0%	$ 63,800.00		0.0%	$ -		$ 58,300.00
3.f	Capital Program Rail Grinding - (50% of Total Cost)	$ 102,415.45	0.0%	$ -		100.0%	$ 102,415.45		0.0%	$ -		$ 304,062.49
3.h-2	Replace 20 Frogs	$ 768,036.80	0.0%	$ -		100.0%	$ 768,036.80		0.0%	$ -		$ 728,557.20
3.h-3	Replace 40 Switch Points and Stock Rails	$ 729,476.80	0.0%	$ -		100.0%	$ 729,476.80		0.0%	$ -		$ 458,201.73
3.h-5	Insulated Joint Replacement	$ 286,816.25	0.0%	$ -		100.0%	$ 286,816.25		0.0%	$ -		$ 256,060.44
3.o	Pump Station Upgrades (Subcontractor)	$ 234,850.00	0.0%	$ -		100.0%	$ 234,850.00		0.0%	$ -		$ 213,500.00
3.r	Trench Emergency Ladder, Stair Study, & Repairs (Subcontractor)	$ 129,000.00	0.0%	$ -		100.0%	$ 129,000.00		0.0%	$ -		$ 129,000.00
3.y	Signal Battery Replacement	$ 121,000.00	0.0%	$ -		100.0%	$ 121,000.00		0.0%	$ -		$ 110,000.00
3.aa-1	Replace Crucero Diamonds	$ -	0.0%	$ -		100.0%	$ -		0.0%	$ -		$ 631,773.17
3.gg-3	Curve Rail Replacement	$ 1,177,293.85	0.0%	$ -		100.0%	$ 1,177,293.85		0.0%	$ -		$ 657,204.85
3.ll	Fixed Trench Ladders (Subcontractor)	$ 420,000.00	0.0%	$ -		100.0%	$ 420,000.00		0.0%	$ -		$ 420,000.00
3.mm	Miscellaneous Trench Structure Repairs (Subcontractor)	$ 63,000.00	0.0%	$ -		100.0%	$ 63,000.00		0.0%	$ -		$ 63,000.00
3.nn	Compton Bridges - Replace Deck Ties	$ 850,273.10	0.0%	$ -		100.0%	$ 850,273.10		0.0%	$ -		$ 572,913.23
3.oo	Replacement of M23A Switches Machines	$ 110,000.00	0.0%	$ -		100.0%	$ 110,000.00		0.0%	$ -		$ 30,800.00
3.pp	Signal Module VHLC Replacements to XLC	$ 155,713.95	0.0%	$ -		100.0%	$ 155,713.95		0.0%	$ -		$ 141,699.60
3.qq	Furnish and Replace Rail Lubricator Systems	$ 102,602.00	0.0%	$ -		100.0%	$ 102,602.00		0.0%	$ -		$ 86,411.66
	SUBTOTAL C:	$ 6,211,539.90		$ -			$ 6,211,539.90			$ -		$ 5,689,326.00
	GRAND TOTAL A, B, C:	$ 19,436,931.72		$ 11,544,681.48			$ 7,710,776.35			$ 181,473.89		$ 14,979,475.33

1. Approved Amended 2023 Labor Costs

1. LABOR		Positions	Needed Portion	EST Hours	2023 Hourly RATE	OT RATE	OT * VALUE	DT RATE	DT ** VALUE	2023 VALUE	Share	R.R. M & O Rail Cost	Hours	Share	Reserve Account Non-Rail Cost	Hours	Share	ACTA Operating Budget Cost	Hours	2022 Amended Approved Budget
MANAGEMENT POSITIONS																				
1.a.i	Contract Manager	1	100.0%	2000	$ 162.49	N/A	N/A	N/A	N/A	$ 324,980.00	70.0%	$ 227,486.00	1,400	20.0%	$ 64,996.00	400	10.0%	$ 32,498.00	200	$ 315,519.95
1.a.ii	Track Supervisor	1	100.0%	2000	$ 128.28	N/A	N/A	N/A	N/A	$ 256,560.00	80.0%	$ 205,248.00	1,600	20.0%	$ 51,312.00	400	0.0%	$ -	-	$ 249,094.70
1.a.iii	Safety Supervisor	1	100.0%	2000	$ 128.28	N/A	N/A	N/A	N/A	$ 256,560.00	80.0%	$ 205,248.00	1,600	20.0%	$ 51,312.00	400	0.0%	$ -	-	$ 249,094.70
1.a.iv	Office Manager	1	100.0%	2000	$ 59.87	N/A	N/A	N/A	N/A	$ 119,740.00	50.0%	$ 59,870.00	1,000	50.0%	$ 59,870.00	1,000	0.0%	$ -	-	$ 116,244.19
1.a.v	Office Assistant	1	100.0%	2000	$ 59.87	N/A	N/A	N/A	N/A	$ 104,240.00	50.0%	$ 48,870.00	1,000	50.0%	$ 55,370.00	1,000	0.0%	$ -	-	$ 116,244.19
																			-	
STAFF POSITIONS																			-	
1.b	Track Inspector	1	100.0%	2000	$ 98.67	$ 132.56	$ 10,207.12	$ 166.44	$ 3,994.56	$ 222,541.68	100.0%	$ 222,541.68	2,000	0.0%	$ -	-	0.0%	$ -	-	$ 202,312.96
1.b.i	Track Foreman	2	100.0%	4000	$ 98.67	$ 132.56	$ 20,414.24	$ 166.44	$ 7,989.12	$ 401,083.36	100.0%	$ 401,083.36	4,000	0.0%	$ -	-	0.0%	$ -	-	$ 202,312.96
1.b.ii	Assistant Foreman	0	100.0%	0	$ 97.17	$ 130.31	$ -	$ 163.45	$ -	$ -	100.0%	$ -	-	0.0%	$ -	-	0.0%	$ -	-	$ 199,076.73
1.b.iii	Track Laborers	4	100.0%	8000	$ 91.19	$ 121.34	$ 37,372.72	$ 151.49	$ 14,543.04	$ 781,435.76	97.5%	$ 761,899.87	7,800	2.5%	$ 19,535.89	200	0.0%	$ -	-	$ 744,527.29
1.b.iv	Equipment Operators	1.5	100.0%	3000	$ 123.90	$ 167.47	$ 19,342.79	$ 211.04	$ 7,597.44	$ 365,340.23	97.5%	$ 350,874.22	2,925	2.5%	$ 14,466.01	75	0.0%	$ -	-	$ 372,955.41
1.b.v	Welder	2	100.0%	4000	$ 95.68	$ 128.07	$ 19,722.78	$ 160.46	$ 7,702.08	$ 410,144.86	100.0%	$ 410,144.86	4,000	0.0%	$ -	-	0.0%	$ -	-	$ 391,681.01
1.b.vi	Welder Helper	1	100.0%	2000	$ 91.19	$ 121.34	$ 9,343.18	$ 151.49	$ 3,635.76	$ 195,358.94	100.0%	$ 195,358.94	2,000	0.0%	$ -	-	0.0%	$ -	-	$ 186,131.82
1.b.vii	Laborer (Non-Rail)	1	100.0%	2000	$ 91.19	$ 121.34	$ 9,343.18	$ 151.49	$ 3,635.76	$ 195,358.94	0.0%	$ -	-	100.0%	$ 195,358.94	2,000	0.0%	$ -	-	$ 186,131.82
1.b.viii	Foreman (Non-Rail)	1	100.0%	2000	$ 98.67	$ 132.56	$ 10,207.12	$ 166.44	$ 3,994.56	$ 211,541.68	0.0%	$ -	-	100.0%	$ 211,541.68	2,000	0.0%	$ -	-	$ 202,312.96
1.b.ix	Track Superintendent	1	100.0%	2000	$ 124.92	$ 171.93	$ 13,238.61	$ 218.95	$ 5,254.80	$ 268,333.41	50.0%	$ 134,166.70	1,000	50.0%	$ 134,166.71	1,000	0.0%	$ -	-	$ 279,060.05
		19.5		39000					SUBTOTAL A:	$ 4,113,218.86		$ 3,222,791.63	30,325		$ 857,929.23	8,475		$ 32,498.00	200	$ 4,012,700.77
									Approved Amended CY2022 Budget	$ 4,012,700.77		$ 3,146,250.83	30,325		$ 834,897.94	8,475		$ 31,552.00	200	$ 4,012,700.77
									Variance	$ 100,518.08		$ 76,541	-		$ 23,031	-		$ 946.00	-	$ -
									% Change	2.5%		2.4%			2.8%			3.0%		0.0%

* OT Value Based on Working 80 Hours of OT During Calendar Year = 3.85% of Base Hours

**DT Value Based on Working 24 Hours of DT During Year = 1.2% of Base Hours

Note: all rates are Fully Burden Labor Rate. Additional detail is available upon request.

2. Approved Amended CY23 Operations Maintenance Budget Detail

Cost Code		U of M	QTY	Rate	Split	Total
2.b	**Pump Station Maintenance**	**U of M**	**QTY**	**Rate**	**Split**	**Total**
	Vehicle (Split 50/50 between 2.b & 2.e)	Monthly	12	$ 2,580.00	50%	$ 15,480.00
					SUBTOTAL:	$ 15,480.00
			Materials	10%	Markup:	$ -
			Subcontractor	5%	Markup:	$ -
			Supplies	15%	Markup:	$ -
					TOTAL:	$ 15,480.00

Cost Code		U of M	QTY	Rate	Split	Total
2.b.i	**Pump Station Repairs and Supplies**	**U of M**	**QTY**	**Rate**	**Split**	**Total**
	Subcontractor - Repairs to Pumps	LS	1	$ 18,700.00	100%	$ 18,700.00
	Environmental Supplies (Chemicals for water treatment)	LS	1	$ 13,200.00	100%	$ 13,200.00
					SUBTOTAL:	$ 31,900.00
			Materials	10%	Markup:	$ -
			Subcontractor	5%	Markup:	$ 935.00
			Supplies	15%	Markup:	$ 1,980.00
					TOTAL:	$ 34,815.00

Cost Code		U of M	QTY	Rate	Split	Total
2.c	**AEI & Other Communications Maintenance**	**U of M**	**QTY**	**Rate**	**Split**	**Total**
	Materials					
	Material - Initial Inventory Purchase	LS	1	$ 13,750.00	100%	$ 13,750.00
	Subtotal - Materials					$ 13,750.00
	Subcontractor					
	Office Administrator	Hour	200	$ 65.00	100%	$ 13,000.00
	AEI / Comm Technician - ST	Hour	2000	$ 128.72	100%	$ 257,440.00
	AEI / Comm Technician - OT (Based on 1Q&2Q2021)	Hour	80	$ 172.33	100%	$ 13,786.40
	AEI / Comm Technician - DT (Based on 1Q&2Q2021)	Hour	16	$ 257.44	100%	$ 4,119.04
	Signal / Comm Supervisor	Hour	200	$ 137.50	100%	$ 27,500.00
	Vehicle - Signal / Comm Supervisor	Monthly	12	$ 312.00	100%	$ 3,744.00
	Vehicle - AEI / Comm Technician (Monthly Rate for FT Position)	Monthly	12	$ 3,120.00	100%	$ 37,440.00
	Vehicle - AEI / Comm Technician (Hourly Rate for Call-Outs)	Hour	120	$ 17.73	100%	$ 2,127.60
	Subtotal - Subcontractor					$ 359,157.04
					SUBTOTAL:	$ 372,907.04
			Materials	10%	Markup:	$ 1,375.00
			Subcontractor	5%	Markup:	$ 17,957.85
			Supplies	15%	Markup:	$ -
					TOTAL:	$ 392,239.89

Cost Code		U of M	QTY	Rate	Split	Total
2.d	**Rail Flaw Detection**	**U of M**	**QTY**	**Rate**	**Split**	**Total**
	Subcontractor - Mobilization	EA	3	$ 5,000.00	100%	$ 15,000.00
	Subcontractor - Daily Rate (3-day minimums)	EA	3	$ 15,000.00	100%	$ 45,000.00
					SUBTOTAL:	$ 60,000.00
			Materials	10%	Markup:	$ -
			Subcontractor	5%	Markup:	$ 3,000.00
			Supplies	15%	Markup:	$ -
					TOTAL:	$ 63,000.00

Cost Code		U of M	QTY	Rate	Split	Total
2.e	**Graffiti Control**	**U of M**	**QTY**	**Rate**	**Split**	**Total**
	Vehicle (Split 50/50 between 2.b & 2.e)	Monthly	12	$ 2,580.00	50%	$ 15,480.00
	Materials	LS	1	$ 13,860.00	100%	$ 13,860.00
					SUBTOTAL:	$ 29,340.00
			Materials	10%	Markup:	$ 1,386.00
			Subcontractor	5%	Markup:	$ -
			Supplies	15%	Markup:	$ -
						$ 30,726.00

2.f	Weed Abatement	U of M	QTY		Rate	Split		Total
	Subcontractor							
	Subcontractor	LS	1	$	36,960.00	100%	$	36,960.00
	Disposal - Dumpsters @ 1 per month	EA	12	$	1,200.00	100%	$	14,400.00
	Subtotal - Subcontractor						$	51,360.00
	Supplies & Rental							
	Specialty Equipment Rental	EA	12	$	1,200.00	100%	$	14,400.00
	Subtotal - Supplies & Rental						$	14,400.00
						SUBTOTAL:	$	65,760.00
			Materials		10%	Markup:	$	-
			Subcontractor		5%	Markup:	$	2,568.00
			Supplies		15%	Markup:	$	2,160.00
						TOTAL:	$	70,488.00

2.g	Safety Training	U of M	QTY		Rate	Split		Total
	Subcontractor - Training (Classes and Seminars)	LS	1	$	20,000.00	100%	$	20,000.00
	Instructor Lodging and Meals	Days	5	$	2,500.00	100%	$	12,500.00
						SUBTOTAL:	$	32,500.00
			Materials		10%	Markup:	$	-
			Subcontractor		5%	Markup:	$	1,625.00
			Supplies		15%	Markup:	$	-
						TOTAL:	$	34,125.00

2.h	Safety Management	U of M	QTY		Rate	Split		Total
	Drug Testing - Employees	EA	30	$	775.00	100%	$	23,250.00
							$	-
						SUBTOTAL:	$	23,250.00
			Materials		10%	Markup:	$	-
			Subcontractor		5%	Markup:	$	1,162.50
			Supplies		15%	Markup:	$	-
						TOTAL:	$	24,412.50

2.i	Vehicles (Cost Accounts % split)	U of M	QTY		Rate	Split		Total
2.i.i	Contract Manager (RR M&O 72%/RA 28%)	Monthly	12	$	2,064.00	100%	$	24,768.00
2.i.ii	Track Supervisor - Hi-Rail (RR M&O 80%/RA 20%)	Monthly	12	$	2,580.00	100%	$	30,960.00
2.i.iii	Welding Truck - Hi-Rail (RR M&O 100%)	Monthly	12	$	6,880.00	100%	$	82,560.00
2.i.iv	Track Foreman - Hi-Rail (2 Each) (RR M&O 50%/RA 50%)	Monthly	24	$	4,988.00	100%	$	119,712.00
2.i.v	Assistant Track Foreman - Hi-Rail (RR M&O 100%)	Monthly	0	$	2,580.00	100%	$	-
2.i.vi	Track Inspector - Hi-Rail (2 Each) (RR M&O 100%)	Monthly	24	$	2,580.00	100%	$	61,920.00
2.i.vii	Track Superintendent - Hi-Rail (RR M&O 50%/RA 50%)	Monthly	12	$	2,580.00	100%	$	30,960.00
2.k	Safety Supervisor Vehicle (RR M&O 80%/RA 20%)	Monthly	12	$	1,204.00	100%	$	14,448.00
						SUBTOTAL:	$	365,328.00
			Materials		10%	Markup:	$	-
			Subcontractor		5%	Markup:	$	-
			Supplies		15%	Markup:	$	-
						TOTAL:	$	365,328.00

2.l	Full-Time Equipment	U of M	QTY		Rate	Split		Total
	Hi-Rail Grapple / Boom Truck	Monthly	12	$	10,492.00	100%	$	125,904.00
	Speedswing	Monthly	12	$	8,256.00	100%	$	99,072.00
	Combination Backhoe	Monthly	12	$	5,332.00	100%	$	63,984.00
							$	-
						SUBTOTAL:	$	288,960.00
			Materials		10%	Markup:	$	-
			Subcontractor		5%	Markup:	$	-
			Supplies		15%	Markup:	$	-
						TOTAL:	$	288,960.00

2.m	Maintenance Program Rail Grinding	U of M	QTY	Rate	Split	Total
	RailWorks Labor & Equipment					
	Foreman	HR	240	$ 98.67	50%	$ 11,840.40
	Laborer	HR	240	$ 91.19	50%	$ 10,942.80
	F350 HiRail Crew Truck	HR	240	$ 15.00	50%	$ 1,800.00
	Subtotal - RWs Labor & Equipment					$ 24,583.20
	Subcontractor					
	Mainline Grinding Subcontractor Mobilization	LS	2	$ 80,000.00	50%	$ 80,000.00
	Mainline Grinding Contractor Basic Charge	Daily	30	$ 10,500.00	50%	$ 157,500.00
	Mainline Grinding Production Charge	Miles	25	$ 400.00	50%	$ 5,000.00
	Mainline Grinding Pre-Grind Survey Mobilization	LS	1	$ 12,500.00	50%	$ 6,250.00
	Mainline Grinding Pre-Grind Survey Daily Rate	Daily	3	$ 8,000.00	50%	$ 12,000.00
	Signal Support	Daily	30	$ 1,033.00	50%	$ 15,495.00
	Subtotal - Subcontractor					$ 276,245.00
	Supplies & Rental					
	Fuel for Grinder	Gallon	6000	$ 7.00	50%	$ 21,000.00
	Water Truck Rental	Monthly	2	$ 7,500.00	50%	$ 7,500.00
	Subtotal - Supplies & Rental					$ 28,500.00
	Total is split 50/50 between R.R. M&O Cost and Capital				SUBTOTAL:	$ 329,328.20
			Materials	10%	Markup:	$ -
			Subcontractor	5%	Markup:	$ 13,812.25
			Supplies	15%	Markup:	$ 4,275.00
					TOTAL:	$ 347,415.45

2.n	Track Materials / Supplies / Rentals	U of M	QTY	Rate	Split	Total
	Materials					
	Miscellaneous Track Materials - Bolts, etc.	Monthly	12	$ 5,500.00	100%	$ 66,000.00
	Curve Grease - Grease and miscellaneous parts and pieces	Monthly	12	$ 5,500.00	100%	$ 66,000.00
	Supplies and Consumables - Welding, etc.	Monthly	12	$ 5,500.00	100%	$ 66,000.00
	Subtotal - Materials					$ 198,000.00
	Supplies & Rental					
	Equipment Rental	Monthly	12	$ 5,500.00	100%	$ 66,000.00
	Subtotal - Supplies & Rental					$ 66,000.00
					SUBTOTAL:	$ 264,000.00
			Materials	10%	Markup:	$ 26,400.00
			Subcontractor	5%	Markup:	$ 3,300.00
			Supplies	15%	Markup:	$ 9,900.00
					TOTAL:	$ 303,600.00

2.o	Signal Maintenance	U of M	QTY	Rate	Split	Total
	Materials					
	Material Ongoing Purchases Total = LS (RWKS purchase)	LS	1	$ 96,000.00	100%	$ 96,000.00
	Subtotal - Materials					$ 96,000.00
	RailWorks Labor & Equipment					
	HiRail Bucket Truck	Monthly	12	$ 3,600.00	100%	$ 43,200.00
	Foreman	HR	416	$ 98.67	100%	$ 41,046.72
	Foreman - OT	HR	96	$ 132.56	100%	$ 12,725.76
	Subtotal - RWs Labor & Equipment					$ 96,972.48
	Subcontractor					
	Office Administrator	HR	1800	$ 65.00	100%	$ 117,000.00
	Signal / Comm Supervisor	HR	1800	$ 137.50	100%	$ 247,500.00
	Signal / Comm Supervisor - OT (Based on 1Q&2Q2022)	HR	75	$ 206.25	100%	$ 15,468.75
	Signal / Comm Supervisor - DT (Based on 1Q&2Q2022)	HR	25	$ 275.00	100%	$ 6,875.00
	Signal Test Maintainer	HR	2000	$ 128.72	100%	$ 257,440.00
	Signal Test Maintainer - OT (Based on 1Q&2Q2022)	HR	75	$ 172.33	100%	$ 12,924.75
	Signal Test Maintainer - DT (Based on 1Q&2Q2022)	HR	25	$ 257.44	100%	$ 6,436.00
	Signal Maintainer	HR	8000	$ 121.34	100%	$ 970,720.00
	Signal Maintainer - OT (Based on 1Q&2Q2022)	HR	225	$ 161.71	100%	$ 36,384.75
	Signal Maintainer - DT (Based on 1Q&2Q2022)	HR	75	$ 242.68	100%	$ 18,201.00
	Vehicle - Signal / Comm Supervisor	Monthly	12	$ 2,808.00	100%	$ 33,696.00
	Vehicle - Signal Test Maintainer	Monthly	12	$ 3,120.00	100%	$ 37,440.00
	Vehicle - Signal Maintainers (4)	Monthly	12	$ 12,480.00	100%	$ 149,760.00
	Vehicle - Signal Test Maintainer &/or Signal Maintainer for Call-Outs	HR	1238	$ 17.73	100%	$ 21,949.74
	Vehicle -Sig/Comm Supv &/or Signal Engineer for Call-Outs	HR	140	$ 17.73	100%	$ 2,482.20
	Subtotal - Subcontractor					$ 1,934,278.19
					SUBTOTAL:	$ 2,127,250.67
			Materials	10%	Markup:	$ 9,600.00
			Subcontractor	5%	Markup:	$ 96,713.91
			Supplies	15%	Markup:	$ -
					TOTAL:	$ 2,233,564.58

2.p	Ladder / Fence / Traffic Support	U of M	QTY	Rate	Split	Total
	Materials					
	Ladder Replacement Parts	LS	1	$ 12,705.00	100%	$ 12,705.00
	Subtotal - Materials					$ 12,705.00
	Subcontractor					
	Traffic Support	LS	1	$ 36,960.00	100%	$ 36,960.00
	Fence Repair / Replacement	LS	1	$ 242,550.00	100%	$ 242,550.00
	Subtotal - Subcontractor					$ 279,510.00
	$60,000 transferred from Contingency to cover fencing repairs thru the end of the year. No markup applied.					$ 60,000.00
					SUBTOTAL:	$ 352,215.00
			Materials	10%	Markup:	$ 1,270.50
			Subcontractor	5%	Markup:	$ 13,975.50
			Supplies	15%	Markup:	$ -
					TOTAL:	$ 367,461.00

2.q	Security - Trench Cameras	U of M	QTY	Rate	Split	Total
	Motion Detector Replacement Parts	LS	1	$ 2,500.00	100%	$ 2,500.00
	Wire Replacement Subcontractor	LS	1	$ 3,500.00	100%	$ 3,500.00
	Camera Replacement Parts	LS	1	$ 12,600.00	100%	$ 12,600.00
					SUBTOTAL:	$ 18,600.00
			Materials	10%	Markup:	$ 1,860.00
			Subcontractor	5%	Markup:	$ -
			Supplies	15%	Markup:	$ -
					TOTAL:	$ 20,460.00

2.r	Yard / Office Security / Maintenance / Support	U of M	QTY	Rate	Split	Total
	Subcontractor					
	Security Guard Services	Monthly	12	$ 16,170.00	100%	$ 194,040.00
	Janitorial Services	Monthly	12	$ 1,800.00	100%	$ 21,600.00
	HVAC and Building Maintenance (Electrical,Mechanical,Pest)	Monthly	12	$ 1,200.00	100%	$ 14,400.00
	Quench / Dumpsters / Portable Sanitation / Pesticides	Monthly	12	$ 1,400.00	100%	$ 16,800.00
					SUBTOTAL:	$ 246,840.00
			Materials	10%	Markup:	$ -
			Subcontractor	5%	Markup:	$ 12,342.00
			Supplies	15%	Markup:	$ -
					TOTAL:	$ 259,182.00

2.s	Underwater Bridge Inspection	U of M	QTY	Rate	Split	Total
	Subcontractor					
	Underwater Bridge Inspection Subcontractor	Day	5	$ 9,750.00	100%	$ 48,750.00
	Costs for Underwater Bridge Repairs per inspection findings. No markup applied.					$ 22,000.00
					SUBTOTAL:	$ 70,750.00
			Materials	10%	Markup:	$ -
			Subcontractor	5%	Markup:	$ 2,437.50
			Supplies	15%	Markup:	$ -
					TOTAL:	$ 73,187.50

2.t	Trench Ditch Cleaning	U of M	QTY	Rate	Split	Total
	Subcontractor					
	Hi-Rail Vac Truck if Required	Weeks	4	$ 12,000.00	100%	$ 48,000.00
	Disposal of Materials	LS	1	$ 22,000.00	100%	$ 22,000.00
						$ -
					SUBTOTAL:	$ 70,000.00
			Materials	10%	Markup:	$ -
			Subcontractor	5%	Markup:	$ 3,500.00
			Supplies	15%	Markup:	$ -
					TOTAL:	$ 73,500.00

2.w	Railroad Reporting & Record Keeping Software System	U of M	QTY		Rate	Split		Total
	Subcontractor							
	Tier Based Management Fee	LS	1	$	40,000.00	100%	$	40,000.00
	Updates	LS	1	$	4,400.00	100%	$	4,400.00
							$	-
						SUBTOTAL:	$	44,400.00
			Materials		10%	Markup:	$	-
			Subcontractor		5%	Markup:	$	2,220.00
			Supplies		15%	Markup:	$	-
						TOTAL:	$	46,620.00

2.x	Railroad Emergency Drill Exercise	U of M	QTY		Rate	Split		Total
	RailWorks Labor & Equipment							
	Track Foreman	HR	12	$	166.44	100%	$	1,997.28
	Crew Truck	HR	24	$	15.00	100%	$	360.00
	Track Laborer	HR	24	$	151.49	100%	$	3,635.76
	Subtotal - RWs Labor & Equipment						$	5,993.04
	Subcontractor							
	Maintenance of Traffic Subcontractor	LS	1	$	2,200.00	100%	$	2,200.00
	Subtotal - Subcontractor						$	2,200.00
	Supplies & Rental							
	Miscellaneous Supplies	LS	1	$	18,700.00	100%	$	18,700.00
	Subtotal - Supplies & Rentals						$	18,700.00
						SUBTOTAL:	$	26,893.04
			Materials		10%	Markup:	$	-
			Subcontractor		5%	Markup:	$	110.00
			Supplies		15%	Markup:	$	2,805.00
						TOTAL:	$	29,808.04

2.dd	Bridge Inspections	U of M	QTY		Rate	Split		Total
	Subcontractor	LS	1	$	36,000.00	100%	$	36,000.00
						SUBTOTAL:	$	36,000.00
			Materials		10%	Markup:	$	-
			Subcontractor		5%	Markup:	$	1,800.00
			Supplies		15%	Markup:	$	-
						TOTAL:	$	37,800.00

2.ee	Communication System Repair	U of M	QTY		Rate	Split		Total
	Ladder 6-15 $1,425,000	LF	8860	$	161.00	100%	$	1,426,460.00
	Additional Impact Area (Ladder 3-5,16-47)	LF	38690	$	161.00	100%	$	6,229,090.00
						SUBTOTAL:	$	7,655,550.00
			Materials		10%	Markup:		
			Subcontractor		5%	Markup:		
			Supplies		15%	Markup:		
						TOTAL:	$	7,655,550.00
			Allow prior to systems value engineering and bid:				$	4,000,000.00

3. Approved Amended CY2023 Capital Program

Cost Code							
3.a	**Surfacing**	**U of M**	**QTY**	**Rate**	**Split**	**Total**
	RailWorks Labor & Equipment					
	Operators	Hour	96	$ 123.90	100%	$ 11,894.40
	Truck	Hour	96	$ 15.00	100%	$ 1,440.00
	Subtotal - RWs Labor & Equipment					$ 13,334.40
	Subcontractor					
	Subcontractor Tamping & Regulating - LazerWest	Day	70	$ 5,506.00	100%	$ 385,420.00
	Signal Support	Day	70	$ 1,033.00	100%	$ 72,310.00
	Subcontract Equipment Trucking	LS	12	$ 4,400.00	100%	$ 52,800.00
	Subtotal - Subcontractor					$ 510,530.00
	Daily Rate with Subcontractor = $5,966.13					
					SUBTOTAL:	$ 523,864.40
			Materials	10%	Markup:	$ -
			Subcontractor	5%	Markup:	$ 25,526.50
			Supplies	15%	Markup:	$ -
					TOTAL:	$ 549,390.90

3.c	**Reballast Program (Labor & Equipment Combined)**	**U of M**	**QTY**	**Rate**	**Split**	**Total**
	RailWorks Labor & Equipment					
	Foreman	Hour	256	$ 98.67	100%	$ 25,259.52
	Laborers	Hour	1024	$ 91.19	100%	$ 93,378.56
	Operators	Hour	768	$ 123.90	100%	$ 95,155.20
	Flagger	Hour	256	$ 98.67	100%	$ 25,259.52
	Hi-Rail Rotary Dump Truck	Hour	256	$ 40.00	100%	$ 10,240.00
	Ballast Regulator	Hour	256	$ 94.00	100%	$ 24,064.00
	Crew Truck	Hour	256	$ 29.00	100%	$ 7,424.00
	Flagger Truck	Hour	256	$ 15.00	100%	$ 3,840.00
	Subtotal - RWs Labor & Equipment					$ 284,620.80
	Supplies & Rental					
	Front End Loader	Month	4	$ 8,250.00	100%	$ 33,000.00
	Mobilizations (Loaders, Regulators, Hi-Rail Dump Truck)	LS	1	$ 22,000.00	100%	$ 22,000.00
	Subtotal - Supplies & Rental					$ 55,000.00
					SUBTOTAL:	$ 339,620.80
			Materials	10%	Markup:	$ -
			Subcontractor	5%	Markup:	$ -
			Supplies	15%	Markup:	$ 8,250.00
					TOTAL:	$ 347,870.80

3.d	**Reballast Program - Ballast**	**U of M**	**QTY**	**Rate**	**Split**	**Total**
	Ballast	Ton	1000	$ 58.00	100%	$ 58,000.00
						$ -
					SUBTOTAL:	$ 58,000.00
			Materials	10%	Markup:	$ 5,800.00
			Subcontractor	5%	Markup:	$ -
			Supplies	15%	Markup:	$ -
					TOTAL:	$ 63,800.00

3.f	Capital Program Rail Grinding	U of M	QTY		Rate	Split		Total
	RailWorks Labor & Equipment							
	Foreman	HR	240	$	98.67	50%	$	11,840.40
	Laborer	HR	240	$	91.19	50%	$	10,942.80
	F350 HiRail Crew Truck	HR	240	$	15.00	50%	$	1,800.00
	Subtotal - RWs Labor & Equipment						$	24,583.20
	Subcontractor							
	Mainline Grinding Subcontractor Mobilization	LS	2	$	80,000.00	50%	$	80,000.00
	Mainline Grinding Contractor Basic Charge	Daily	30	$	10,500.00	50%	$	157,500.00
	Mainline Grinding Production Charge	Miles	25	$	400.00	50%	$	5,000.00
	Mainline Grinding Pre-Grind Survey Mobilization	LS	1	$	12,500.00	50%	$	6,250.00
	Mainline Grinding Pre-Grind Survey Daily Rate	Daily	3	$	8,000.00	50%	$	12,000.00
	Signal Support	Daily	30	$	1,033.00	50%	$	15,495.00
	Subtotal - Subcontractor						$	276,245.00
	Supplies & Rental							
	Fuel for Grinder	Gallon	6000	$	7.00	50%	$	21,000.00
	Water Truck Rental	Monthly	2	$	7,500.00	50%	$	7,500.00
	Subtotal - Supplies & Rental						$	28,500.00
	Transferred $35k to 3.h-2 and $210k to 3.h-3 to cover increased costs. No markup applied.						$	(245,000.00)
	Total is split 50/50 between R.R. M&O Cost (2.m) and Capital					SUBTOTAL:	$	84,328.20
			Materials		10%	Markup:	$	-
			Subcontractor		5%	Markup:	$	13,812.25
			Supplies		15%	Markup:	$	4,275.00
						TOTAL:	$	102,415.45

3.h-2	Replace 20 Frogs	U of M	QTY		Rate	Split		Total
	RailWorks Labor & Equipment							
	Foreman	Hour	160	$	98.67	100%	$	15,787.20
	Laborers	Hour	320	$	91.19	100%	$	29,180.80
	Operators	Hour	160	$	123.90	100%	$	19,824.00
	Welder	Hour	320	$	95.68	100%	$	30,617.60
	Welder Helper	Hour	320	$	91.19	100%	$	29,180.80
	Flagger	Hour	320	$	98.67	100%	$	31,574.40
	Foreman Truck	Hour	160	$	29.00	100%	$	4,640.00
	Welding Truck	Hour	320	$	40.00	100%	$	12,800.00
	CWR Rail Heater / Vibrator	Hour	160	$	63.00	100%	$	10,080.00
	Rail Saw	Hour	160	$	11.00	100%	$	1,760.00
	Rail Drill	Hour	160	$	11.00	100%	$	1,760.00
	Mobile Power Pack	Hour	160	$	11.00	100%	$	1,760.00
	Flagger Truck	Hour	320	$	15.00	100%	$	4,800.00
	Subtotal - RWs Labor & Equipment						$	193,764.80
	Materials							
	#10 RBM Frogs	EA	2	$	17,600.00	100%	$	35,200.00
	#14 RBM Frogs	EA	10	$	20,900.00	100%	$	209,000.00
	#20 RBM Frogs	EA	8	$	25,300.00	100%	$	202,400.00
	Thermite Weld Kits	EA	80	$	138.00	100%	$	11,040.00
	Subtotal - Materials						$	457,640.00
	Subcontractor							
	Signal Support	Day	20	$	1,033.00	100%	$	20,660.00
	Trucking Sub	Day	10	$	1,350.00	100%	$	13,500.00
	Subtotal - Subcontractor						$	34,160.00
	Transferred $35k from 3.f to cover installing of 20 frogs. No markup applied.						$	35,000.00
						SUBTOTAL:	$	720,564.80
			Materials		10%	Markup:	$	45,764.00
			Subcontractor		5%	Markup:	$	1,708.00
			Supplies		15%	Markup:	$	-
						TOTAL:	$	768,036.80

3.h-3	Replace 40 Switch Points and Stock Rails	U of M	QTY	Rate	Split	Total
	RailWorks Labor & Equipment					
	Foreman	Hour	160	$ 98.67	100%	$ 15,787.20
	Laborers	Hour	480	$ 91.19	100%	$ 43,771.20
	Operators	Hour	320	$ 123.90	100%	$ 39,648.00
	Welder	Hour	160	$ 95.68	100%	$ 15,308.80
	Welder Helper	Hour	160	$ 91.19	100%	$ 14,590.40
	Flagger	Hour	160	$ 98.67	100%	$ 15,787.20
	Foreman Truck	Hour	160	$ 29.00	100%	$ 4,640.00
	Welding Truck	Hour	160	$ 40.00	100%	$ 6,400.00
	CWR Rail Heater / Vibrator	Hour	160	$ 63.00	100%	$ 10,080.00
	Rail Saw	Hour	160	$ 11.00	100%	$ 1,760.00
	Rail Drill	Hour	160	$ 11.00	100%	$ 1,760.00
	Mobile Power Pack	Hour	160	$ 11.00	100%	$ 1,760.00
	Flagger Truck	Hour	160	$ 15.00	100%	$ 2,400.00
	Subtotal - RWs Labor & Equipment					$ 173,692.80
	Materials					
	Switch Points	EA	20	$ 9,980.00	100%	$ 199,600.00
	Stock Rails	EA	20	$ 3,800.00	100%	$ 76,000.00
	Thermite Weld Kits	EA	60	$ 138.00	100%	$ 8,280.00
	Subtotal - Materials					$ 283,880.00
	Subcontractor					
	Signal Support	Day	20	$ 1,033.00	100%	$ 19,680.00
	Trucking Sub	Day	10	$ 1,350.00	100%	$ 12,240.00
	Subtotal - Subcontractor					$ 31,920.00
	Transferred $210k to cover labor and materials/freight increases. No markup applied.					$ 210,000.00
					SUBTOTAL:	$ 699,492.80
			Materials	10%	Markup:	$ 28,388.00
			Subcontractor	5%	Markup:	$ 1,596.00
			Supplies	15%	Markup:	$ -
					TOTAL:	$ 729,476.80

3.h-5	Insulated Joint Replacement	U of M	QTY	Rate	Split	Total
	RailWorks Labor & Equipment					
	Foreman	Hour	200	$ 98.67	100%	$ 19,734.00
	Laborers	Hour	200	$ 91.19	100%	$ 18,238.00
	Operators	Hour	200	$ 123.90	100%	$ 24,780.00
	Welder	Hour	200	$ 95.68	100%	$ 19,136.00
	Welder Helper	Hour	200	$ 91.19	100%	$ 18,238.00
	Flagger	Hour	200	$ 98.67	100%	$ 19,734.00
	Foreman Truck	Hour	200	$ 29.00	100%	$ 5,800.00
	Welding Truck	Hour	200	$ 40.00	100%	$ 8,000.00
	CWR Rail Heater / Vibrator	Hour	200	$ 63.00	100%	$ 12,600.00
	Rail Saw	Hour	200	$ 11.00	100%	$ 2,200.00
	Rail Drill	Hour	200	$ 11.00	100%	$ 2,200.00
	Mobile Power Pack	Hour	200	$ 11.00	100%	$ 2,200.00
	Flagger Truck	Hour	200	$ 15.00	100%	$ 3,000.00
	Subtotal - RWs Labor & Equipment					$ 155,860.00
	Materials					
	Thermite Welds	EA	50	$ 138.00	100%	$ 6,900.00
	Insulated Joint Plug Rails	EA	25	$ 3,500.00	100%	$ 87,500.00
	Subtotal - Materials					$ 94,400.00
	Subcontractor					
	Signal Support	Day	25	$ 1,033.00	100%	$ 25,825.00
	Subtotal - Subcontractor					$ 25,825.00
					SUBTOTAL:	$ 276,085.00
			Materials	10%	Markup:	$ 9,440.00
			Subcontractor	5%	Markup:	$ 1,291.25
			Supplies	15%	Markup:	$ -
					TOTAL:	$ 286,816.25

3.o	Pump Station Upgrades	U of M	QTY	Rate	Split	Total
	Materials	LS	1	$ 77,000.00	100%	$ 77,000.00
	Subcontractor	LS	1	$ 143,000.00	100%	$ 143,000.00
					SUBTOTAL:	$ 220,000.00
		Materials		10%	Markup:	$ 7,700.00
		Subcontractor		5%	Markup:	$ 7,150.00
		Supplies		15%	Markup:	$ -
					TOTAL:	$ 234,850.00

3.r	Trench Emergency Ladder, Stair Study, & Repairs	U of M	QTY	Rate	Split	Total
	Materials - Parts and other materials	LS	1	$ 60,000.00	100%	$ 60,000.00
	Subcontractor	LS	1	$ 60,000.00	100%	$ 60,000.00
					SUBTOTAL:	$ 120,000.00
		Materials		10%	Markup:	$ 6,000.00
		Subcontractor		5%	Markup:	$ 3,000.00
		Supplies		15%	Markup:	$ -
					TOTAL:	$ 129,000.00

3.y	Signal Battery Replacement	U of M	QTY	Rate	Split	Total
	Materials - Signal Batteries	Ea	1	$ 110,000.00	100%	$ 110,000.00
					SUBTOTAL:	$ 110,000.00
		Materials		10%	Markup:	$ 11,000.00
		Subcontractor		5%	Markup:	$ -
		Supplies		15%	Markup:	$ -
					TOTAL:	$ 121,000.00

3.aa-1	Replace Long Beach Diamonds (procurement into 2024)	U of M	QTY	Rate	Split	Total
	RailWorks Labor & Equipment					
	Foreman	Hour	100	$ 98.67	100%	$ 9,867.00
	Laborers (x4)	Hour	400	$ 91.19	100%	$ 36,476.00
	Operators (x2)	Hour	200	$ 123.90	100%	$ 24,780.00
	Welder	Hour	100	$ 95.68	100%	$ 9,568.00
	Welder Helper	Hour	100	$ 91.19	100%	$ 9,119.00
	Flagger	Hour	100	$ 98.67	100%	$ 9,867.00
	Foreman Truck	Hour	100	$ 29.00	100%	$ 2,900.00
	Welding Truck	Hour	100	$ 40.00	100%	$ 4,000.00
	CWR Rail Heater / Vibrator	Hour	40	$ 63.00	100%	$ 2,520.00
	Rail Saw	Hour	80	$ 11.00	100%	$ 880.00
	Rail Drill	Hour	80	$ 11.00	100%	$ 880.00
	Mobile Power Pack	Hour	80	$ 11.00	100%	$ 880.00
	Flagger Truck	Hour	100	$ 15.00	100%	$ 1,500.00
	Subtotal - RWs Labor & Equipment					$ 113,237.00
	Materials					
	Thermite Welds	EA	15	$ 138.00	100%	$ 2,070.00
	Ballast	Ton	100	$ 59.00	100%	$ 5,900.00
	Diamonds	LS	1	$ 550,000.00	100%	$ 550,000.00
	Insulated Joint Plug Rails	EA	12	$ 3,500.00	100%	$ 42,000.00
	Subtotal - Materials					$ 599,970.00
	Subcontractor					
	Signal Support	Day	5	$ 1,033.00	100%	$ 5,165.00
	Subcontract Tamping	Day	2	$ 5,506.00	100%	$ 11,012.00
	Subcontract Tamping Mobilization	LS	1	$ 11,000.00	100%	$ 11,000.00
	Subtotal - Subcontractor					$ 27,177.00
	Supplies & Rental					
	Front End Loader Rental (2x)	Month	2	$ 8,250.00	100%	$ 16,500.00
	Front End Loader Mobilization	Ea	4	$ 127.00	100%	$ 508.00
	Subtotal - Supplies & Rental					$ 17,008.00
					SUBTOTAL:	$ 757,392.00
		Materials		10%	Markup:	$ 59,997.00
		Subcontractor		5%	Markup:	$ 1,358.85
		Supplies		15%	Markup:	$ 2,551.20
					TOTAL:	$ -

3.gg-3	Curve Rail Replacement (Furnish and Install 8,000 LF)	U of M	QTY	Rate	Split	Total
	RailWorks Labor & Equipment					
	Foreman	Hour	296	$ 98.67	100%	$ 29,206.32
	Laborers	Hour	1480	$ 91.19	100%	$ 134,961.20
	Operators	Hour	592	$ 123.90	100%	$ 73,348.80
	Welder	Hour	296	$ 95.68	100%	$ 28,321.28
	Welder Helper	Hour	296	$ 91.19	100%	$ 26,992.24
	Flagger	Hour	296	$ 98.67	100%	$ 29,206.32
	Foreman Truck	Hour	592	$ 29.00	100%	$ 17,168.00
	Welding Truck	Hour	296	$ 40.00	100%	$ 11,840.00
	CWR Rail Heater / Vibrator	Hour	296	$ 63.00	100%	$ 18,648.00
	Rail Saw	Hour	296	$ 11.00	100%	$ 3,256.00
	Rail Drill	Hour	296	$ 11.00	100%	$ 3,256.00
	Mobile Power Pack	Hour	296	$ 11.00	100%	$ 3,256.00
	Flagger Truck	Hour	296	$ 15.00	100%	$ 4,440.00
	Flash-Butt Welding Truck	Hour	232	$ 220.00	100%	$ 51,040.00
	Flash Weld Support Truck - F350 HR	Hour	232	$ 15.00	100%	$ 3,480.00
	Subtotal - RWs Labor & Equipment					$ 438,420.16
	Materials					
	Rail - 136RE, HH, 80' Lengths, Blank	Ton	270.368	$ 1,936.00	100%	$ 523,432.45
	Rail Seat Pads, Insulators, Clips (per tie)	Each	5800	$ 18.00	100%	$ 104,400.00
	Weld Kits	Each	50	$ 138.00	100%	$ 6,900.00
	Subtotal - Materials					$ 634,732.45
	Subcontractor					
	Signal Support	Day	20	$ 1,033.00	100%	$ 20,660.00
	Subtotal - Subcontractor					$ 20,660.00
	Supplies & Rental					
	Front End Loader Rental	Month	2	$ 8,250.00	100%	$ 16,500.00
	Subtotal - Supplies & Rental					$ 16,500.00
					SUBTOTAL:	$ 1,110,312.61
			Materials	10%	Markup:	$ 63,473.24
			Subcontractor	5%	Markup:	$ 1,033.00
			Supplies	15%	Markup:	$ 2,475.00
					TOTAL:	$ 1,177,293.85

3.ll	Fixed Trench Ladders	U of M	QTY	Rate	Split	Total
	Subcontractor Labor, Equipment & Materials	LS	4	$ 100,000.00	100%	$ 400,000.00
					SUBTOTAL:	$ 400,000.00
			Materials	10%	Markup:	$ -
			Subcontractor	5%	Markup:	$ 20,000.00
			Supplies	15%	Markup:	$ -
					TOTAL:	$ 420,000.00

3.mm	Miscellaneous Trench Structure Repairs	U of M	QTY	Rate	Split	Total
	Subcontractor - Labor, Equipment & Materials	LS	1	$ 60,000.00	100%	$ 60,000.00
					SUBTOTAL:	$ 60,000.00
			Materials	10%	Markup:	$ -
			Subcontractor	5%	Markup:	$ 3,000.00
			Supplies	15%	Markup:	$ -
					TOTAL:	$ 63,000.00

3.nn	Replace Compton Bridge Deck Ties - Track 3	U of M	QTY		Rate	Split		Total
	RailWorks Labor & Equipment (44 Bays at 2 Bays per Shift)							
	Foreman & Flagger	Hour	400	$	98.67	100%	$	39,468.00
	Laborers	Hour	1400	$	91.19	100%	$	127,666.00
	Operators	Hour	400	$	123.90	100%	$	49,560.00
	Assistant Foreman	Hour	400	$	97.17	100%	$	38,868.00
	Foreman Truck x2	Hour	400	$	29.00	100%	$	11,600.00
	Flagger Truck	Hour	200	$	15.00	100%	$	3,000.00
	Grapple Truck	Hour	200	$	61.00	100%	$	12,200.00
	Hi-Rail Excavator	Month	3	$	11,000.00	100%	$	33,000.00
	Rail Cart	Hour	200	$	11.00	100%	$	2,200.00
	Mobile Power Pack	Hour	200	$	11.00	100%	$	2,200.00
	Hydraulic Tools x 2	Hour	400	$	22.00	100%	$	8,800.00
	Possible Carryover from Unspent CY2022 Approved Budget	LS	1	$	160,000.00	100%	$	160,000.00
	Subtotal - RWs Labor & Equipment						$	488,562.00
	Materials							
	Bridge Timbers - 10"x10"x10' SYP, Dapped, Pre-Drilled, then Treated	Each	300	$	350.00	100%	$	105,000.00
	Sidewalk Support Timbers - 4'x10'x14' DF, Cut, Dapped, Treated	Each	150	$	200.00	100%	$	30,000.00
	Timber Guard - 4-1/2 x 7-1/2 x 8' DF, Cut, Treated	Each	120	$	115.00	100%	$	13,800.00
	Rolled Pandrol Tie Plates - 136RE, 4R/2SQ	Each	600	$	30.00	100%	$	18,000.00
	E-Clips - RH Galvanized	Each	1200	$	10.00	100%	$	12,000.00
	15/16" x 6-1/2" Evergrip Coach Screws	Each	2400	$	6.00	100%	$	14,400.00
	Rail - 136RE (500TF plus waste)	Ton	26	$	1,936.00	100%	$	50,336.00
	Weld Kits	Each	30	$	138.00	100%	$	4,140.00
	Miscellaneous Hardware	LS	1	$	8,250.00	100%	$	8,250.00
	Fall Protection Materials	LS	1	$	11,000.00	100%	$	11,000.00
	Subtotal - Materials						$	266,926.00
	Subcontractor							
	Tie Disposal	EA	600	$	22.00	100%	$	13,200.00
	Signal Support	Day	50	$	1,033.00	100%	$	51,650.00
	Subtotal - Subcontractor						$	64,850.00
						SUBTOTAL:	$	820,338.00
			Materials		10%	Markup:	$	26,692.60
			Subcontractor		5%	Markup:	$	3,242.50
			Supplies		15%	Markup:	$	-
						TOTAL:	$	850,273.10

		U of M	QTY		Rate	Split		Total
3.oo	**Replacement of M23A Switches Machines**	**U of M**	**QTY**		**Rate**	**Split**		**Total**
	M23A Switch Machine Materials - Refurbishments	EA	4	$	25,000.00	100%	$	100,000.00
							$	-
						SUBTOTAL:	$	100,000.00
		Materials			10%	Markup:	$	10,000.00
		Subcontractor			5%	Markup:	$	-
		Supplies			15%	Markup:	$	-
						TOTAL:	$	110,000.00
3.pp	**Signal Module VHLC Replacements to XLC - Repeat for 3 Locations**	**U of M**	**QTY**		**Rate**	**Split**		**Total**
	Materials							
	Materials - New XLC Module	EA	3	$	36,300.00	100%	$	108,900.00
	Design Changes and Prints	EA	3	$	3,850.00	100%	$	11,550.00
	Software + Engineering	EA	3	$	6,050.00	100%	$	18,150.00
	Subtotal - Materials						$	138,600.00
	Subcontractor							
	Signal Subcontractor	Days	3	$	1,033.00	100%	$	3,099.00
	Subtotal - Subcontractor						$	3,099.00
						SUBTOTAL:	$	141,699.00
		Materials			10%	Markup:	$	13,860.00
		Subcontractor			5%	Markup:	$	154.95
		Supplies			15%	Markup:	$	-
						TOTAL:	$	155,713.95
3.qq	**Furnish and Replace Rail Lubricator Systems**	**U of M**	**QTY**		**Rate**	**Split**		**Total**
	Railworks Labor & Equipment							
	Foreman	Hour	40	$	98.67	100%	$	3,946.80
	Laborers	Hour	80	$	91.19	100%	$	7,295.20
	Foreman Truck	Hour	40	$	29.00	100%	$	1,160.00
	Subtotal - RWs Labor & Equipment						$	12,402.00
	Furnish and Replace Rail Lubricator Systems							
	Rail Wheel Lubricator System	EA	2	$	41,000.00	100%	$	82,000.00
	Subtotal - Materials						$	82,000.00
						SUBTOTAL:	$	94,402.00
		Materials			10%	Markup:	$	8,200.00
		Subcontractor			5%	Markup:	$	-
		Supplies			15%	Markup:	$	-
						TOTAL:	$	102,602.00

ACTA
Alameda Corridor Transportation Authority

Maintenance of Way Services

Appendix R

2023 Bridge Inspection Report

ALAMEDA CORRIDOR TRANSPORTATION AUTHORITY (ACTA)

Long Beach, California

2023 ANNUAL INSPECTION

RAILPROS

811 Wilshire Blvd, Suite 1820
Los Angeles, California - 90017
Office : 213.627.0044
www.railpros.com

Inspection Method

For each inspection location, the track approaches, track profile, deck, superstructure, substructure, and the site conditions at the bridge site were inspected. The inspection was performed by means of visual assessment, measurement when appropriate, and in the case of concrete, sounding methods were used when necessary.

All the bridges inspected may have hidden conditions that cannot be determined without removal of members or destructive testing, which was not a part this inspection. Therefore, the railroad should conduct periodic bridge inspections, and have the track inspectors observe track line and surface on each inspection trip to detect problems with bridges in a timely manner.

Report Methodology

All bridges were numbered according to the master list provided by the Railroad. The bridge components were numbered in the following manner:

- Bents, Piers and Abutments were numbered starting with Bent or Abutment 1 increasing with mileposts.
- Piles were numbered starting with Pile 1 on the left while looking to increasing mileposts.
- Spans were numbered starting with Span 1 increasing with mileposts.
- Stringers were numbered starting with Stringer 1 on the left while looking to increasing mileposts.

The inspection reports show conditions reported by the inspectors regarding extent and type of conditions impacting the bridge components. The conditions are categorized into standardized condition codes. The condition codes and priority levels used by the inspector for the reported findings are shown in the *Condition Codes and Priority Levels* table below.

Condition Codes and Priority Levels

CONDITION RATING	PRIORITY
A. Failed (may require bridge out of service)	1. Immediately
B. Deficient (Trains are operating but have restrictions)	2. Within 3 to 6 months
C. Satisfactory but with exceptions (no impact on operations or safety)	3. Within 1 year
D. Good with minor exceptions	4. Within 3 years
E. Very good (no exceptions)	5. Within 5 years
F. Not inspected/Inaccessible	6. Monitor

Disclaimer

All assessments given in this report are an opinion given in good faith by the inspectors at the time of the inspection. Due to inaccessibility and hidden conditions, not all structural members, connections or conditions could be completely assessed. RailPros makes no guarantee, expressed or implied, of the structural load rating or integrity and assumes no responsibility for any damages incurred because of any performance failure of any bridge or structure observed during this inspection. Inspection of bridges, especially track line and surface, should be included as a regular part of daily and weekly track inspection by the railroad. Report any variations in track line or surface to the individual responsible for bridge maintenance. Underwater inspection is coordinated and performed by others.

	ALAMEDA CORRIDOR TRANSPORTATION AUTHORITY – Bridge Inventory								
Subdivision	Bridge Number	Mile Post	Crossing	Bridge Type	Length	Number of Spans	Center Height	Span Lengths	Built Date
ACTA Mainline	Br. 0.1	0.1	Washington Blvd.	Ballasted Deck Plate Girder	184’	2	15’-3”/24’-6”	92’	2000
ACTA Mainline	Br. 10.2	10.2	Compton Creek	Open Deck Thru Plate Girder	354’	4	16’-7”	2@100’,2@77’	2000
ACTA Mainline	Br. 14.6	14.6	Dominguez Channel	Precast Concrete Box Girder	204’	6	15’	34’	2000
ACTA Mainline	Br. 16.3	16.3	Alameda Street	Ballasted Rolled Beam	130’	2	15’	62’	Unknown
ACTA Long Beach Lead	Br. 16.9	16.9	Dominguez Channel	Ballasted Rolled Beam	205’	6	14’	31’ to 42’	Unknown
ACTA Mainline	Br. 17.4	17.4	Dominguez Channel	Ballasted Rolled Beam	337’	12	10’	28’	Unknown
ACTA Mainline	Br. 17.8-1	17.8	Dominguez Channel	Ballasted Deck Plate Girder	127’	1	16’	127’	2000
ACTA Mainline	Br. 17.8-2	17.8	Dominguez Channel/Henry Ford Ave	Ballasted Through Truss	297’	1	17’	297’	2000
ACTA Mainline	Br. 17.8-3	17.8	Henry Ford Ave	Ballasted Deck Plate Girder	127’	1	17’	127’	2000
ACTA Mainline	Br. 17.8-4	17.8	Henry Ford Ave	Ballasted Through Truss	295’	1	19’	295’	2000
ACTA Mainline	Br. 17.8-5	17.8	Terminal Island Lead	Precast Concrete Girder	1410’	36	Varies/25’	Varies/44’	2000

BRIDGE ID 0.1 ANNUAL INSPECTION REPORT

Prepared By:	Marcos Lozano
Date Prepared:	9/7/2023
Reviewed By:	Julina Corona
Date Reviewed:	9/7/2023
Date of Inspection:	8/16/2023
Weather:	Sunny
Temperature (F°):	74
Inspectors:	Marcos Lozano Julina Corona

Bridge Location Information

Bridge ID:	0.1
Section Number:	1 of 1
Railroad:	ACTA
Subdivision:	ACTA
Crossing Feature:	Washington Blvd
Latitude:	34.018230°
Longitude:	-118.227861°
Nearest Hy-Rail Access:	2 tenths RR-East
City:	Los Angeles
County:	Los Angeles
State:	CA

Immediate Action Required

If Yes to any item below contact RBE and BPM

Yes	***Need railroad bridge engineer (RBE) review?***
No	***Slow order recommended?***
No	***Need bridge out of service?***
No	***Special inspection required?***

Notes: Sheared bolts near midspan of Span 1 noted in 2019 at tension bottom cover plates. Review bridge load rating.

BRIDGE ID 0.1 ANNUAL INSPECTION REPORT

Structure Data

Bridge Type:	BDPG
Year Built:	Unknown
Plans On File:	Yes
Deck Type(s):	Ballasted
Number of Spans:	2
Number of Walkways:	2
Bridge Length (ft.):	184 (max.)
Maximum Structure Height (ft.)	24.5
Skewed:	Yes
Vertical Clearance (ft.):	Unrestricted
Horizontal Clearance (ft.):	Unrestricted
Vehicle Clearance (ft.):	15'-3"

Governing Bridge Condition & Priority Level

CONDITION RATING	PRIORITY LEVEL
A. Failed (may require bridge out of service)	1. Immediately
B. Deficient (Trains are operating but have restrictions)	2. Within 3 to 6 months
C. Satisfactory but with exceptions (no impact on operations or safety)	3. Within 1 year
D. Good with minor exceptions	4. Within 3 years
E. Very good (no exceptions)	5. Within 5 years
F. Not inspected/Inaccessible	6. Monitor

Notes:

Notify RBE of sheared bolts for RBE review.

Track Data

Operating Speed (mph):	30
Number of Tracks:	5 into 4
Rail Size:	136 #
Degree of Curve:	varies
Super Elevation:	varies
Mile Post Increases:	East to West

Site Conditions

Subject to Scour:	No	
Vegetation Removal Needed:	No	
Corrosive Materials Exposure:	No	
Subject to Impact (type):	Motor Vehicle	no vertical clearance signs
Subject to Heavy Drift:	No	
Dangerous Fauna/Flora:	No	
Active Faults:	No	
Tidal Waters:	No	

BRIDGE ID 0.1 ANNUAL INSPECTION REPORT

Priority Level Recommendations

DECK & APPROACH

The following repairs are recommended:

		Priority
1.	*Span 1 : Continue to monitor condition exceptions.*	*6*
2.	*Walkway : Monitor handrail post conections. Some posts are loose at base due to cracks.*	*6*
3.	*Walkway : Tighten upper handrail cable at right side of bridge for pedestrian and MOW staff safety.*	*6*

SUPERSTRUCTURE

The following repairs are recommended:

		Priority
1.	*Span 1 : Sound test bolts to identify and tighten loose bolts. Bolts provide strength to the beam, refer to the RBE.*	*3*
2.	*Span 2 : Repaint protective paint and replace missing bolts.*	*6*

SUBSTRUCTURE

The following repairs are recommended:

		Priority
1.	*There are no recommendations.*	

Condition Report & General Notes

DECK & APPROACH *(includes approach, ties, tie fasteners, rail, ballast ballast retainers, etc.)*

All members reported to be in good condition except as indicated below:

		Condition
1.	*Track: Line and Surface: Fair*	*D*
2.	*Deck: Bridge-ties: N/A*	*D*
3.	*Exterior Girder: Signage: Right side of bridge is missing overhead vertical clearance sign (Photo 1).*	*B*
4.	*Exterior Girder: Signage: Left side of bridge is missing overhead vertical clearance sign.*	*B*
5.	*Deck: Walkways: Mineral deposit found in cracks, locations varied along walkways.*	*C*

BRIDGE ID 0.1 ANNUAL INSPECTION REPORT

PRIMARY MEMBERS *(includes beams, girders, plate girder components, stiffeners, etc.)*

All members reported to be in good condition except as indicated below:

		Condition
1.	*Span 1, Girder 22: Girders : Missing 3 bolts from bottom cover plate aproximately 16' from face of down-mile abutment wall. (Photo 2)*	*C*
2.	*Span 1, Girder 23: Girders : Missing 8 bolts from bottom cover plate between 16' to 18' from face of down-mile abutment wall. (Photo 3)*	*C*
3.	*Span 1, Girder 24: Girders : Missing 8 bolts from bottom cover plate between 15' to 18' from face of down-mile abutment wall.*	*C*
4.	*Overall: Girders : Girders have three bottom flange cover plates. No other damage to girders and cover plates.*	**Note*
5.	*Span 2: Girders : Minor bridge strike, most visible at right side end girder.*	*D*
6.	*Span 2, Girder 20: Girders : Missing 1 bolt from bottom cover plate approximately 12' from face of Bent 2 cap.*	*C*

SECONDARY MEMBERS *(includes bracing, diaphragms, connection plates and bolts, etc.)*

All members reported to be in good condition except as indicated below:

		Condition
1.	*Good, with minor exceptions.*	*D*

BRIDGE SEAT *(includes bridge seat, bearing connections, etc.)*

All members reported to be in good condition except as indicated below:

		Condition
1.	*Bearings: Inaccessible.*	*F*

ABUTMENTS

All members reported to be in good condition except as indicated below:

		Condition
1.	*Abutment wall: Missing or broken street lights under bridge.*	*C*

BENT

All members reported to be in good condition except as indicated below:

		Condition
1.	*Pier: Grafitti on both side of pier.*	*D*

BENT CAPS

All members reported to be in good condition except as indicated below:

		Condition
1.	*Bent 2: Cap has minor local damage above column 1 from vehicular impact.*	*D*

Typical Bridge Photos:

Photo No.	Note: Right side of bridge, missing overhead vertical clearance sign.
1	

Photo No.	Note: Span 1, Girder 22, sheared bolts.
2	

Photo No.	Note: Span 1, Girder 23, 8 sheared bolts.
3	

Photo No.	Note: Handrail cable hardware missing at right side of bridge.
4	

Typical Bridge Photos:

Photo No.	Note: Loose handrail cable at right side of bridge.
5	

Photo No.	Note: Cap at concrete bent.
6	

BRIDGE ID 10.2 ANNUAL INSPECTION REPORT

Prepared By: Marcos Lozano
Date Prepared: 9/13/2023

Reviewed By: Julina Corona
Date Reviewed: 9/13/2023

Date of Inspection: 8/15/2023
Weather: Sunny
Temperature (F˚): 78
Inspectors: Marcos Lozano
Julina Corona

Bridge Location Information

Bridge ID: 10.2
Section Number: 1 of 1
Railroad: ACTA
Subdivision: ACTA
Crossing Feature: Compton Creek
Latitude: 33.872545
Longitude: -118.216502
Nearest Hy-Rail Access: 300' east of bridge
City: Compton
County: Los Angeles
State: CA

Immediate Action Required

If Yes to any item below contact RBE and BPM

No	***Need railroad bridge engineer (RBE) review?***	
Yes	***Slow order recommended?***	**ML #2**
No	***Need bridge out of service?***	
No	***Special inspection required?***	

BRIDGE ID 10.2 ANNUAL INSPECTION REPORT

Structure Data

Bridge Type:	TPG
Year Built:	2000
Plans On File:	Yes
Deck Type(s):	Open
Number of Spans:	4
Number of Walkways:	6
Bridge Length (ft.):	354.58
Maximum Structure Height (ft.)	16.6
Skewed:	Yes
Vertical Clearance (ft.):	N/A
Horizontal Clearance (ft.):	9.6'
Vehicle Clearance (ft.):	N/A

Governing Bridge Condition & Priority Level

CONDITION RATING	PRIORITY LEVEL
A. Failed (may require bridge out of service)	1. Immediately
B. Deficient (Trains are operating but have restrictions)	2. Within 3 to 6 months
C. Satisfactory but with exceptions (no impact on operations or safety)	3. Within 1 year
D. Good with minor exceptions	4. Within 3 years
E. Very good (no exceptions)	5. Within 5 years
F. Not inspected/Inaccessible	6. Monitor
Notes:	
Plan and schedule to replace bridge-ties. Recommend a slow order on Main Line #2 until repairs are completed.	

Track Data

Operating Speed (mph):	40
Number of Tracks:	3
Rail Size:	136
Degree of Curve:	Tangent
Super Elevation:	N/A
Mile Post Increases:	East to West

Site Conditions

Subject to Scour:	Yes	(No scour identified)
Vegetation Removal Needed:	No	
Corrosive Materials Exposure:	No	
Subject to Impact (type):	No	
Subject to Heavy Drift:	No	
Dangerous Fauna/Flora:	No	
Active Faults:	No	
Tidal Waters:	No	

BRIDGE ID 10.2 ANNUAL INSPECTION REPORT

Priority Level Recommendations

DECK & APPROACH

The following repairs are recommended:

		Priority
1.	*Deck : Lag Bolts to timber ties connection need to be repaired at main line #2*	*2*
2.	*Deck : Replace bad bridge-ties on all spans on main track #2.*	*3*
3.	*Span : Repair Tie Fasteners/anchors at floor system throughout bridge deck. (Photo #5 & #7)*	*3*
4.	*Approaches : Install missing handrail cables at north approach on right side to prevent workers from falling. (Photo #1)*	*3*

SUPERSTRUCTURE

The following repairs are recommended:

		Priority
1.	*Span 4 : Remove homeless camp prior to next years inpection at Abutment #5 bridge seat.*	*3*

SUBSTRUCTURE

The following repairs are recommended:

		Priority
1.	*Abutment : Monitor crack.*	*6*

BRIDGE ID 10.2 ANNUAL INSPECTION REPORT

Condition Report & General Notes

DECK & APPROACH *(includes approach, ties, tie fasteners, rail, ballast ballast retainers, etc.)*

All members reported to be in good condition except as indicated below:

		Condtion
1.	*Deck: Bridge-ties: 115 bad ties on Track 2 of 265 total ties.*	*B*
2.	*Deck: Tie Fasteners: Lag Bolts are becoming loose at main line #2. (Photo #7)*	*B*
3.	*Down-mile End: Approach: Missing handrail cables at north approach on right side. (Photo #1)*	*B*
4.	*Deck: Bridge-ties: 97 bad ties on Track 3 of 264 total ties.*	*C*
5.	*Deck: Tie Fasteners: Broken tie plate at up-mile left rail on Track 2.*	*C*
6.	*Deck: Tie Fasteners: Tie Fasteners (lateral) are missing or loose at floorsystem, observed from below deck. (Photo*	*C*
7.	*Approaches: Approaches: 30 10' approach ties on Abutment 1 Track 3. All in good condition.*	*D*
8.	*Deck: Bridge-ties: Signs of fire at guard timber and ties with some section loss. Fire started from below by homeless encampment. (Photo #8)*	*C*
9.	*Approaches: Approaches: 28 10' approach ties on Abutment 5 Track 3. All in good condition.*	*D*
10.	*Approaches: Approaches: 30 approach ties on Abutment 1 Track 2. All in good condition.*	*D*
11.	*Approaches: Approaches: 30 total approach ties on Abutment 1 and Aboutment 5, of Track 2. All in good condition.*	*D*
12.	*Deck: Bridge-ties: 36 bad ties on Track 1 of 264 total ties.*	*D*
13.	*Deck: Rail: Bridge has guard rails. In good condition.*	*D*
14.	*Deck: Tie Fasteners: Guard Timber bolts are loose at main line #3, observed from above deck (Photo #5)*	*D*

PRIMARY MEMBERS *(includes beams, girders, plate girder components, stiffeners, etc.)*

All members reported to be in good condition except as indicated below:

		Condtion
1.	*Good, with minor exceptions.*	*D*

SECONDARY MEMBERS *(includes bracing, diaphragms, connection plates and bolts, etc.)*

All members reported to be in good condition except as indicated below:

		Condtion
1.	*Good, with minor exceptions.*	*D*

BRIDGE SEAT *(includes bridge seat, bearing connections, etc.)*

All members reported to be in good condition except as indicated below:

		Condtion
1.	*Abutment #5: Bridge seat not able to inspect due to homeless camp.*	*D*

PIERS

All members reported to be in good condition except as indicated below:

		Condtion
1.	*Good, with minor exceptions.*	*D*

BRIDGE ID 10.2 ANNUAL INSPECTION REPORT

ABUTMENTS

All members reported to be in good condition except as indicated below:

		Condtion
1.	*Good, with minor exceptions.*	*D*

BACKWALL

All members reported to be in good condition except as indicated below:

		Condtion
1.	*Backwall: Hairline crack between Tracks #1 and #2.*	*D*

BRIDGE ID 10.2 ANNUAL INSPECTION REPORT

Typical Bridge Photos:

Photo No.	**Note:** Missing handrail cables at north approach on right side.
1	

Photo No.	**Note:** Floor system and bottom lateral bracing.
2	

Photo No.	**Note:** Homeless encampment at Span #3.
3	

Photo No.	**Note:** Typical substructure.
4	

Typical Bridge Photos:

Photo No.	Note: Split ties and loose lag bolts at multiple locations.
5	

Photo No.	Note: Tie Fasteners at Floorbeam system are loose and/or missing.
6	

Photo No.	Note: Loose lag bolts at multiple locations.
7	

Photo No.	Note: Section loss at gurad timber and burned at ties.
8	

BRIDGE ID 14.6 ANNUAL INSPECTION REPORT

Prepared By: Marcos Lozano
Date Prepared: 9/13/2023

Reviewed By: Julina Corona
Date Reviewed: 9/13/2023

Date of Inspection: 8/15/2023
Weather: Overcast
Temperature (F˚): 75
Inspectors: Marcos Lozano
Julina Corona

Bridge Location Information

Bridge ID: 14.6
Section Number: 1 of 1
Railroad: ACTA
Subdivision: ACTA
Crossing Feature: Domingez Channnel
Latitude: 33.815555
Longitude: -118.232773
Nearest Hy-Rail Access: TBD
City: Wilmington, CA
County: Los Angeles
State: CA

Immediate Action Required

If Yes to any item below contact RBE and BPM

No	***Need railroad bridge engineer (RBE) review?***
No	***Slow order recommended?***
No	***Need bridge out of service?***
No	***Special inspection required?***

BRIDGE ID 14.6 ANNUAL INSPECTION REPORT

Structure Data

Bridge Type: Concrete Box Beam
Year Built: Unknown
Plans On File: Yes
Deck Type(s): Ballasted
Number of Spans: 6
Number of Walkways: 2
Bridge Length (ft.): 204
Maximum Structure Height (ft.) 15'
Skewed: No
Vertical Clearance (ft.): N/A
Horizontal Clearance (ft.): N/A
Vehicle Clearance (ft.): N/A

Governing Bridge Condition & Priority Level

CONDITION RATING	PRIORITY LEVEL
A. Failed (may require bridge out of service)	1. Immediately
B. Deficient (Trains are operating but have restrictions)	2. Within 3 to 6 months
C. Satisfactory but with exceptions (no impact on operations or safety)	3. Within 1 year
D. Good with minor exceptions	4. Within 3 years
E. Very good (no exceptions)	5. Within 5 years
F. Not inspected/Inaccessible	6. Monitor
Notes:	
N/A	

Track Data

Operating Speed (mph): 40
Number of Tracks: 4
Rail Size: 136
Degree of Curve: Tangent
Super Elevation: N/A
Mile Post Increases: East to West

Site Conditions

Subject to Scour: No
Vegetation Removal Needed: No
Corrosive Materials Exposure: No
Subject to Impact (type): No
Subject to Heavy Drift: No
Dangerous Fauna/Flora: No
Active Faults: No
Tidal Waters: No

BRIDGE ID 14.6 ANNUAL INSPECTION REPORT

Priority Level Recommendations

DECK & APPROACH

	The following repairs are recommended:	Priority
1.	*Handrails : Tighten hardwared during periodic maintenance.*	*6*

SUPERSTRUCTURE

	The following repairs are recommended:	Priority
1.	*Span 1 : Monitor crack at Box Girder annualy for growth.*	*6*

SUBSTRUCTURE

	The following repairs are recommended:	Priority
1.	*Backwall : Monitor for spalling.*	*5*

Condition Report & General Notes

DECK & APPROACH *(includes approach, ties, tie fasteners, rail, ballast ballast retainers, etc.)*

	All members reported to be in good condition except as indicated below:	Conditions
1.	*Track: Line and Surface: Fair*	*D*
2.	*Deck: Bridge-ties: N/A*	*D*
3.	*Up-mile: Approaches: Good.*	*D*
4.	*Approach: Handrails: hardware is loose and disconnected.*	*C*
5.	*Deck: Walkways: Multiple small cracks at both walkways from top to bottom. (Photo #4)*	*D*

PRIMARY MEMBERS *(includes beams, girders, plate girder components, stiffeners, etc.)*

	All members reported to be in good condition except as indicated below:	Conditions
1.	*Abutment #1: Girders : Large crack starting at Bridge Seat. (Photo #6)*	*C*

SECONDARY MEMBERS *(includes bracing, diaphragms, connection plates and bolts, etc.)*

	All members reported to be in good condition except as indicated below:	Conditions
1.	*Good, with minor exceptions.*	*D*

BRIDGE SEAT *(includes bridge seat, bearing connections, etc.)*

	All members reported to be in good condition except as indicated below:	Conditions
1.	*Good, with minor exceptions.*	*D*

BRIDGE ID 14.6 ANNUAL INSPECTION REPORT

ABUTMENTS

All members reported to be in good condition except as indicated below:

		Conditions
1.	*Good, with minor exceptions.*	*D*

BENT PILES

All members reported to be in good condition except as indicated below:

		Conditions
1.	*Double pile rows with concrete caps.*	*D*

BENT CAPS

All members reported to be in good condition except as indicated below:

		Conditions
1.	*Good, with minor exceptions.*	*D*

BACKWALL

All members reported to be in good condition except as indicated below:

		Conditions
1.	*Abutment #1: Multiple cracks at Backwall at right side of bridge.*	*D*

Typical Bridge Photos:

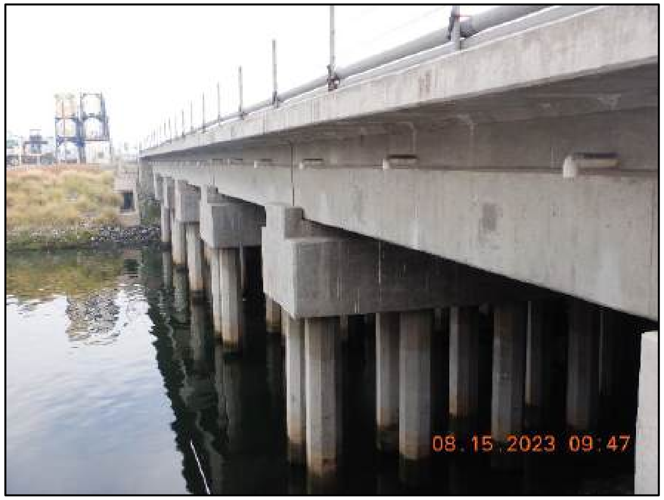


Photo No.	Note: All concrete bents composed of columns and caps.
1	

Photo No.	Note: Typical concrete end span.
2	

Photo No.	Note: Drain pipes along entire walkway
3	

Photo No.	Note: Hairline cracks along entire walkway from top to bottom
4	

Typical Bridge Photos:

Photo No.	Note: Utility conduit along walkway.
5	

Photo No.	Note: Vertical crack at left side of box girder end bearing at Abutment #1.
6	

BRIDGE ID 16.3 ANNUAL INSPECTION REPORT

Prepared By: Marcos Lozano
Date Prepared: 9/13/2023

Reviewed By: Julina Corona
Date Reviewed: 9/13/2023

Date of Inspection: 8/15/2023
Weather: Overcast
Temperature (F˚): 74
Inspectors: Marcos Lozano
Julina Corona

Bridge Location Information

Bridge ID: 16.3
Section Number: 1 of 1
Railroad: ACTA
Subdivision: ACTA
Crossing Feature: Alameda St.
Latitude: 33.795089
Longitude: -118.239435
Nearest Hy-Rail Access: TBD
City: Compton
County: Los Angeles
State: CA

Immediate Action Required

If Yes to any item below contact RBE and BPM

Yes	***Need railroad bridge engineer (RBE) review?***
No	***Slow order recommended?***
No	***Need bridge out of service?***
No	***Special inspection required?***

Notes: ***Sheared bolts near midspan @ span #2 at bottom lower plate.***

BRIDGE ID 16.3 ANNUAL INSPECTION REPORT

Structure Data

Bridge Type: Concrete Box Beam
Year Built: Uknown
Plans On File: Yes
Deck Type(s): Ballasted
Number of Spans: 2
Number of Walkways: 2
Bridge Length (ft.): 130
Maximum Structure Height (ft.) TBD
Skewed: Yes
Vertical Clearance (ft.): N/A
Horizontal Clearance (ft.): N/A
Vehicle Clearance (ft.): 15'

Governing Bridge Condition & Priority Level

CONDITION RATING	PRIORITY LEVEL
A. Failed (may require bridge out of service)	1. Immediately
B. Deficient (Trains are operating but have restrictions)	2. Within 3 to 6 months
C. Satisfactory but with exceptions (no impact on operations or safety)	3. Within 1 year
D. Good with minor exceptions	4. Within 3 years
E. Very good (no exceptions)	5. Within 5 years
F. Not inspected/Inaccessible	6. Monitor
Notes:	
No vertical clearance signs on northbound side of the bridge. Notify RBE of missing/sheared bolts for RBE review.	

Track Data

Operating Speed (mph): 40
Number of Tracks: 4
Rail Size: 136
Degree of Curve: 0°45'00"
Super Elevation: TBD
Mile Post Increases: East to West

Diamond at down-mile approach

Site Conditions

Subject to Scour: No
Vegetation Removal Needed: No
Corrosive Materials Exposure: No
Subject to Impact (type): Motor Vehicle
Subject to Heavy Drift: No
Dangerous Fauna/Flora: No
Active Faults: No
Tidal Waters: No

BRIDGE ID 16.3 ANNUAL INSPECTION REPORT

Priority Level Recommendations

DECK & APPROACH

The following repairs are recommended:

		Priority
1.	*Span 2 : Install missing handrail cables at up-mile end approach to prevent workers from falling. (Photo #4)*	*3*

SUPERSTRUCTURE

The following repairs are recommended:

		Priority
1.	*Span 1 : Monitor for additional impacts at NB side of the bridge.*	*6*
2.	*Span 2 : Monitor for additional impacts at SB side of the bridge.*	*6*

SUBSTRUCTURE

The following repairs are recommended:

		Priority
1.	*Pier 2 : impact at top right side near girder bearing caused by vehicular traffic. (Photo #2)*	*6*

Condition Report & General Notes

DECK & APPROACH *(includes approach, ties, tie fasteners, rail, ballast ballast retainers, etc.)*

All members reported to be in good condition except as indicated below:

		Conditions
1.	*Track: Line and Surface: Fair*	*D*
2.	*Deck: Walkway: Hairline cracks on walkways on both sides of the bridge.*	*D*
3.	*Up-mile End: Handrail: Missing handrail cables at approach. (Photo #4)*	*B*

PRIMARY MEMBERS *(includes beams, girders, plate girder components, stiffeners, etc.)*

All members reported to be in good condition except as indicated below:

		Conditions
1.	*Span 2: Beams: Have been subject to vehicular impact. (Photo #1)*	*D*
2.	*Span 2: Beam: Missing rivets (3) at lower center plate. (Photo #1)*	*C*
3.	*Span 1: Beams: Have been subject to vehicular impact.*	*D*

SECONDARY MEMBERS *(includes bracing, diaphragms, connection plates and bolts, etc.)*

All members reported to be in good condition except as indicated below:

		Conditions
1.	*Good, with minor exceptions.*	*D*

BRIDGE SEAT *(includes bridge seat, bearing connections, etc.)*

All members reported to be in good condition except as indicated below:

		Conditions
1.	*Good, with minor exceptions.*	*D*

BRIDGE ID 16.3 ANNUAL INSPECTION REPORT

ABUTMENTS

	All members reported to be in good condition except as indicated below:	**Conditions**
1.	*Pier 2: A crash cushion was previously installed at left side of Pier #2; no crash cushion currently. (Photo #3)*	*D*

BENT PILES

	All members reported to be in good condition except as indicated below:	**Conditions**
1.	*Good, with minor exceptions.*	*D*

BENT CAPS

	All members reported to be in good condition except as indicated below:	**Conditions**
1.	*Good, with minor exceptions.*	*D*

BACKWALL

	All members reported to be in good condition except as indicated below:	**Conditions**
1.	*Good, with minor exceptions.*	*D*

Typical Bridge Photos:

Photo No.	Note: Missing min. clearance vehicular sign. Missing 3 rivets due to bridge impacts.
1	

Photo No.	Note: Pier #2 - Impact at top right side, near bearing seat, caused by vehicular traffic.
2	

Photo No.	Note: Crash cusion is no longer at left side of Pier #2.
3	

Photo No.	Note: missing guard cable at retaining wall connectiong with Abutment #3 right side.
4	

BRIDGE ID 16.9 ANNUAL INSPECTION REPORT

Prepared By: Marcos Lozano
Date Prepared: 9/13/2023

Reviewed By: Julina Corona
Date Reviewed: 9/13/2023

Date of Inspection: 8/14/2023

Weather: Sunny
Temperature (F˚): 74
Inspectors: Marcos Lozano
Julina Corona

Bridge Location Information

Bridge ID: 16.9
Section Number: 1 of 1
Railroad: ACTA
Subdivision: Long Beach
Crossing Feature: Dominguez Channel
Latitude: 33.7853023
Longitude: -118.2350872
Nearest Hy-Rail Access: TBD
City: Wilmington
County: Los Angeles
State: CA

Immediate Action Required

If Yes to any item below contact RBE and BPM

No	***Need railroad bridge engineer (RBE) review?***
No	***Slow order recommended?***
No	***Need bridge out of service?***
	Special inspection required?

Underwater inspection performed and coordinated by others

BRIDGE ID 16.9 ANNUAL INSPECTION REPORT

Structure Data

Bridge Type:	BDPG
Year Built:	Unknown
Plans On File:	TBD
Deck Type(s):	Ballasted
Number of Spans:	6
Number of Walkways:	2 with a cross over
Bridge Length (ft.):	205
Maximum Structure Height (ft.)	14.0
Skewed:	No
Vertical Clearance (ft.):	Unrestricted
Horizontal Clearance (ft.):	N/A
Vehicle Clearance (ft.):	N/A

Governing Bridge Condition & Priority Level

CONDITION RATING	PRIORITY LEVEL
A. Failed (may require bridge out of service)	1. Immediately
B. Deficient (Trains are operating but have restrictions)	2. Within 3 to 6 months
C. Satisfactory but with exceptions (no impact on operations or safety)	**3. Within 1 year**
D. Good with minor exceptions	4. Within 3 years
E. Very good (no exceptions)	5. Within 5 years
F. Not inspected/Inaccessible	6. Monitor

Notes:

Span #1 and #6 were inaccessible.

Track Data

Operating Speed (mph):	20
Number of Tracks:	1
Rail Size:	136
Degree of Curve:	Tangent
Super Elevation:	N/A
Mile Post Increases:	East to West

Site Conditions

Subject to Scour:	No
Vegetation Removal Needed:	No
Corrosive Materials Exposure:	No
Subject to Impact (type):	No
Subject to Heavy Drift:	Yes
Dangerous Fauna/Flora:	No
Active Faults:	No
Tidal Waters:	Yes

BRIDGE ID 16.9 ANNUAL INSPECTION REPORT

Priority Level Recommendations

DECK & APPROACH

The following repairs are recommended:

		Priority
1.	*Near Abutment 1 : Signal cables exposed; monitor for vandalism.*	*6*

SUPERSTRUCTURE

The following repairs are recommended:

		Priority
1.	*End Spans : Monitor homeless encampment before next annual inspection.*	*6*

SUBSTRUCTURE

The following repairs are recommended:

		Priority
1.	*Abutments : Monitor homeless encampment before next annual inspection.*	*6*
2.	*Piles : Underwater inspection performed and coordinated by others. (Photo #4)*	

Condition Report & General Notes

DECK & APPROACH *(includes approach, ties, tie fasteners, rail, ballast ballast retainers, etc.)*

All members reported to be in good condition except as indicated below:

		Condition
1.	*Track: Line and Surface: Fair*	*D*
2.	*Deck: Bridge-ties: N/A*	*D*
3.	*Deck: Walkways: Span #1 and #2, top handrail cable is loose. Missing hardware. (Photo #4)*	*C*
4.	*Deck: Approach: exposed signal cables near Abut #1 left side at signal post. Monitor for vandalism. (Photo #3)*	*D*

PRIMARY MEMBERS *(includes beams, girders, plate girder components, stiffeners, etc.)*

All members reported to be in good condition except as indicated below:

		Condition
1.	*No conditions to report.*	*D*

BRIDGE SEAT *(includes bridge seat, bearing connections, etc.)*

All members reported to be in good condition except as indicated below:

		Condition
1.	*Good, with minor exceptions.*	*D*

BRIDGE ID 16.9 ANNUAL INSPECTION REPORT

ABUTMENTS

All members reported to be in good condition except as indicated below:

	All members reported to be in good condition except as indicated below:	Condition
1.	*Span #1 & #6: No access due to new riprap & barbed wire fence on both sides of the bridge. (Photo #1)*	*F*

BENT PILES

	All members reported to be in good condition except as indicated below:	Condition
1.	*All Bents: Pile wrap at multiple piles showing aquatic vegetation growth.*	*C*

BENT CAPS

	All members reported to be in good condition except as indicated below:	Condition
1.	*All Bents: Utility mounted to bent caps on right side of bridge*	*F*
2.	*Bent #6: Cold joint between column #2 and #3. Monitor for crack development.*	*D*

BACKWALL

	All members reported to be in good condition except as indicated below:	Condition
1.	*Good, with minor exceptions.*	*D*

Typical Bridge Photos:

Photo No.	Note:
1	Span #1 and #6 not accessable

Photo No.	Note:
2	Typical Bent

Photo No.	Note:
3	Exposed signal cables near Abut #1.

Photo No.	Note:
4	Span #1 and #2, top handrail cable is lose on right side. Missing hardware.

BRIDGE ID 17.4 ANNUAL INSPECTION REPORT

Prepared By: Marcos Lozano
Date Prepared: 9/13/2023

Reviewed By: Julina Corona
Date Reviewed: 9/13/2023

Date of Inspection: 8/14/2023
Weather: Sunny
Temperature (F˚): 74
Inspectors: Marcos Lozano
Julina Corona

Bridge Location Information

Bridge ID: 17.4
Section Number: 1 of 1
Railroad: ACTA
Subdivision: Long Beach
Crossing Feature: Dominguez Channel
Latitude: 33.77722
Longitude: -118.24052739999
Nearest Hy-Rail Access: TBD
City: Wilmington
County: Los Angeles
State: CA

Immediate Action Required

If Yes to any item below contact RBE and BPM

Yes	***Need railroad bridge engineer (RBE) review?***
No	***Slow order recommended?***
No	***Need bridge out of service?***
No	***Special inspection required?***

BRIDGE ID 17.4 ANNUAL INSPECTION REPORT

Structure Data

Bridge Type:	ODPG
Year Built:	Unknown
Plans On File:	Yes
Deck Type(s):	Open
Number of Spans:	12
Number of Walkways:	2
Bridge Length (ft.):	337
Maximum Structure Height (ft.)	8.5
Skewed:	No
Vertical Clearance (ft.):	Unrestricted
Horizontal Clearance (ft.):	N/A
Vehicle Clearance (ft.):	N/A

Governing Bridge Condition & Priority Level

CONDITION RATING	PRIORITY LEVEL
A. Failed (may require bridge out of service)	1. Immediately
B. Deficient (Trains are operating but have restrictions)	2. Within 3 to 6 months
C. Satisfactory but with exceptions (no impact on operations or safety)	3. Within 1 year
D. Good with minor exceptions	4. Within 3 years
E. Very good (no exceptions)	5. Within 5 years
F. Not inspected/Inaccessible	6. Monitor
Notes:	
Monitor charred bridge-ties. Shear failure. At Abutments, damage/broken bearing concrete protection at anchor plates; getting out of place due to vibrations.	

Track Data

Operating Speed (mph):	40
Number of Tracks:	1
Rail Size:	136
Degree of Curve:	Tangent
Super Elevation:	N/A
Mile Post Increases:	East to West

Site Conditions

Subject to Scour:	No	
Vegetation Removal Needed:	No	
Corrosive Materials Exposure:	No	
Subject to Impact (type):	No	
Subject to Heavy Drift:	No	
Dangerous Fauna/Flora/hazard:	Yes	Trash/hazardous material from homeless encampment at Span #1 and #12
Active Faults:	No	
Tidal Waters:	Yes	

BRIDGE ID 17.4 ANNUAL INSPECTION REPORT

Priority Level Recommendations

DECK & APPROACH

	The following repairs are recommended:	Priority
1.	*Various locations : Handrail was temporarily removed at left side. Handrail was torched to prevent homeless encampment on bridge bearing seats. Re-install handrail. (Photo #5 and #6)*	*2*
2.	*Bridge-ties : Monitor charred bridge-ties.*	*6*

SUPERSTRUCTURE

	The following repairs are recommended:	Priority
1.	*Multiple Spans : Concrete riser below bearing plates at Abutment #13 has sheared; bridge seat - right side. RBE review plans to confirm structural integrity is not affected.*	*2*

SUBSTRUCTURE

	The following repairs are recommended:	Priority
1.	*There are no recommendations.*	

Condition Report & General Notes

DECK & APPROACH *(includes approach, ties, tie fasteners, rail, ballast ballast retainers, etc.)*

	All members reported to be in good condition except as indicated below:	Condition
1.	*Deck: Bridge-ties: Ties 6-13 minor charring. (Photo #3)*	*C*
2.	*Up-mile: Approaches: 34 approach ties (towards the crossing); good condition.*	*D*
3.	*Down-mile: Approaches: 23 approach ties; good condition.*	*D*
4.	*Deck: Bridge-ties: 42 of the total ties are also supporting walkway and pipe couples.*	**Note*
5.	*Deck: Bridge-ties: 5 1/2" clear space between ties.*	**Note*
6.	*Deck: Bridge-ties: 267 total ties, 10"x9.5"x10' (15 ctc).*	**Note*
7.	*Deck: Bridge-ties: every 4th tie supports walkway.*	**Note*

PRIMARY MEMBERS *(includes beams, girders, plate girder components, stiffeners, etc.)*

	All members reported to be in good condition except as indicated below:	Condition
1.	*Good, with minor exceptions.*	*D*

SECONDARY MEMBERS *(includes bracing, diaphragms, connection plates and bolts, etc.)*

	All members reported to be in good condition except as indicated below:	Condition
1.	*Overall: Diaphragms: 4 welded beams, hardware on diaphragms in good condition.*	*D*

BRIDGE ID 17.4 ANNUAL INSPECTION REPORT

BRIDGE SEAT *(includes bridge seat, bearing connections, etc.)*

All members reported to be in good condition except as indicated below:	Condition
1. *Abutments and Bent Caps: Concrete riser or grout fill sheared around anchors at bearing plates. Cracked concrete is breaking up with train load vibrations. (Photo #1 and #2)*	*C*

ABUTMENTS

All members reported to be in good condition except as indicated below:	Condition
1. *Good, with minor exceptions.*	*D*

BENT PILES

All members reported to be in good condition except as indicated below:	Condition
1. *Good, with minor exceptions.*	*D*

BENT CAPS

All members reported to be in good condition except as indicated below:	Condition
1. *All Bents: Shear key at every cap. Good condition for all that were visible. (Photo 4)*	*D*

BACKWALL

All members reported to be in good condition except as indicated below:	Condition
1. *Good, with minor exceptions.*	*D*

Typical Bridge Photos:

Photo No.	Note:
1	Concrete riser or grout fill is cracked below bearing plates, Abut #1 right side

Photo No.	Note:
2	Concrete below bearing plates is cracked, Abut #13 right side

Photo No.	Note:
3	Open Timber Deck. Several charred timber bridge-ties at Span #1.

Photo No.	Note:
4	Skewed bent. Seismic Keys show minor cracks at base of bearing seat.

Typical Bridge Photos:

Photo No.	Note: Missing handrail section on left side at low mile approach.
5	

Photo No.	Note: Missing upper handrail section at multiple spans.
6	

Photo No.	Note: Utility lines run on top of both walkways
7	

Photo No.	Note: Utility conduit has been tampered with.
8	

BRIDGE ID 17.8 ANNUAL INSPECTION REPORT

Prepared By:	Marcos Lozano
Date Prepared:	9/14/2022
Reviewed By:	Julina Corona
Date Reviewed:	9/14/2022
Date of Inspection:	8/14/2023
Weather:	Sunny
Temperature (F˚):	74
Inspectors:	Marcos Lozano Julina Corona

Bridge Location Information

Bridge ID:	17.8
Section Number:	Multiple - 5
Railroad:	ACTA
Subdivision:	Long Beach
Crossing Feature:	Henry Ford Ave
Latitude:	33.7771765
Longitude:	-118.24045299999
Nearest Hy-Rail Access:	TBD
City:	Wilmington
County:	Los Angeles
State:	CA

Immediate Action Required

If Yes to any item below contact RBE and BPM

No	***Need railroad bridge engineer (RBE) review?***
No	***Slow order recommended?***
No	***Need bridge out of service?***
No	***Special inspection required?***

BRIDGE ID 17.8 ANNUAL INSPECTION REPORT

Structure Data

Bridge Type: DPG, Truss, Concrete Beams
Year Built: Unknown
Plans On File: Yes
Deck Type(s): Ballasted
Number of Spans: 36
Number of Walkways: 2
Bridge Length (ft.): 2256
Maximum Structure Height (ft.) 30.0
Skewed: No
Vertical Clearance (ft.): TBD
Horizontal Clearance (ft.): TBD
Vehicle Clearance (ft.): TBD

Governing Bridge Condition & Priority Level

CONDITION RATING	PRIORITY LEVEL
A. Failed (may require bridge out of service)	1. Immediately
B. Deficient (Trains are operating but have restrictions)	2. Within 3 to 6 months
C. Satisfactory but with exceptions (no impact on operations or safety)	3. Within 1 year
D. Good with minor exceptions	4. Within 3 years
E. Very good (no exceptions)	5. Within 5 years
F. Not inspected/Inaccessible	6. Monitor
Notes:	
Remove homeless encampment before next annual inspection at Span 1 (Segment 1).	

Track Data

Operating Speed (mph): 30
Number of Tracks: 2
Rail Size: 136
Degree of Curve: TBD
Super Elevation: TBD
Mile Post Increases: East to West

Site Conditions

Subject to Scour: No
Vegetation Removal Needed: Yes Photo #8
Corrosive Materials Exposure: No
Subject to Impact (type): Motor Vehicle
Subject to Heavy Drift: No
Dangerous Fauna/Flora: No
Active Faults: No
Tidal Waters: No

BRIDGE ID 17.8 ANNUAL INSPECTION REPORT

Priority Level Recommendations

DECK & APPROACH

The following repairs are recommended:

		Priority
1.	*Span 36 : Remove vegetation to avoid future damage to the end approach MSE wall panels. (Photo #8)*	*3*

SUPERSTRUCTURE

The following repairs are recommended:

		Priority
1.	*Segment 4 : Install vehicle clearance sign.*	*3*

SUBSTRUCTURE

The following repairs are recommended:

		Priority
1.	*Columns : Monitor map cracks*	*6*

Condition Report & General Notes

DECK & APPROACH *(includes approach, ties, tie fasteners, rail, ballast ballast retainers, etc.)*

All members reported to be in good condition except as indicated below:

		Condition
1.	*Track: Line and Surface: Fair*	*D*
2.	*Deck: Bridge-ties: N/A*	*D*
3.	*Approaches: Handrail: Lower handrail cable is loose at end post. (Photo 7)*	*D*
4.	*Approaches: Retaining Wall: Vegetation growing at both sides of the approach behind Abutment #36. (Photo #8)*	*C*

PRIMARY MEMBERS *(includes beams, girders, plate girder components, stiffeners, etc.)*

All members reported to be in good condition except as indicated below:

		Condition
1.	*Girder (Segment 3): Girder 4 & 5 : missing nuts in earthquake restrain.*	*C*
2.	*Truss (Segment 4): Chord: Left side vertical vehicle clearance not posted.*	*C*
3.	*Girder (Segment 1): Girders : Barbed wire added between girders. Not accessible for inspection.*	*F*

SECONDARY MEMBERS *(includes bracing, diaphragms, connection plates and bolts, etc.)*

All members reported to be in good condition except as indicated below:

		Condition
1.	*Good, with minor exceptions.*	*D*

BRIDGE SEAT *(includes bridge seat, bearing connections, etc.)*

All members reported to be in good condition except as indicated below:

		Condition
1.	*Concrete beams (Segment 5): Bearing pads inaccessible and not visible for inspection.*	*F*

BRIDGE ID 17.8 ANNUAL INSPECTION REPORT

PIERS

All members reported to be in good condition except as indicated below:

		Condition
1.	*Columns: Map cracks at all columns. (Photo #4)*	*C*

ABUTMENTS

All members reported to be in good condition except as indicated below:

		Condition
1.	*Good, with minor exceptions.*	*D*

BENT PILES

All members reported to be in good condition except as indicated below:

		Condition
1.	*Good, with minor exceptions.*	*D*

BENT CAPS

All members reported to be in good condition except as indicated below:

		Condition
1.	*Good, with minor exceptions.*	*D*

BENT BRACING *(includes transverse and longitudinal bracing)*

All members reported to be in good condition except as indicated below:

		Condition
1.	*Good, with minor exceptions.*	*D*

BACKWALL

All members reported to be in good condition except as indicated below:

		Condition
1.	*Good, with minor exceptions.*	*D*

BRIDGE ID 17.8 ANNUAL INSPECTION REPORT

Typical Bridge Photos:

Photo No.	**Note:** Underwater column repairs around column wraps
1	

Photo No.	**Note:** Span 3 - Second through truss span over road.
2	

Photo No.	**Note:** Underwater column repairs around column wraps
3	

Photo No.	**Note:** Typical map cracks at columns and crash walls
4	

Typical Bridge Photos:

Photo No.	Note:
5	Typical two column concrete bents.

Photo No.	Note:
6	Typical Truss bays, in good condition.

Photo No.	Note:
7	Lower handrail cable is loose at end post at up-mile approach.

Photo No.	Note:
8	Growing vegetation at both approach walls behind up-mile Abutment

BRIDGE ID 17.8 ANNUAL INSPECTION REPORT

Prepared By: Marcos Lozano
Date Prepared: 9/14/2022

Reviewed By: Julina Corona
Date Reviewed: 9/14/2022

Date of Inspection: 8/14/2023
Weather: Sunny
Temperature (F˚): 74
Inspectors: Marcos Lozano
Julina Corona

Bridge Location Information

Bridge ID: 17.8
Section Number: Multiple - 5
Railroad: ACTA
Subdivision: Long Beach
Crossing Feature: Henry Ford Ave
Latitude: 33.7771765
Longitude: -118.24045299999
Nearest Hy-Rail Access: TBD
City: Wilmington
County: Los Angeles
State: CA

Immediate Action Required

If Yes to any item below contact RBE and BPM

No	***Need railroad bridge engineer (RBE) review?***
No	***Slow order recommended?***
No	***Need bridge out of service?***
No	***Special inspection required?***

BRIDGE ID 17.8 ANNUAL INSPECTION REPORT

Structure Data

Bridge Type: DPG, Truss, Concrete Beams
Year Built: Unknown
Plans On File: Yes
Deck Type(s): Ballasted
Number of Spans: 36
Number of Walkways: 2
Bridge Length (ft.): 2256
Maximum Structure Height (ft.) 30.0
Skewed: No
Vertical Clearance (ft.): TBD
Horizontal Clearance (ft.): TBD
Vehicle Clearance (ft.): TBD

Governing Bridge Condition & Priority Level

CONDITION RATING	PRIORITY LEVEL
A. Failed (may require bridge out of service)	1. Immediately
B. Deficient (Trains are operating but have restrictions)	2. Within 3 to 6 months
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D. Good with minor exceptions	4. Within 3 years
E. Very good (no exceptions)	5. Within 5 years
F. Not inspected/Inaccessible	6. Monitor
Notes:	
Remove homeless encampment before next annual inspection at Span 1 (Segment 1).	

Track Data

Operating Speed (mph): 30
Number of Tracks: 2
Rail Size: 136
Degree of Curve: TBD
Super Elevation: TBD
Mile Post Increases: East to West

Site Conditions

Subject to Scour: No
Vegetation Removal Needed: Yes
Corrosive Materials Exposure: No
Subject to Impact (type): Motor Vehicle
Subject to Heavy Drift: No
Dangerous Fauna/Flora: No
Active Faults: No
Tidal Waters: No

Photo #8

BRIDGE ID 17.8 ANNUAL INSPECTION REPORT

Priority Level Recommendations

DECK & APPROACH

The following repairs are recommended:

		Priority
1.	*Span 36 : Remove vegetation to avoid future damage to the end approach MSE wall panels. (Photo #8)*	*3*

SUPERSTRUCTURE

The following repairs are recommended:

		Priority
1.	*Segment 4 : Install vehicle clearance sign.*	*3*

SUBSTRUCTURE

The following repairs are recommended:

		Priority
1.	*Columns : Monitor map cracks*	*6*

Condition Report & General Notes

DECK & APPROACH *(includes approach, ties, tie fasteners, rail, ballast ballast retainers, etc.)*

All members reported to be in good condition except as indicated below:

		Condition
1.	*Track: Line and Surface: Fair*	*D*
2.	*Deck: Bridge-ties: N/A*	*D*
3.	*Approaches: Handrail: Lower handrail cable is loose at end post. (Photo 7)*	*D*
4.	*Approaches: Retaining Wall: Vegetation growing at both sides of the approach behind Abutment #36. (Photo #8)*	*C*

PRIMARY MEMBERS *(includes beams, girders, plate girder components, stiffeners, etc.)*

All members reported to be in good condition except as indicated below:

		Condition
1.	*Girder (Segment 3): Girder 4 & 5 : missing nuts in earthquake restrain.*	*C*
2.	*Truss (Segment 4): Chord: Left side vertical vehicle clearance not posted.*	*C*
3.	*Girder (Segment 1): Girders : Barbed wire added between girders. Not accessible for inspection.*	*F*

SECONDARY MEMBERS *(includes bracing, diaphragms, connection plates and bolts, etc.)*

All members reported to be in good condition except as indicated below:

		Condition
1.	*Good, with minor exceptions.*	*D*

BRIDGE SEAT *(includes bridge seat, bearing connections, etc.)*

All members reported to be in good condition except as indicated below:

		Condition
1.	*Concrete beams (Segment 5): Bearing pads inaccessible and not visible for inspection.*	*F*

BRIDGE ID 17.8 ANNUAL INSPECTION REPORT

PIERS

All members reported to be in good condition except as indicated below:

		Condition
1.	*Columns: Map cracks at all columns. (Photo #4)*	*C*

ABUTMENTS

All members reported to be in good condition except as indicated below:

		Condition
1.	*Good, with minor exceptions.*	*D*

BENT PILES

All members reported to be in good condition except as indicated below:

		Condition
1.	*Good, with minor exceptions.*	*D*

BENT CAPS

All members reported to be in good condition except as indicated below:

		Condition
1.	*Good, with minor exceptions.*	*D*

BENT BRACING *(includes transverse and longitudinal bracing)*

All members reported to be in good condition except as indicated below:

		Condition
1.	*Good, with minor exceptions.*	*D*

BACKWALL

All members reported to be in good condition except as indicated below:

		Condition
1.	*Good, with minor exceptions.*	*D*

Typical Bridge Photos:

Photo No.	Note: Underwater column repairs around column wraps
1	

Photo No.	Note: Span 3 - Second through truss span over road.
2	

Photo No.	Note: Underwater column repairs around column wraps
3	

Photo No.	Note: Typical map cracks at columns and crash walls
4	

Typical Bridge Photos:

Photo No.	Note: Typical two column concrete bents.
5	

Photo No.	Note: Typical Truss bays, in good condition.
6	

Photo No.	Note: Lower handrail cable is loose at end post at up-mile approach.
7	

Photo No.	Note: Growing vegetation at both approach walls behind up-mile Abutment
8	

ACTA

Alameda Corridor Transportation Authority

Maintenance of Way Services

Appendix S

2023 Underwater Bridge Inspection Report

INSpection

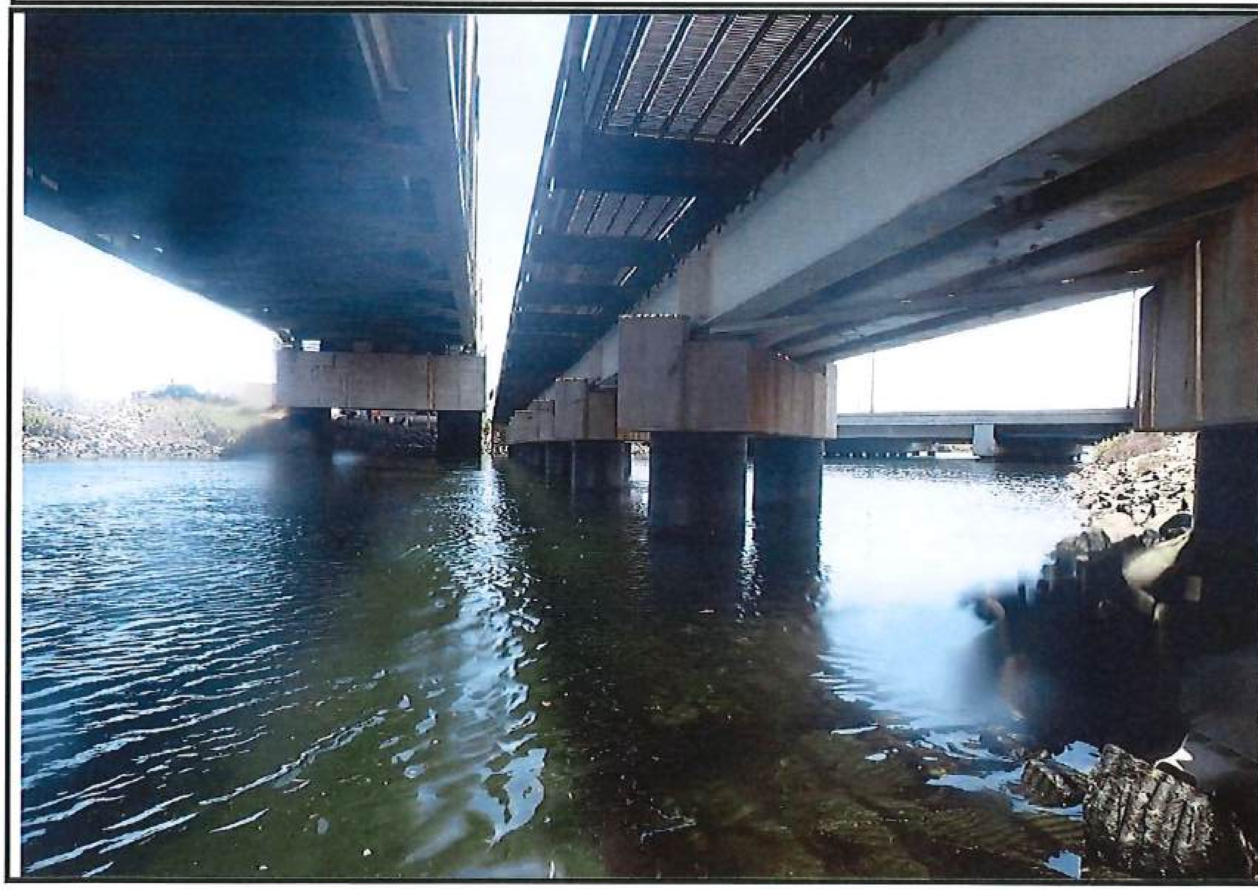
PHAMARINE
COMMERCIAL DIVING SERVICES
LONG BEACH, CALIFORNIA

PHAMARINE
Commercial Diving Services
Long Beach, CA 90813
Voice: 805 825 6035
Email: INFO@PHAMARINE.COM
Website: www.phamarine.com

DIVE REPORT

ALAMEDA CORRIDOR BRIDGE – HENRY FORD BRIDGE

7TH JUNE 2023



UNDERWATER ASSIGNMENT

DATE:	6.7.2023	SITE:	HENRY FORD		JOB NO:	0523022
CUSTOMER:	RAILWORKS TRACK SERVICES, LLC				P.O:	
LOCATION:	LONG BEACH, CALIFORNIA				Depth:	7M
SEA STATE:	CALM	VISIBILITY:	5FT		CURRENT:	-2KT-

SERVICE PERFORMED

BRIDGE INSPECTION WITH PHOTOS	YES

ATTENDING PERSONNEL

SUPERVISOR	BILLY PHAM
DIVERS	ROBERT FALLON
TENDER	ANDY FREEMAN
START TIME	0700
END TIME	1500

PHONE : 714-833-1930 • E-Mail : info@phamarine.com • WWW.PHAMARINE.COM

Summary of Findings

- Phamarine Commercial Diving services attended the HENRY FORD TRAIN BRIDGE on DATE 6.7.2023 IN LONG BEACH CALIFORNIA
- All Diving activities have been performed safely and in compliance with USCG, ADC and OSHA.

Henry Ford Bridge runs across the Dominguez channel from North to South, with the channel water flowing East and West. Henry Ford Bridge consists of two sections. The Bridges sit side by side, with the West side bridge (BRIDGE A) consisting of 9 Bents, with 2 piles per Bent. The second bridge (BRIDGE B) sitting on the East side consists of 4 main structural piles spread across two Bents.

Bridge A was inspected and labelled BENT 1 NORTH SIDE and all 'A' piles West side, 'B' piles East side, . Bridge A appeared free from any structural damage. All piles were inspected from the waterline down to the Mudline. The piles appear to be steel, and then wrapped in a 1mm polyurethane wrap from top to bottom. On all the piles, the Polyurethane appeared to go below the mudline, ensuring no steel was exposed. On several piles above the waterline, previous repairs have been made to the Polyurethane, which appears to be peeling, exposing the steel beneath and allowing active corrosion to take place. Phamarine have suggested the areas identified be cleaned and re wrapped to provide protection for the foreseeable future.

Bridge B was inspected and labelled BENT 1 NORTH SIDE and all 'A' piles West side, 'B' piles East side, . Bridge B had 3 piles on land and one in the water. The north side piles (bent 1) was not fully accessible due to fencing and trash. The South side piles (bent 2) were accessible, one of which sat in the water, the other on land.

All piles were inspected from the waterline down to the Mudline. The piles appear to be steel, and then wrapped in approximately half an inch of concrete and then painted with a polyurethane coating.

On the 3 piles that were accessible, the polyurethane coating is blistering, peeling, or completely gone, just leaving concrete exposed.

On Bent 2 Pile A on the South side, the Base of the pile was sighted to have some damage. Due to excessive surge, there appears to be major scouring on the North side of the piles mudline, which has completely exposed the North face of the piles foundation which is made of concrete. The exposure size of the concrete foundation is approximately 34 inches tall, and 4 feet wide. The concrete is not coated, exposed to direct flow of water and appears to have some chipping. The steel pile that sits on the foundation also shows signs of excessive surge impact over the years. The steel pile from the West side of the pile, moving clockwise around to the South East side of the pile has active corrosion. The Piles protective concrete layer of approximately 1 inch is missing and the steel pile beneath has been exposed, which is leading to erosion of the steel. Total depth when measured with a tape appears to be around 3 inches deep.

Phamarine has suggested the Pile should be cleaned and protected to prevent further damage, and that the Footing should be recovered with Rocks to prevent further damage.

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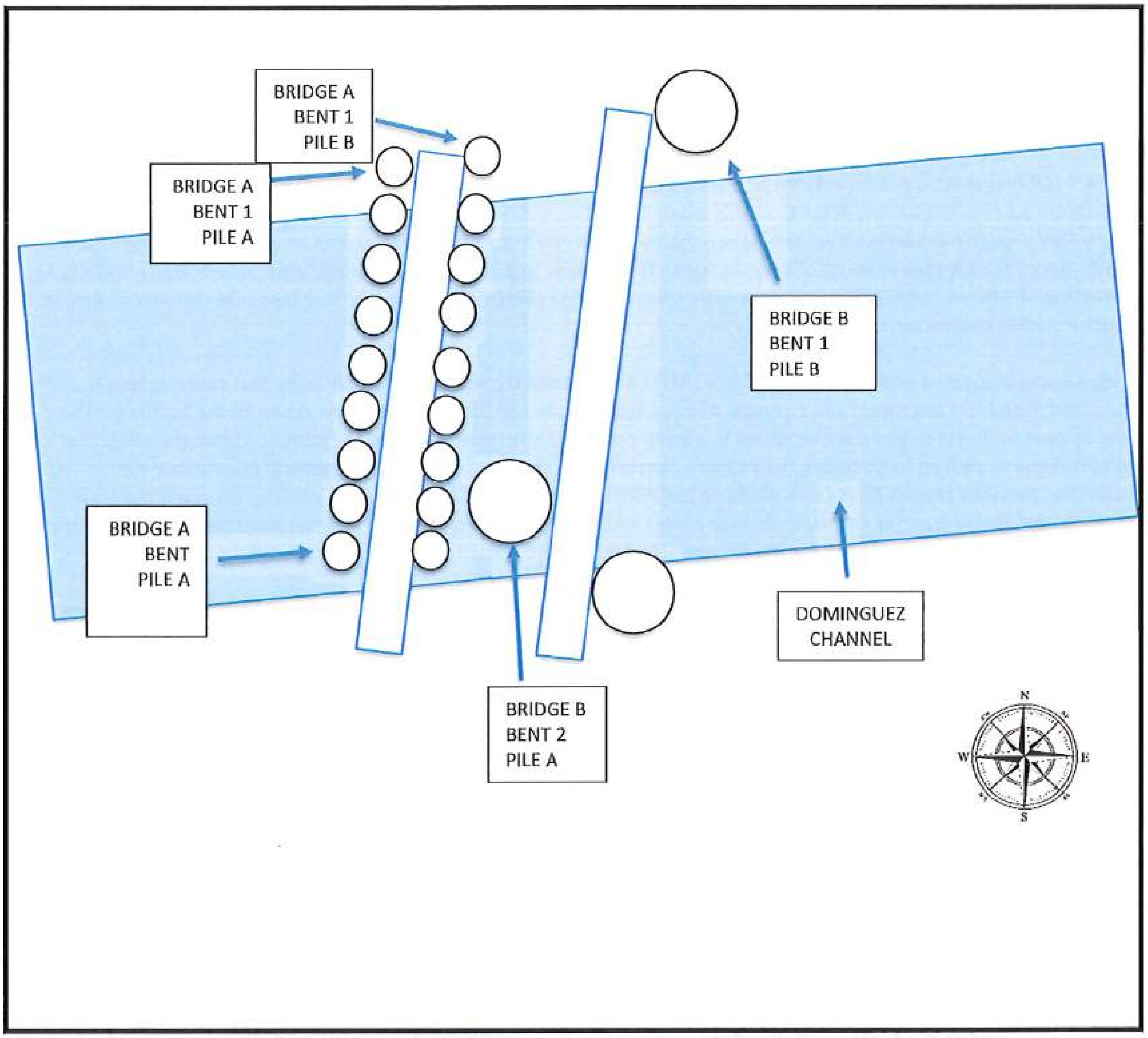

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HENRY FORD- BRIDGE A								
						STEEL PILES ONLY	CONCRETE PILES ONLY	
BENT I/D	PILE I/D	PILE MATERIAL	WRAP MATERIAL	WRAP MATERIAL RIPS/TEARS	MUDLINE SCOUR	STEEL ACTIVE CORROSION	SCALING	SPALING
1	A	STEEL	1MM POLYURETHANE		NO		N/A	N/A
1	B	STEEL	1MM POLYURETHANE		NO		N/A	N/A
2	A	STEEL	1MM POLYURETHANE		NO		N/A	N/A
2	B	STEEL	1MM POLYURETHANE		NO		N/A	N/A
3	A	STEEL	1MM POLYURETHANE		NO		N/A	N/A
3	B	STEEL	1MM POLYURETHANE	YES	NO		N/A	N/A
4	A	STEEL	1MM POLYURETHANE	YES	NO		N/A	N/A
4	B	STEEL	1MM POLYURETHANE		NO		N/A	N/A
5	A	STEEL	1MM POLYURETHANE	YES	NO		N/A	N/A
5	B	STEEL	1MM POLYURETHANE	YES	NO	YES	N/A	N/A
6	A	STEEL	1MM POLYURETHANE		NO		N/A	N/A
6	B	STEEL	1MM POLYURETHANE	YES	NO		N/A	N/A
7	A	STEEL	1MM POLYURETHANE	YES	NO	YES	N/A	N/A
7	B	STEEL	1MM POLYURETHANE	YES	NO	YES	N/A	N/A
8	A	STEEL	1MM POLYURETHANE	YES	NO		N/A	N/A
8	B	STEEL	1MM POLYURETHANE	YES	NO	YES	N/A	N/A
9	A	STEEL	1MM POLYURETHANE	YES	NO	YES	N/A	N/A
9	B	STEEL	1MM POLYURETHANE		NO		N/A	N/A

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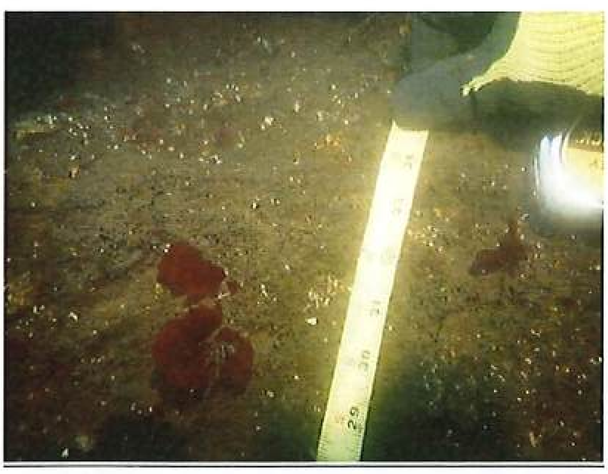
HENRY FORD- BRIDGE B								
						STEEL PILES ONLY	CONCRETE PILES ONLY	
BENT I/D	PILE I/D	PILE MATERIAL	WRAP MATERIAL	WRAP MATERIAL RIPS/TEARS	MUDLINE SCOUR	STEEL ACTIVE CORROSION	SCALING	SPALLING
1	A	STEEL	NOT ACCESSIBLE					
1	B	STEEL	CONCRETE					
2	A	STEEL	CONCRETE		YES	YES	NO	NO
2	B	STEEL	CONCRETE					



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7
6
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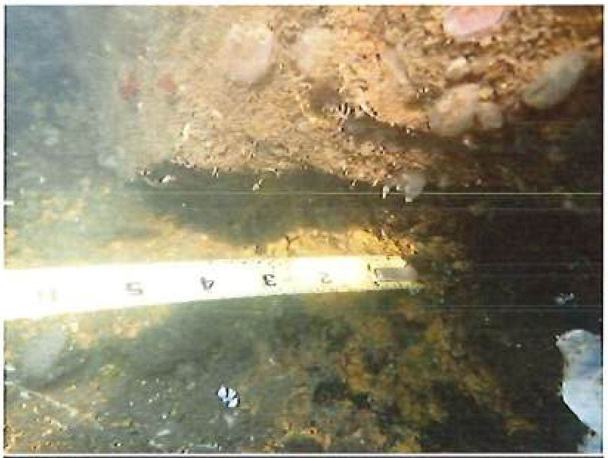
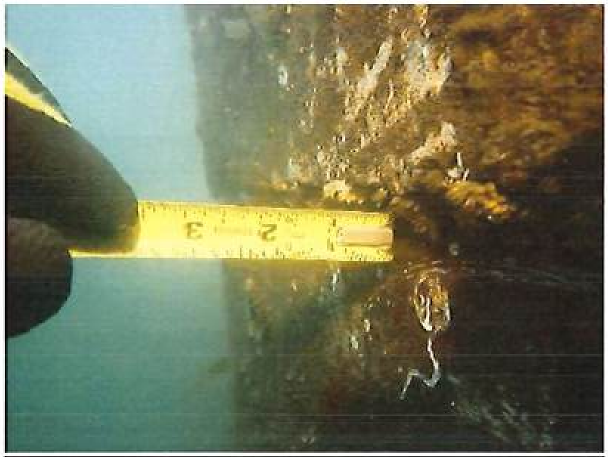






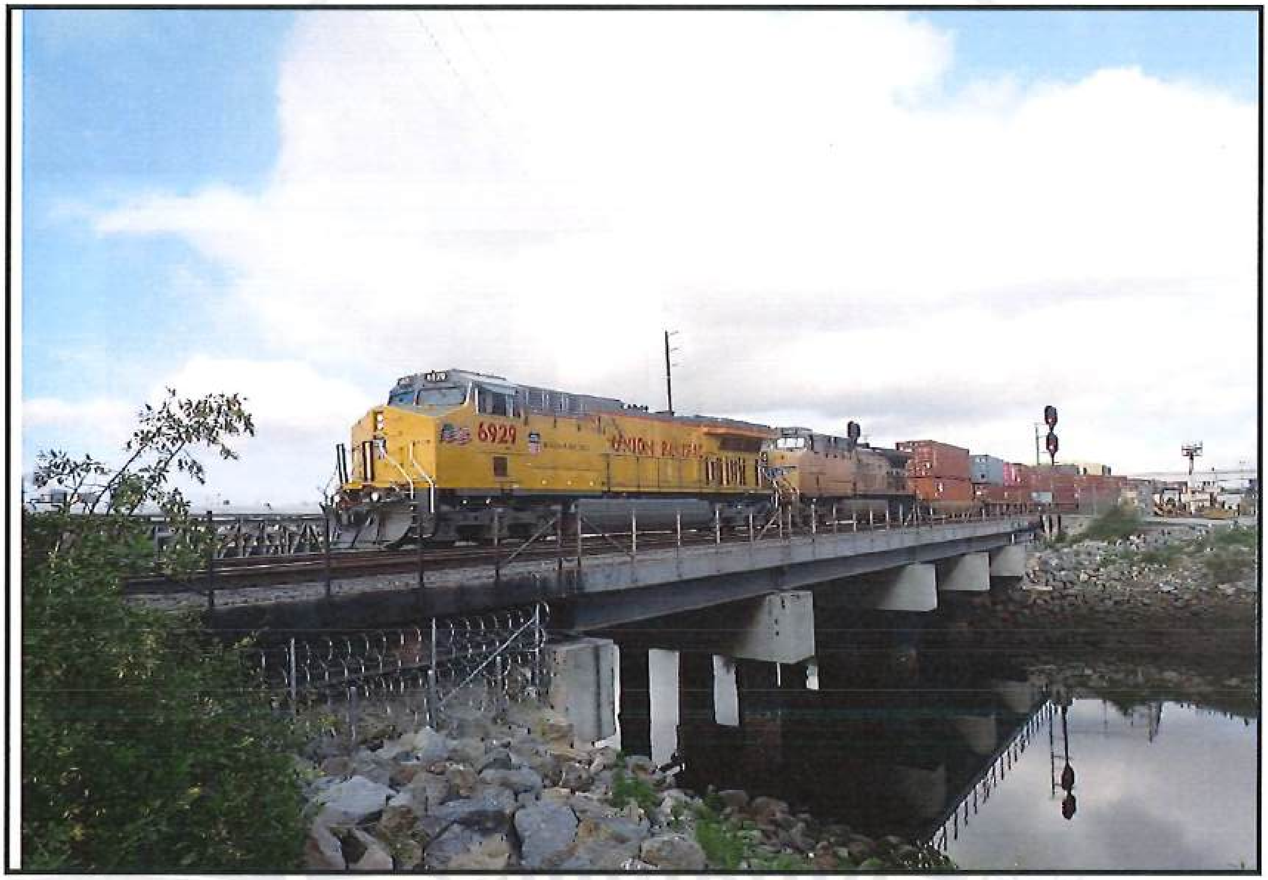



PHONE : 714-833-1930 • E-Mail : info@phamarine.com • WWW.PHAMARINE.COM

DIVE REPORT

ALAMEDA CORRIDOR BRIDGE – TESORO BRIDGE

8TH JUNE 2023



PHONE : 714-833-1930 • E-Mail : info@phamarine.com • WWW.PHAMARINE.COM

UNDERWATER ASSIGNMENT

DATE:	6.7.2023	SITE:	TESORO			JOB NO:	0523022
CUSTOMER:	RAILWORKS TRACK SERVICES, LLC					P.O:	
LOCATION:	LONG BEACH, CALIFORNIA					Depth:	5M
SEA STATE:	CALM		VISIBILITY:	5FT		CURRENT:	-1KT-

SERVICE PERFORMED

BRIDGE INSPECTION WITH PHOTOS	YES

ATTENDING PERSONNEL

SUPERVISOR	BILLY PHAM
DIVERS	ROBERT FALLON
TENDER	ANDY FREEMAN
START TIME	0700
END TIME	1500

Summary of Findings

- Phamarine Commercial Diving services attended the HENRY FORD TRAIN BRIDGE on DATE 6.7.2023 IN LONG BEACH CALIFORNIA
- All Diving activities have been performed safely and in compliance with USCG, ADC and OSHA.

Tesoro Bridge runs across the Dominguez channel from East to West, with the channel water flowing North East and South West. Tesoro Bridge consists of one main bridge with 5 Bents, and 5 Piles per Bent (25 piles total). The piles appear to be steel, and then wrapped in a 1mm polyurethane wrap from top to bottom. On all the piles, the Polyurethane appeared to go below the mudline, ensuring no steel was exposed.

All the Piles were sighted to be in good order except for on Bent 4. Multiple Piles on Bent 4 had damage on either the North face of the pile or the South face of the pile, which is the direction the river travels, suggesting the damage is Surge damage. The extent of the damage appears to be rips and tears to the Polyurethane wrap which has resulted in active corrosion of the steel below. Depth of the active corrosion is not identified as no Polyurethane wrap was removed.

Phamarine have suggested the areas identified be cleaned and re wrapped to provide protection for the foreseeable future.

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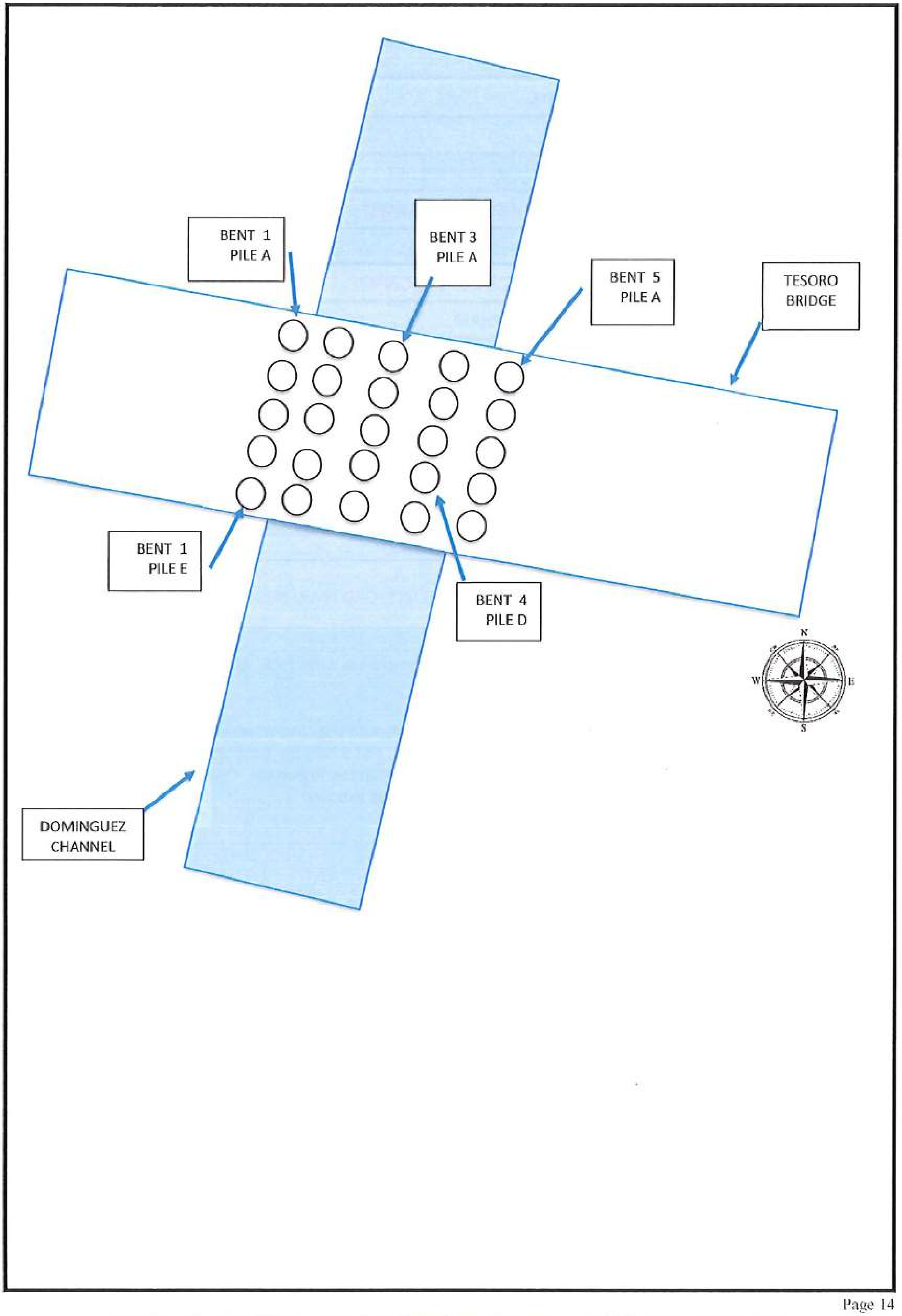
BENT 1
PILE A
BENT 3
PILE A
BENT 5
PILE A
TESORO
BRIDGE
BENT 1
PILE E
BENT 4
PILE D
N
W
E
S
DOMINGUEZ
CHANNEL

TESORO BRIDGE								
						STEEL PILES ONLY	CONCRETE PILES ONLY	
BENT I/D	PILE I/D	PILE MATERIAL	WRAP MATERIAL	WRAP MATERIAL RIPS/TEARS	MUDLINE SCOUR	STEEL ACTIVE CORROSION	SCALING	SPALING
1	A	STEEL	1MM POLYURETHANE	YES	NO	YES	N/A	N/A
1	B	STEEL	1MM POLYURETHANE	YES	NO	YES	N/A	N/A
1	C	STEEL	1MM POLYURETHANE		NO		N/A	N/A
1	D	STEEL	1MM POLYURETHANE		NO		N/A	N/A
1	E	STEEL	1MM POLYURETHANE		NO		N/A	N/A
2	A	STEEL	1MM POLYURETHANE		NO		N/A	N/A
2	B	STEEL	1MM POLYURETHANE		NO		N/A	N/A
2	C	STEEL	1MM POLYURETHANE		NO		N/A	N/A
2	D	STEEL	1MM POLYURETHANE		NO		N/A	N/A
2	E	STEEL	1MM POLYURETHANE		NO		N/A	N/A
3	A	STEEL	1MM POLYURETHANE		NO		N/A	N/A
3	B	STEEL	1MM POLYURETHANE		NO		N/A	N/A
3	C	STEEL	1MM POLYURETHANE		NO		N/A	N/A
3	D	STEEL	1MM POLYURETHANE		NO		N/A	N/A
3	E	STEEL	1MM POLYURETHANE		NO		N/A	N/A
4	A	STEEL	1MM POLYURETHANE	YES	NO	YES	N/A	N/A
4	B	STEEL	1MM POLYURETHANE	YES	NO	YES	N/A	N/A
4	C	STEEL	1MM POLYURETHANE	YES	NO	YES	N/A	N/A
4	D	STEEL	1MM POLYURETHANE		NO		N/A	N/A
4	E	STEEL	1MM POLYURETHANE		NO		N/A	N/A
5	A	STEEL	1MM POLYURETHANE	YES	NO	YES	N/A	N/A
5	B	STEEL	1MM POLYURETHANE		NO		N/A	N/A
5	C	STEEL	1MM POLYURETHANE		NO		N/A	N/A
5	D	STEEL	1MM POLYURETHANE		NO		N/A	N/A
5	E	STEEL	1MM POLYURETHANE		NO		N/A	N/A

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2B

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WEST
BENT
PILE A

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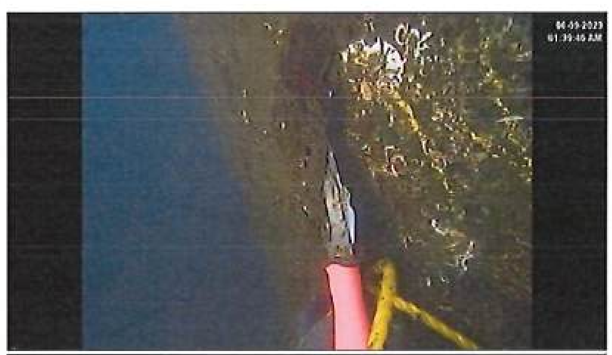

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DIVE REPORT

ALAMEDA CORRIDOR BRIDGE – CHANNEL BRIDGE

9^{TH} JUNE 2023

PHONE : 714-833-1930 • E-Mail : info@phamarine.com • WWW.PHAMARINE.COM

UNDERWATER ASSIGNMENT					
DATE:	6.9.2023	SITE:	CHANNEL BRIDGE	JOB NO:	0523022
CUSTOMER:	RAILWORKS TRACK SERVICES, LLC			P.O:	
LOCATION:	LONG BEACH, CALIFORNIA			Depth:	5M
SEA STATE:	CALM	VISIBILITY:	5FT	CURRENT:	-0KT-

SERVICE PERFORMED	
BRIDGE INSPECTION WITH PHOTOS	YES
ATTENDING PERSONNEL	
SUPERVISOR	BILLY PHAM
DIVERS	ANDY FREEMAN
TENDER	GABRIEL MENDOZA
START TIME	0700
END TIME	1700

PHONE : 714-833-1930 • E-Mail : info@phamarine.com • WWW.PHAMARINE.COM

Summary of Findings

- Phamarine Commercial Diving services attended the CHANNEL BRIDGE on DATE 6.9.2023 IN LONG BEACH CALIFORNIA

- All Diving activities have been performed safely and in compliance with USCG, ADC and OSHA.

Channel Bridge runs across the Dominguez channel from North to South, with the channel water flowing East and West. Channel Bridge consists of one main bridge with multiple piles stretching under the bridge. Half of the bridge is operated by Rail works which was inspected. The other half was operated by Union Pacific and not inspected. Phamarine inspected 5 Bents. The first 22 piles in each bent were inspected (11 rows deep/2 piles each = 22)

All the piles on Channel Bridge appeared to be concrete. No wrapping of the pile was sighted at time of inspection. The inspected areas of the piles were cleaned to remove Bio fouling prior to inspection. Piles were inspected from the surface of the water to the mudline for those that sat in water. For the piles sitting out of the water, the entire pile was inspected.

No damage was sighted. All piles are free from any Scaling and Spalling.

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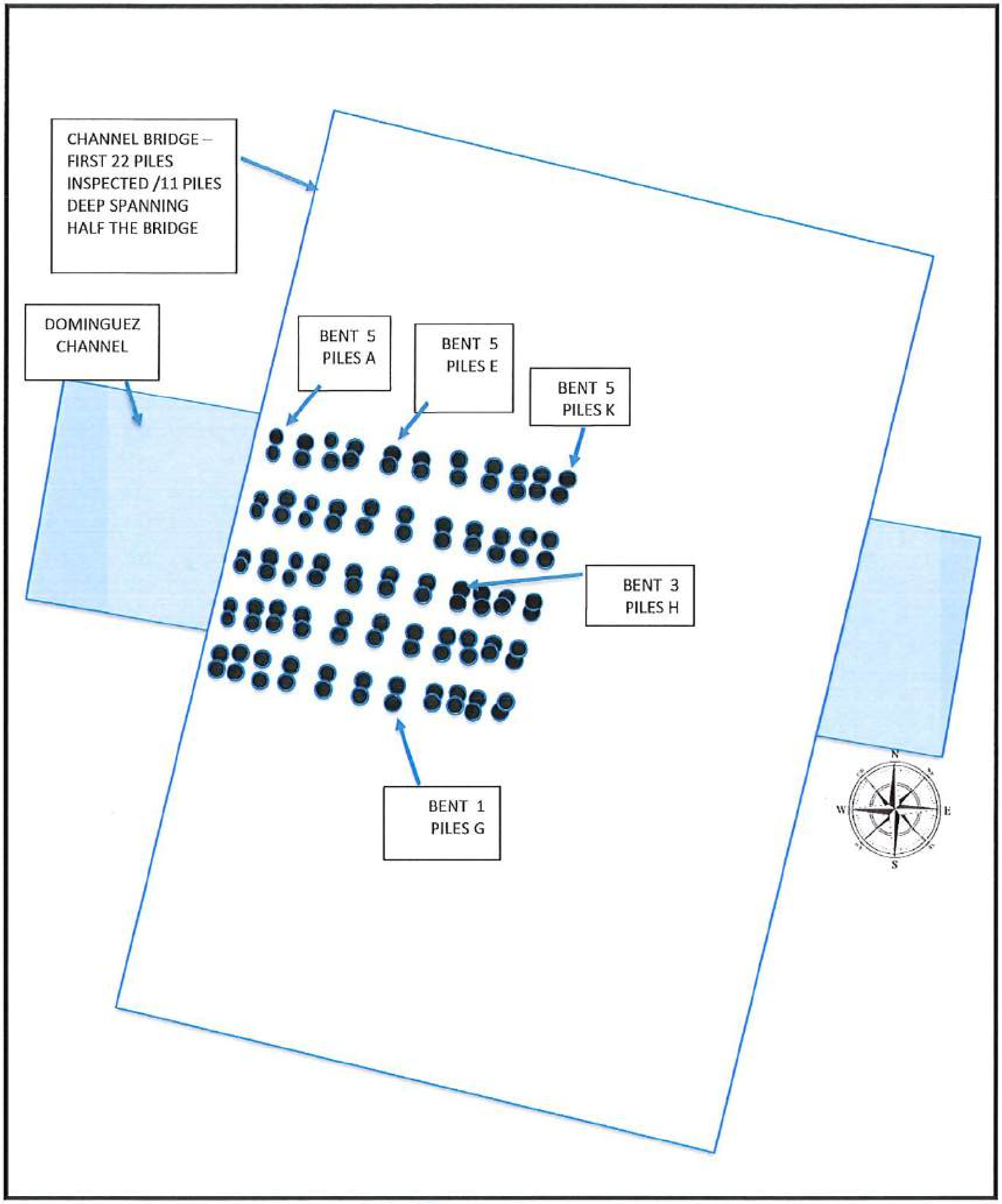

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CHANNEL BRIDGE								
						STEEL PILES ONLY	CONCRETE PILES ONLY	
BENT I/D	PILE I/D	PILE MATERIAL	WRAP MATERIAL	WRAP MATERIAL RIPS/TEARS	MUDLINE SCOUR	STEEL ACTIVE CORROSION	SCALING	SPALLING
1	A	CONCETE	N/A	N/A	NO	N/A	NO	NO
1	B	CONCETE	N/A	N/A	NO	N/A	NO	NO
1	C	CONCETE	N/A	N/A	NO	N/A	NO	NO
1	D	CONCETE	N/A	N/A	NO	N/A	NO	NO
1	E	CONCETE	N/A	N/A	NO	N/A	NO	NO
1	F	CONCETE	N/A	N/A	NO	N/A	NO	NO
1	G	CONCETE	N/A	N/A	NO	N/A	NO	NO
1	H	CONCETE	N/A	N/A	NO	N/A	NO	NO
1	I	CONCETE	N/A	N/A	NO	N/A	NO	NO
1	J	CONCETE	N/A	N/A	NO	N/A	NO	NO
1	K	CONCETE	N/A	N/A	NO	N/A	NO	NO
2	A	CONCETE	N/A	N/A	NO	N/A	NO	NO
2	B	CONCETE	N/A	N/A	NO	N/A	NO	NO
2	C	CONCETE	N/A	N/A	NO	N/A	NO	NO
2	D	CONCETE	N/A	N/A	NO	N/A	NO	NO
2	E	CONCETE	N/A	N/A	NO	N/A	NO	NO
2	F	CONCETE	N/A	N/A	NO	N/A	NO	NO
2	G	CONCETE	N/A	N/A	NO	N/A	NO	NO
2	H	CONCETE	N/A	N/A	NO	N/A	NO	NO
2	I	CONCETE	N/A	N/A	NO	N/A	NO	NO
2	J	CONCETE	N/A	N/A	NO	N/A	NO	NO
2	K	CONCETE	N/A	N/A	NO	N/A	NO	NO
3	A	CONCETE	N/A	N/A	NO	N/A	NO	NO
3	B	CONCETE	N/A	N/A	NO	N/A	NO	NO
3	C	CONCETE	N/A	N/A	NO	N/A	NO	NO
3	D	CONCETE	N/A	N/A	NO	N/A	NO	NO
3	E	CONCETE	N/A	N/A	NO	N/A	NO	NO
3	F	CONCETE	N/A	N/A	NO	N/A	NO	NO
3	G	CONCETE	N/A	N/A	NO	N/A	NO	NO
3	H	CONCETE	N/A	N/A	NO	N/A	NO	NO
3	I	CONCETE	N/A	N/A	NO	N/A	NO	NO
3	J	CONCETE	N/A	N/A	NO	N/A	NO	NO
3	K	CONCETE	N/A	N/A	NO	N/A	NO	NO
4	A	CONCETE	N/A	N/A	NO	N/A	NO	NO
4	B	CONCETE	N/A	N/A	NO	N/A	NO	NO
4	C	CONCETE	N/A	N/A	NO	N/A	NO	NO
4	D	CONCETE	N/A	N/A	NO	N/A	NO	NO
4	E	CONCETE	N/A	N/A	NO	N/A	NO	NO
4	F	CONCETE	N/A	N/A	NO	N/A	NO	NO
4	G	CONCETE	N/A	N/A	NO	N/A	NO	NO
4	H	CONCETE	N/A	N/A	NO	N/A	NO	NO
4	I	CONCETE	N/A	N/A	NO	N/A	NO	NO
4	J	CONCETE	N/A	N/A	NO	N/A	NO	NO
4	K	CONCETE	N/A	N/A	NO	N/A	NO	NO
5	A	CONCETE	N/A	N/A	NO	N/A	NO	NO
5	B	CONCETE	N/A	N/A	NO	N/A	NO	NO
5	C	CONCETE	N/A	N/A	NO	N/A	NO	NO
5	D	CONCETE	N/A	N/A	NO	N/A	NO	NO
5	E	CONCETE	N/A	N/A	NO	N/A	NO	NO
5	F	CONCETE	N/A	N/A	NO	N/A	NO	NO
5	G	CONCETE	N/A	N/A	NO	N/A	NO	NO
5	H	CONCETE	N/A	N/A	NO	N/A	NO	NO
5	I	CONCETE	N/A	N/A	NO	N/A	NO	NO
5	J	CONCETE	N/A	N/A	NO	N/A	NO	NO
5	K	CONCETE	N/A	N/A	NO	N/A	NO	NO






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ACTA

Alameda Corridor Transportation Authority

Maintenance of Way Services

Appendix T

Ultrasonic Rail Testing 2024 Defect Reports

HERZOG Services, INC.
PO BOX 368 St. Joseph, MO 64502
Phone: (816) 364-3000 Fax: (816) 233-7757

HERZOG ULTRASONIC TESTING REPORT

Client: RAILWORKS TRACK SERVICES **Test Car:** HRZ043 **Operator:** DM **Test Date:** 9/9/2024

Crew: Derek Meyer, Eric Medina

LINES TESTED

Line Segment:	Division:	Subdivision:	Location:	Remarks:
2	RAILWORKS TRACK	ACTA	0 To 9999	EIC: Ariel Manjarrez Tested Main 3 and part of Main 2 track. Will continue testing tomorrow.

MOVEMENT DETAIL

Line	Mode	Remarks	Time	Mile Post Beg	Mile Post End	Track	Dir	Type	Suf ID	Tested Miles	Tested Min	Run-Light	Non-Tran	Delay Train	Delay Other	Delay Supt	Delay Hzg	Non-Bill	Service Minutes
2	On Call	On Call	06:00																
2	Delay (Other)	Job Briefing	06:00												0:18				0:18
2	Delay (Train)	Train Delay	06:18											2:24					2:24
2	Test	Main 3	08:42	0.000	7.447	-	W	M	3	7.447	0:48								0:48
2	Delay (Train)	Train Delay	09:30											0:30					0:30
2	Test	Main 3	10:00	7.447	11.538	-	W	M	3	4.091	0:30								0:30
2	Delay (Train)	Train Delay	10:30											0:06					0:06
2	Test	Main 3	10:36	11.538	15.810	-	W	M	3	4.272	0:30								0:30
2	Delay (Train)	Train Delay	11:06											0:12					0:12
2	Test	Main 3	11:18	15.810	17.700	-	W	M	3	1.890	0:30								0:30
2	Run-Light Non-Transfer		11:48									0:36							0:36
2	Test	Main 2	12:24	18.200	15.992	-	E	M	2	2.208	0:18								0:18
2	Delay (Train)	Train Delay	12:42											1:18					1:18
2	Off Call	Long Beach	14:00																
				Totals:						19.908	2:36	0:36	0:00	4:30	0:18	0:00	0:00	0:00	8:00

NO DEFECTS FOUND

HERZOG Chief Operator: Derek Meyer

Railroad Track Escort: ____________________

HERZOG Services, INC.
PO BOX 368 St. Joseph, MO 64502
Phone: (816) 364-3000 Fax: (816) 233-7757

HERZOG ULTRASONIC TESTING REPORT

Client: RAILWORKS TRACK SERVICES **Test Car:** HRZ043 **Operator:** DM **Test Date:** 9/10/2024

Crew: Derek Meyer, Eric Medina

LINES TESTED

Line Segment:	Division:	Subdivision:	Location:	Remarks:
2	RAILWORKS TRACK	ACTA	0 To 9999	EIC: Ariel Manjarrez Tested and completed Main 1. Will be back tomorrow to test Main 2.

MOVEMENT DETAIL

Line	Mode	Remarks	Time	Mile Post Beg	Mile Post End	Track	Dir	Type	Suf ID	Tested Miles	Tested Min	Run-Light	Non-Tran	Delay Train	Delay Other	Delay Supt	Delay Hzg	Non-Bill	Service Minutes
2	On Call	On Call	06:00																
2	Delay (Other)	Job Briefing	06:00												0:18				0:18
2	Delay (Train)	Train Delay	06:18											1:24					1:24
2	Test	Main 1	07:42	0.000	7.412	-	W	M	1	7.412	0:42								0:42
2	Delay (Train)	Train Delay	08:24											0:30					0:30
2	Test	Main 1	08:54	7.412	12.626	-	W	M	1	5.214	0:24								0:24
2	Delay (Train)	Train Delay	09:18											0:06					0:06
2	Test	Main 1	09:24	12.626	18.200	-	W	M	1	5.574	1:06								1:06
2	Run-Light Non-Transfer		10:30									3:30							3:30
2	Off Call	Long Beach	14:00																
			Totals:							18.200	2:12	3:30	0:00	2:00	0:18	0:00	0:00	0:00	8:00

NO DEFECTS FOUND

HERZOG Chief Operator: Derek Meyer

Railroad Track Escort: [signature]

HERZOG Services, INC.
PO BOX 368 St. Joseph, MO 64502
Phone: (816) 364-3000 Fax: (816) 233-7757

HERZOG ULTRASONIC TESTING REPORT

Client: RAILWORKS TRACK SERVICES **Test Car:** HRZ043 **Operator:** DM **Test Date:** 9/11/2024

Crew: Derek Meyer, Eric Medina

LINES TESTED

Line Segment:	Division:	Subdivision:	Location:	Remarks:
2	RAILWORKS TRACK	ACTA	0 To 9999	EIC: Ariel Manjarrez Finished Main 2 Track Tested Main 1 Track from CP Cruscero to CP Gaspur. This concludes Railworks testing. Thank you.

MOVEMENT DETAIL

Line	Mode	Remarks	Time	Mile Post Beg	Mile Post End	Track	Dir	Type	Suf ID	Tested Miles	Tested Min	Run-Light	Non-Tran	Delay Train	Delay Other	Delay Supt	Delay Hzg	Non-Bill	Service Minutes
2	On Call	On Call	06:00																
2	Delay (Other)	Job Briefing	06:00												0:18				0:18
2	Delay (Train)	Train Delay	06:18											1:06					1:06
2	Test	Main 2	07:24	0.000	12.564	-	W	M	2	12.564	1:12								1:12
2	Delay (Train)	Train Delay	08:36											0:30					0:30
2	Test	Main 2	09:06	12.564	16.000	-	W	M	2	3.436	0:36								0:36
2	Run-Light Non-Transfer		09:42									0:12							0:12
2	Test	Main 1 CP CRUSCERO to CP GASPUR	09:54	17.000	17.950	-	W	M	1	0.950	0:12								0:12
2	Run-Light Non-Transfer		10:06									3:54							3:54
2	Off Call	Longbeach	14:00																
				Totals:						16.950	2:00	4:06	0:00	1:36	0:18	0:00	0:00	0:00	8:00

NO DEFECTS FOUND

HERZOG Chief Operator: Derek Meyer

Railroad Track Escort:

ACTA
Alameda Corridor Transportation Authority

Maintenance of Way Services

Appendix U

Geometry Car Inspection Report 2024

Vehicle: BNSF 2-3-2023 Date: 02/03/2023 Test Time: 09:24 AM Page Nbr: 1

Line Segment: 8930 Division: SOU CALIFORNIA Subdivision: ALAMEDA Roadmaster: RDM UNKNOWN

Defect Number	Tag Type	Track Type:Nbr	Milepost/ Location	Latitude	Longitude	Tag Amplitude	Defect Name	Tag Length	Trk Class	TSR (P/F)	Curve/ Tangent	Repeat Tag
294327	YEL	M:3	0.596	34.016975	-118.225715	7/8"	STIFF_CAR	4	3		C	
294328	RED	M:3	0.661	34.017699	-118.226457	1 1/2"	STIFF_CAR	69	3	0/10	C	
294333	RED	M:3	0.710	34.018087	-118.227161	6 1/16"	UNB_F_XLEV	508	3	N/A /25	C	
294329	ORG	M:3	0.743	34.018189	-118.227716	1 1/16"	STIFF_CAR	9	3		C	
294330	YEL	M:3	0.743	34.018189	-118.227719	15/16"	STIFF_CAR	28	3		C	
294331	RED	M:3	0.748	34.018196	-118.227807	1 3/8"	TWIST31	19	3	0/25	C	
294332	RED	M:3	0.751	34.018199	-118.227852	1 1/2"	STIFF_CAR	40	3	0/10	C	
294334	YEL	M:3	0.751	34.018199	-118.227859	1 7/8"	WARP62:62	6	3		C	
294338	YEL	M:3	0.923	34.018145	-118.230850	1 1/2"	STIFF_CAR	58	3		C	
294339	YEL	M:3	1.496	34.013752	-118.239096	2 13/16"	UNB_F_XLEV	455	3		C	
294340	YEL	M:3	11.295	33.862366	-118.216330	13/16"	GAGE_WIDE_WOOD	12	3		C	
294341	YEL	M:3	11.299	33.862305	-118.216343	9/16"	LVHW_136RE	125	3		C	
294343	YEL	M:3	11.352	33.861563	-118.216587	9/16"	LVHW_136RE	80	3		C	
294342	YEL	M:3	11.355	33.861512	-118.216610	9/16"	LGFW_136RE	351	3		C	
294344	YEL	M:3	11.355	33.861512	-118.216610	1 1/8"	LCRW_136RE	368	3		C	
294345	YEL	M:3	13.657	33.829705	-118.228114	11/16"	LVHW_136RE	52	3		C	
294346	YEL	M:3	13.663	33.829624	-118.228170	13/16"	LVHW_141RE	26	3		C	
294347	YEL	M:3	13.681	33.829401	-118.228311	11/16"	LVHW_136RE	93	3		C	
294348	YEL	M:3	13.686	33.829341	-118.228346	13/16"	LVHW_141RE	26	3		C	
294349	YEL	M:3	13.700	33.829147	-118.228451	11/16"	LVHW_136RE	90	3		C	
294350	YEL	M:3	13.705	33.829080	-118.228486	13/16"	LVHW_141RE	41	3		C	
294351	YEL	M:3	13.721	33.828864	-118.228586	11/16"	LVHW_136RE	82	3		C	
294354	ORG	M:3	13.862	33.826920	-118.229305	1 1/4"	RCRW_136RE	37	3		C	
294356	ORG	M:3	13.862	33.826920	-118.229305	3/4"	RGFW_136RE	84	3		C	
294357	YEL	M:3	13.863	33.826903	-118.229311	1 1/8"	RCRW_136RE	398	3		C	
294352	YEL	M:3	13.870	33.826798	-118.229342	11/16"	LVHW_136RE	80	3		C	
294353	ORG	M:3	13.871	33.826792	-118.229344	13/16"	LVHW_136RE	5	3		C	
294355	YEL	M:3	13.872	33.826769	-118.229350	7/8"	LVHW_141RE	29	3		C	
294358	YEL	M:3	13.895	33.826458	-118.229424	5/8"	RGFW_136RE	366	3		C	
294359	YEL	M:3	13.895	33.826458	-118.229424	11/16"	LVHW_136RE	331	3		C	
294361	YEL	M:3	15.836	33.799439	-118.238659	3/4"	GAGE_WIDE_WOOD	4	3		C	
294362	ORG	M:3	15.984	33.797572	-118.239902	1 1/8"	STIFF_CAR	83	2		C	
294363	ORG	M:3	16.128	33.795607	-118.239769	1 3/16"	STIFF_CAR	32	2		C	
294364	RED	M:3	16.134	33.795528	-118.239708	1 5/8"	STIFF_CAR	58	2	0/10	C	

Vehicle: Date: **02/03/2023** Test Time: **09:24 AM**

Line Segment: **8930** Division: **SOU CALIFORNIA** Subdivision: **ALAMEDA** Roadmaster: **RDM UNKNOWN**

Defect Number	Tag Type	Track Type:Nbr	Milepost/ Location	Latitude	Longitude	Tag Amplitude	Defect Name	Tag Length	Trk Class	TSR (P/F)	Curve/ Tangent	Repeat Tag
294366	YEL	M:3	16.134	33.795525	-118.239706	2"	WARP62:62	2	2		C	
294365	YEL	M:3	16.139	33.795469	-118.239662	1 5/16"	STIFF_CAR	12	2		C	
294367	YEL	M:3	16.457	33.791258	-118.237859	13/16"	GAGE_WIDE_WOOD	2	2		C	