

FOR CONTRACT NO.: 07-1218W4

INFORMATION HANDOUT

MATERIALS INFORMATION

AGENCIES' MANUAL (Railroad)

Southern California Regional Rail Authority (SCRRA)
METROLINK

General Safety Regulations for Third Party Construction and Maintenance
Activity on SCRRA Member Agency Property

ROUTE: 07-LA-5, PM 29.4/31.6

**SOUTHERN CALIFORNIA
REGIONAL RAIL
AUTHORITY**



**General Safety Regulations for Third Party
Construction
and Maintenance
Activity on SCRRA Member Agency Property**

2002



TABLE OF CONTENTS

ACKNOWLEDGEMENT OF THE RECEIPT	1
I. OVERVIEW	2
II. Right-of-Way Encroachment Approval Procedures	3
A. REVIEW PROCESS	3
B. APPROVAL PROCESS	3
C. Documentation and Identification	4
III. General Responsibilities and Safety	4
A. OVERVIEW	4
B. EMPLOYEE IN CHARGE (EIC)	4
C. JOB BRIEFINGS	5
D. General Safety	6
E. Right-of-Way Safety	6
F. Personal Protective Equipment	8
G. House Keeping	8
H. Electrical	9
I. HAND TOOLS	9
J. EMERGENCY SITUATIONS	10
K. RAILROAD FLAGGING/PROTECTION	11
L. Work Equipment	12
IV. DEFINITIONS	13

All Contractors' employee(s), regardless of gender, whose duties are affected by them, must comply with these rules. They supersede all previous General Safety Regulations for Third Party Construction and Maintenance Activity on SCRRRA Member Agency Property.

**Acknowledgement of the receipt of
GENERAL SAFETY REGULATIONS FOR THIRD PARTY CONSTRUCTION AND
MAINTENANCE ACTIVITY ON SCRRA MEMBER AGENCY PROPERTY**

Southern California Regional Rail Authority (SCRRA) is a joint powers authority of five county transportation authorities, organized under the provisions of the Joint Powers Act, Section 6500 *et seq.* of the California Government Code and Section 130255 of the California Public Utilities Code, that builds, maintains, and operates Metrolink commuter railway system within Los Angeles, Orange, Riverside, San Bernardino and Ventura Counties.

The rules published herein are for the benefit of the third party contractor personnel and others who are involved in construction, maintenance or other activities while on SCRRA member agency property.

Employees must be knowledgeable of and obey these rules and instructions at all times. If in doubt as to the meaning, they must ask their supervisor for an explanation. **Violation of any of these safety rules subjects the Contractor to work stoppage until compliance is reached.** These rules coincide with the General Code of Operating Rules for Maintenance of Way Employees.

These rules and instructions supersede any previous safety rules and regulations governing third party contractors working on SCRRA member agency property. In addition, affected employees must observe the applicable portions of all other rules with any other applicable or subsequent instruction.

The intention of these safety rules is to advise third party contractor personnel working on SCRRA member agency property that **Safety is of the utmost importance.** For this reason, employees to whom these rules and regulations apply shall:

- Be furnished a copy of the "General Safety Regulations for Third Party Construction and Maintenance Activity on SCRRA Member Agency Property".
- Be required to read and study these rules and regulations as furnished.
- Know and understand their application.
- Have a copy of these rules and regulations in their possession while on duty or on SCRRA member agency property.
- Immediately call to the attention of a supervisor and the SCRRA EIC any action not in compliance with these rules and regulations.
- Hold daily safety meetings and/or job briefings prior to beginning work; change in work and/or fouling the track.

All Third Party Contractor personnel working on or about SCRRA property shall attend a Safety class given by SCRRA prior to beginning work.

SCRRA management will regularly make observations and checks and advise the Training Manager or Supervisor to take the necessary action(s) to ensure compliance with the Safety Rules and Regulations.

Director of Engineering and Construction

This is to certify that I have been issued a copy of the "General Safety Regulations for Third Party Construction and Maintenance Activity on SCRRA Member Agency Property".

Print Employee Name

Signature

Company

Date

GENERAL SAFETY REGULATIONS FOR THIRD PARTY CONSTRUCTION AND MAINTENANCE ACTIVITY ON SCRRA MEMBER AGENCY PROPERTY

I. Overview

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Director of Engineering and Construction

GENERAL SAFETY REGULATIONS FOR THIRD PARTY CONSTRUCTION AND MAINTENANCE ACTIVITY ON SCRRA MEMBER AGENCY PROPERTY

II. RIGHT-OF-WAY ENCROACHMENT APPROVAL PROCEDURES.

Contact must be made by the Third Party Contractor with the appropriate SCRRA representative who will cooperatively work with the Contractor to ensure that all appropriate documents, plans and agreements have been submitted, reviewed, approved and executed. These procedures can also be found by visiting the Metrolink website at www.metrolinktrains.com under Public Projects/Engineering.

A. REVIEW PROCESS

1. SCRRA reviews engineering plans for compliance to technical and safety regulations, which include but are not limited to:
 - Location of work,
 - Horizontal and vertical clearances to tracks,
 - Shoring, jacking and false work,
 - Any issue determined to impact safety or railroad operations,
 - Maintainability,
 - Drainage impacts,
 - Access to member agency property,
 - Compatibility with future plans for rail improvements or use of rail roadway,
 - Existing underground railroad utilities (signal & communications lines).
2. Member Agency (MTA, OCTA, etc) Real Estate Department will review applications for use of the right-of way. Right of entry cannot be granted until both SCRRA and member agency real estate approvals are complete.

B. APPROVAL PROCESS

1. The Contractor shall submit a right-of-way encroachment application with three (3) copies of applicable design or construction drawings. (Half size prints of 24"x36" drawings are generally acceptable.)
2. SCRRA will provide written comments on all submittals.
3. If there are no comments requiring corrections, SCRRA will advise the applicant in writing and will then advise the Contractor of the requirements to obtain the Right-of-Entry from SCRRA.
4. Real Estate Agreement (Lease, License or Easement) from SCRRA member agency.
5. The approved SCRRA Right-of-Entry document consists of:
 - Right-of-Entry Agreement (Form 6) or,
 - Indemnification and Assumption of Liability (Form 5) or,
 - Agreement for House Moving (Form 4).

These forms demonstrate approval by SCRRA of the technical aspects of the work and the insurance and indemnification certifications.

In addition to the above form(s) the complete Right-of-Entry package will include reference to the approved drawings and to any unique instructions, specifications, MOU or other requirements of the SCRRA.

6. When all required agreements have been executed, (including Right-of-Entry) the Contractor must contact SCRRA Right-of-Way Engineer, or designee, to obtain a SCRRA EIC for the work to be done.

C. DOCUMENTATION AND IDENTIFICATION

All Third Party Contractors working on SCRRA property must have a Right of Entry or other approved document(s) with them at all times when on property. In addition, all individuals working or otherwise entering SCRRA member agency property must have:

- Approved picture identification
- Picture ID can be: current valid driver license, employer issued identification, etc.
- Must be SCRRA safety trained annually.
- Must display current safety trained sticker on their hard hat.

Please note that failure to have approved Right-of-Entry document, picture identification and SCRRA safety trained sticker, is grounds for removal from property.

III. GENERAL RESPONSIBILITIES AND SAFETY

A. Overview

These safety regulations govern your activities while on SCRRA member agency property regardless if on or off duty. Any work performed without obtaining proper authorization or compliance with these rules will permanently jeopardize your ability to be allowed on railroad right-of-way. These rules cover unique requirements and general workplace safety.

B. Employee In Charge

1. Duties and Responsibilities: On-Track Safety.

Work performed by any contractor is regulated by Title 49 Part 214 of the Code of Federal Regulations, as specified in SCRRA's General Code of Operating Rules (GCOR) and as administered by a SCRRA EIC. A SCRRA EIC is referred to as providing "Flag" protection against trains. SCRRA EICs have been trained and qualified in GCOR and the characteristics of the SCRRA territory. They will provide selected training, job briefings, and flag protection to assure both the contractor's safe work environment and the safe passage of trains. The SCRRA EIC has the authority to temporarily or permanently halt work and to remove contractor's employee(s) from the right-of-way in order to assure safe work. In all cases the contractor's employees must comply immediately with the instructions of the EIC.

2. Appeals: Right To Challenge

Contractor employees may, during the job briefing process, request clarification of the protection against trains being provided by the EIC. If the Contractor employee does not believe that the protection against trains is sufficient, the employee may, in good faith, challenge the EIC's form of protection and must remain clear of all tracks until the challenge is resolved. The EIC, Contractor Supervisor and the SCRRA Supervisor will resolve the challenge before work can begin.

3. Appeals: EIC Decisions

If the Contractor has concerns about instructions of the EIC, the Contractor and Contractor's employees are to immediately comply with the EIC's instructions. After employees are clear of tracks, Contractor may contact EIC's Supervisor to resolve concerns. In other words, "comply, then complain."

C. Job Briefings

1. Job briefings, as given by the EIC, are meetings of all who are or will be involved in a particular task or job at the same work site and are required prior to beginning work each day.

2. All information related to On-Track-Safety must be given in the job briefing to any worker who will enter railroad property. In addition to other safety issues, the minimum On-Track Safety information must include:

- Designation of the Employee In Charge (EIC),
- Type of track protection,
- Time limits of the protection,
- Track(s) that may be fouled,
- Status of other track(s) at worksite,
- A designated place of safety where workers clear for trains,
- A designated assembly place in case of an emergency,
- Designated work zones,
- Specific job(s) to be done or equipment moves(s) to be made,
- Responsibilities of each worker,
- Method of notification (e.g. air horn) of approach of trains.

Additional instructions may include an unusual or a specific reminder due to a hazardous condition or unusual practice.

3. Additional job briefings will be given when:

- Working conditions or procedures change,
- Workers arrive late or new workers enter working limits,
- When the main track protection or time allowed to foul the track changes,
- When visitor(s) enter the work site.

D. General Safety

1. **SAFETY IS PARAMOUNT AND ALWAYS TOP PRIORITY.** Safety takes precedence over deadlines, production schedules, and all other considerations. When uncertainty arises, take the safe course. **Remember accidents are a result of carelessness, unsafe practices, lack of attention or complacency. Any accident can be avoided.**
2. Using, possessing, or working under the influence of alcohol and /or drugs is not permitted while working anywhere on railroad property. This includes prescription drugs that cause drowsiness or otherwise impair one's ability to perform their assigned task.
3. The use or possession of unauthorized radio equipment is forbidden. Use of personal radios, portable tape cassette players or portable disc or record players while working is prohibited.
4. Horseplay, physical altercations, running or jumping are forbidden.
5. Firearms or other deadly weapons, including knives with a blade in excess of three (3) inches are prohibited on SCRRA member agency property.
6. Work on public streets, roadway crossings, and highway bridges should be performed with due regard for the convenience and safety of the public.
7. All employees must look in both directions before crossing any track or roadway.
8. Only authorized employees are allowed on engines, cars, cabooses, track cars or other railroad equipment.
9. When using cellular phones you must remain at least 25-feet from the nearest running rail

E. RIGHT-OF-WAY SAFETY

When on or near the tracks, the following precautions must be taken:

1. Keep clear of all tracks unless an SCRRA EIC protects them.
2. Before crossing tracks look both ways.
3. Expect movement of locomotives, railroad cars or on-track equipment in either direction at any time. (Remember: there could be an uncontrolled movement.)
4. Always step over the rails when crossing the tracks. Never walk, stand, or sit on the rails. The rail surface can be extremely slippery.

5. Stay away from track switches. The switch points can move unexpectedly and with enough force to crush ballast rock! Stand 150 feet from track switches when trains are approaching, make sure that you face approaching trains at all times. Stay away from any other railroad device you are not sure of.
6. When crossing the tracks in a group, walk single file.
7. Never stand between adjacent tracks in multiple track territory when a train is passing.
8. When crossing tracks occupied by standing engines, railroad cars, or on-track equipment workers must provide at least 20 feet clearance from the end of any piece of equipment.
9. Do not cross track(s) if there is less than 50 feet between trains, cars, or equipment.
10. Employees must not cross tracks by going underneath, over or through cars, engines or on-track equipment.
11. Work is not allowed within 50 feet of the track centerline while trains are passing the work site. Always stand as far back as possible to prevent injury from flying debris or loose rigging. Face the direction from which the trains or on-track equipment is approaching
12. Visually inspect all passing trains. If you detect a dangerous condition, inform your EIC immediately. The EIC will warn the train crew to stop their train. If the train does not stop immediately, the EIC will notify the train dispatcher.
13. Never remain in a vehicle that is within 20 feet of the nearest running rail of a passing train. Stop your vehicle on the approach of a moving train. Move vehicles away from the track at least 20 feet or park the vehicles away from the tracks and, if safety permits, get out of your vehicle and walk to a safe location away from the tracks.
14. Equipment must be stopped while train is passing through your working limits. No movement will be allowed toward an approaching train that would cause the engineer to believe the track was going to be fouled.
15. Trains are traveling faster than they appear and are relatively quiet. Moving trains are to be expected on any track at anytime from either direction. Engines can push or pull a train. Employees should not rely on past experiences to determine train schedule. Train's schedules are unpredictable and trains are subject to schedule changes or delays.

F. PERSONAL PROTECTIVE EQUIPMENT

All employees working on SCRRA member agency property will be required to wear the following protective equipment (except in offices and motor vehicles):

1. Hard hats that meet the requirements of ANSI Z89.1 or ANSI Z89.2, as specified by CAL/OSHA and /or Fed/OSHA must be worn. Metallic hard hats shall not be worn on any SCRRA project
2. Eye protection that meets the requirements of ANSI Z87.1 is required on SCRRA property. Eye protection with side shields which meets the requirements of ANSI Z89.1 is required for those employees or contractors falling under 49CFR 214.
3. Orange vest with reflective tape for night work must be worn. An orange T-shirt, sweatshirt, jacket may be worn during the day.
4. Footwear that provides ankle support has soles thick enough to give good traction and to withstand punctures from sharp objects and is a lace type boots at least 8" high with a defined heel. Steel toe boots are required for those employees who fall under 49 CFR 214 and are recommended for all.
5. Proper attire when working on SCRRA member agency's right-of-way includes:
 - Waist length shirts, with sleeves and ankle-length pants.
 - Clothing must not interfere with vision or hearing, and must allow free use of hands and feet.
 - Loose or ragged clothing must not be worn at anytime.
 - Neckties, or loose jewelry must not be worn while operating or working on machinery.
 - Shoes constructed without a defined heel, open toed, lounging or jogging-type shoes, unlaced shoes or unbuckled overshoes, badly worn with loose sole shoes must not be worn on SCRRA property.

G. HOUSE KEEPING

1. CPUC General Order 260 and 118 require that lateral and vertical clearance around a railroad track and a safe walkway parallel to both sides of the track be maintained. The EIC will observe construction and material storage activities and may direct contractor's employee(s) to correct conditions not in compliance with the CPUC General Orders.
2. Keeping premises, tools and equipment in a clean and orderly condition is essential to safety and is the responsibility of the contract's employee(s).
3. Material must not be stored closer than 20 feet of the closest rail.

4. Contractor's employee(s) must be aware of areas with spilled oil or grease and apply sand or an equivalent (approved) material to minimize slipping hazards.
5. Contractor must remove all unused materials and debris created by the construction project.
6. Clear site immediately of all tripping hazards such as wire, loose material, etc.
7. Flammable materials, petroleum products, paints, caustics, acids and solvents must be stored in designated areas and in containers which are provided for them.
8. Contractor is responsible for restoring the property to its previous condition or a condition of betterment, making repairs to drainage facilities, fences, gates, or buildings damaged or removed by the Contractor or its forces.

H. ELECTRICAL

1. Electric wires must be considered live at all times. Employees shall not depend on the insulation of wires for their safety. Employees must keep away from all overhead and underground wires they may come in contact with.
2. When using power cords, they must be placed 2-inches below base of rail.
3. Employees must not place any metal objects across rails.
4. Signal cables/conduits may be encountered or damaged while undergoing excavations along the right-of-way. Call the signal desk prior to excavations to have cable and conduits located. (888.446.9720)
5. Excavation is not permitted until:
 - Dig Alert (USA) – identification is complete,
 - SCRRRA Signals Department has identified signal conduits.

I. HAND TOOLS

1. Employees must inspect tools, machinery and equipment for defects before using.
2. Employees must use all tools and appliances in the manner intended and for the purpose designed and only those employees qualified and authorized to operate equipment and machinery can do so in the performance of duty.
3. Tools and appliances must not be altered from their intended use.

J. EMERGENCY SITUATIONS

1. When persons are injured, everything possible must be done for their care.
2. If equipment was involved in the accident it must be examined to make sure the equipment was in proper working order. Any defective tools, machinery and equipment is prohibited from use.
3. Report to the EIC by the first available means of communication any accidents, personal injuries, defects in tracks, bridges, signals utilities or communication facilities or any unusual condition that may affect the safe operation of the Railroad.
4. Employees must exercise care to prevent injury to themselves or others. They must be alert and attentive at all times when performing their work and plan their work to avoid injury.
5. In case of personal injury, loss of life, or damage to property, the Foreman (Supervisor or others in charge) must immediately secure the names, addresses and occupation of all persons involved, including all persons at the scene regardless of whether these persons admit knowing anything about the accident. This information should be included in reports covering each occurrence.
6. If an accident causes personal injury or death, all tools, machinery and other equipment involved, including premises where such accident occurred must be promptly inspected by the Foreman or by other competent inspectors. Tools, equipment and machinery must be secured until Foreman, Safety Officer, or other competent inspector has completed inspection. A report of such inspection, stating the conditions found and names of persons making the inspection, must be promptly forwarded to SCRRA and the supervising officer of person making the inspection.
7. Information concerning accidents or personal injuries occurring to persons who are not employees, must not be given to anyone except authorized representatives of the SCRRA or an officer of the law.
8. Prior to starting work the EIC will have available on site, a list of these emergency phone numbers:
 - Ambulance,
 - Police,
 - SCRRA's and/or its operating contractors representative,
 - Metrolink Operation Center (MOC),
 - Signals emergency number.

K. RAILROAD FLAGGING/PROTECTION

The Contractor's Foremen working on or about the tracks are responsible for the safety of their crews and must guard their crews against impending danger or injury. They shall bear in mind that **Safety is the first and most important consideration**. Contractor's Foreman must be advised of train, engine and on-track equipment movements and that protection has been furnished as required by On-Track Safety rules.

The contractor must request and arrange for flagging services from SCRRA's authorized representatives five (5) working days before the work begins for the following conditions:

1. A railroad flagger is required for your protection any time you are on SCRRA member agency property. On-track protection will be provided by a flagger when the following work is being performed, but not limited to:
 - When any part of equipment is standing or being operated within 20 feet of the nearest track or has the potential to foul the track,
 - When any erection or construction activities are in progress within such limits, regardless of elevation above or below track,
 - For any excavation in or around the tracks that, in the opinion of SCRRA or it's member agency representative, may subject the tracks or other property to settlement or movement,
 - For any clearing, grubbing, or demolition in proximity to the property which, in the opinion of SCRRA, may endanger the property or operation,
 - For any street construction and maintenance activities requiring temporary work area traffic control. All activities that change the flow of traffic across a railroad crossing, e.g., traffic cones, etc., must be protected. SCRRA must approve traffic control plans before work can begin.
2. A job briefing must be conducted prior to beginning any work and/or anyone fouling the track. A new job briefing will be conducted each time conditions of the protection change and/or new personnel arrive. Everyone must have a working knowledge of:
 - The limits and time of the protection,
 - Location of where everyone is to clear for all trains or on-track equipment.
3. Good communication between the contractor and the EIC is imperative! The EIC is responsible for clearing all workers and/or equipment near or on the main track.

L. WORK EQUIPMENT

1. Equipment operators must be properly trained and qualified before operating equipment on railroad right-of-way, and must operate equipment in a safe, skillful and reliable manner.
2. Operators are responsible for knowing that their machines are in safe, operating condition before starting and must assure themselves that proper protection is being afforded their operations. Operators must make a running brake test before actual operations of work equipment when operating on the main track. The appropriate equipment must be used and operated for each task as per the manufacturer's instructions.
3. Do not engage in reckless operations of vehicles while on the railroad's right-of-way. The speed limit on the right-of-way is not more than 15mph and may be lowered if conditions warrant. Offenders may be asked to leave the railroad's right-of-way by any railroad employee or representative observing unsafe behavior.
4. Audible backup warning devices are required on all heavy equipment.
5. Operator must make sure that the equipment manual is on their machine.
6. While trains, engines or on-track equipment are passing:
 - Machines must be stopped,
 - Vehicles must be stopped,
 - Brakes must be set,
 - Buckets and shovels or clams must be lowered to rest,
 - Machines without buckets must have their load line tightened to prevent movement.
7. Operators are responsible for seeing that unauthorized persons are not carried on equipment and must know that persons qualified to be on equipment are properly positioned before movement is made. Do not transport passengers in truck beds or on heavy equipment.
8. Use of equipment such as loaders and backhoes to raise or lower people is strictly forbidden.
9. Operators of equipment must know the locations of overhead and underground utilities. Operator must have a clear understanding of how to protect utility lines before operating machinery.
10. NEVER move equipment across the tracks except at established road crossings. Tracked or rubber tire equipment will require the supervision of a SCRRA EIC any time railroad tracks are crossed.
11. NEVER move tracked or rubber tire equipment across railroad bridges or through tunnels.

12. When equipment is left unattended:
- Motor must be stopped and ignition must be locked,
 - Parking or hand brake must be securely set,
 - Keys must be in possession of operator or authorized employee,
 - Wheels must be securely blocked on grades,
 - Equipment secured in a highly visible area.

IV. DEFINITIONS

Ballast – The rock that supports the track and ties. This rock is groomed to keep the track in place, drain water away from the track, and to distribute the weight of trains to surrounding soil. DO NOT DISTURB OR PLACE SOIL, SAND, OR DEBRIS ON IT.

California Public Utilities Commission (CPUC) - The State Agency that administers certain rule regulations of the railroad industry.

Center Line of Track – An imaginary line, that runs down the center of the two rails of a track.

Confined Space – A space that is large enough and so configured that an individual can enter and perform assigned work. The space has limited or restricted means for entry or exit and is not designed for continuous individual occupancy. This would include but not limited to tanks, vessels, silos, storage bins, hoppers, vaults and pits.

Contractor – Any Third Party Contractor's authorized worker, other than a railroad employee, who is working on railroad property.

Derailment - A potentially dangerous condition, whereby rail cars or engines leave the tracks.

Directional Bore – A method that controls the direction of boring and eliminates the need for multiple conventional bore pits allowing for a longer bore length than conventional methods. Directional bores utilizes pressurized bentonite to auger and slurry to backfill the bore. Excess bentonite must be contained.

Employee-In-Charge (EIC or SCRRA EIC) – A roadway worker designated to provide On-Track-Protection for one or more work groups.

Engine – A unit propelled by any form of energy or more than one of these units operated from a single control typically referred to as a locomotive.

Excavation – Any removal of earth. Any excavation and/or shoring, no matter how large or small requires prior approval from SCRRA Engineer.

Fall Protection – A requirement of the FRA and SCRRA, that ensures training and protection for work performed on any bridge structure that is at a height of 10 feet or more above water or ground and/or while working at a height of 10 feet or more.

Fill – A section of earth built up to support the railroad's track structure.

Foul the ballast – Anything that contaminates the ballast section of the roadbed and inhibits the ballast from supporting the track, draining water, or suppressing weed growth. In most cases ballast is fouled by excavated material being placed on the ballast.

Foul the track – Placement of an individual or a piece of equipment in such a proximity to a track that the individual or equipment could be struck by a moving train or track equipment. SCRRA fouling distance is defined as within 20 feet from the nearest running rail.

General Code of Operating Rules (GCOR) – The rules that govern the use of railroad tracks by trains, maintenance employees, contractors and others.

Hy-rail Vehicle - This vehicle is considered on-track equipment. It is typically driven on highways, but has specially manufactured attachments that allow the vehicle to travel on railroad tracks. They are viewed as trains and only authorized railroad personnel may operate them.

Industry Track – A secondary track designated to allow access to industries along the main track.

Job Site – Any area where work is performed, where materials and equipment are stored, or which employees access during the project.

Mainline (main track) – The primary track used by trains. Some of the routes have more than one track.

Member Agency- is that specific county transportation Member Agency(s), whose Property is directly affected by the Contractor's actions. The five county transportation Member Agencies are the Los Angeles County Metropolitan Transportation Authority, the Orange County Transportation Authority, the Riverside County Transportation Commission, the San Bernardino Associated Governments, and the Ventura County Transportation Commission.

Mileposts – Field indicators of approximate distance from a specific point the Railroad system used for approximate locations of Railroad facilities. They are not to be used for field surveys.

MOU- is a memorandum of understanding.

On-Track Equipment - Maintenance of Way machines such as track cars, Hy-rail vehicles, tampers, ballast regulators, etc. which may be operated on the track.

On-Track Safety - A set of safety rules, developed and promulgated by the FRA, that must be complied with to work on or near railroad property. Specific training and obedience to these rules is a requirement of the FRA and is managed by SCRRA for its member agencies. The GCOR embodies the FRA On-Track Safety Rules. When SCRRA rules are more stringent those rules shall apply. Loss of your privilege to work on SCRRA member agency right-of-way can result from the violation of these rules.

Roadbed - A graded area beneath and on either side of the track structure that provides support and drainage of the track.

Roadway Worker – Any employee of the railroad or any contractor on a railroad right-of-way, whose duties include inspection, construction, maintenance or repair of railroad track, bridges, roadway, signal and communication systems, electric traction systems, roadway facilities or roadway machinery on or near track, or with the potential of fouling a track.

Safety Training - A session conducted by a qualified SCRRRA representative at which On-Track Safety and Railroad Rules and Regulations are discussed.

Safety Sticker - An emblem that indicates completion of Railroad Training. The non transferable “Safety Trained” emblem is to be placed on each individual’s hard hat so it is visible when working on the Railroad’s Right-of Way.

Shoring – Methods and materials used to prevent the collapse of the earthen walls of excavations. Shoring in close proximity to the tracks requires design pursuant to Cooper E-80 loading. In all cases, shoring drawings require approval prior to construction.

Siding – A secondary track used for the passing of trains on single-track routes.

Signal - Railroad facility used to inform Railroad personnel of track conditions.

Spur Track – A secondary track designated to allow access to industries along the main track.

Tracks – The rails, ties, and ballast that composes the traveling surface by trains.

Track Structure – The rails, ties ballast, and roadbed that compose the traveling surface used by trains.

Trains – One or more engines coupled together, with or without cars, which use the Railroad track.

Train Movement – Any motion of engines and/or cars over the railroad tracks.

Yard- A collection of secondary tracks used to store equipment (cars, engines, maintenance machines, etc.), for assembling or disassembling trains, and/or conducting other railroad operations.

Suggested for your use.

RAILROAD EMERGENCY RESPONSE FORM

Location (Subdivision & Milepost) _____

Closest City and Directions from it to the job site or nearest crossing if job site is inaccessible from roadway. _____

Location of the closest hospital and directions from job site. Or nearest crossing if job site is inaccessible from roadway _____

Nearest emergency Services:

Ambulance: _____

Fire _____

Police _____

Railroad Contacts:

Name _____

Nextel _____

Emergency Numbers

Grade Crossing Hot Line	888.446.9721
Manager, Maintenance-of-Way (Cell phone)	213.792.7904
Public Projects Right-of-Way Engineer	213.452.0256
Cell phone	213.305.8508

Southern California Regional Rail Authority

Third Party Contractor

Zero Tolerance Safety Rules

- All third party contractors must have a Right-of-Entry or approved document to work on SCRRA right-of-way.
- Drinking alcoholic beverages, being under the influence of any drug or medication or having them in your possession at any time on SCRRA property will not be tolerated.
- All third party contractor personnel must have been SCRRA Roadway Worker Safety trained and have a valid SCRRA safety sticker on their hard hat or they will not be allowed on SCRRA property.
- All third party contractor personnel must wear a hard hat, safety glasses, orange vest with reflectorized tape long pants, and lace type boot not less than 8" high.
- **WORKING ON OR AROUND TRACKS:**
 1. All work within 20 feet of the nearest running rail must be coordinated with the Right-of-Way Engineer so that positive protection can be provided for personnel.
 2. Do not foul the track with any piece of equipment without a flagger and positive protection.
- Do not stand on the track or within 10 feet of the centerline of the track. The track is not an observation platform.
- Do not leave open holes or trenches unattended.
- Do not disturb or foul the ballast at any time.

VIOLATION OF ANY OF THESE RULES WILL RESULT IN REMOVAL FROM THE PROPERTY AND MAY CAUSE THE JOB TO BE SHUT DOWN.

FOR CONTRACT NO.: 07-1218W4

INFORMATION HANDOUT

MATERIALS INFORMATION

AGENCIES' MANUAL (Railroad)

Southern California Regional Rail Authority (SCRRA)
METROLINK

Track Maintenance, Right of Way and Structures, Engineering Instructions
5th Edition

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SOUTHERN CALIFORNIA REGIONAL RAIL AUTHORITY
TRACK MAINTENANCE, RIGHT OF WAY AND STRUCTURES,
ENGINEERING INSTRUCTIONS



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INTRODUCTION

The Track Maintenance, Right of Way, and Structures, Engineering Instructions are for the use of all SCRRRA employees, contractors, and consultants who comprise our engineering team. Its instructions, policies, and guidelines cover many aspects of Railroad Engineering and Maintenance-of-Way activities.

These instructions provide guidelines, procedures, and policies for the maintenance of SCRRRA owned track, right of way, and structures. Engineering personnel responsible for maintaining the track, right of way, and structures shall maintain a copy of this handbook and keep it available while on duty for reference.

Engineering personnel responsible for maintenance and inspection of the track, right of way, and structures must exercise every effort to correct conditions not found in compliance with this publication.

The Fifth Edition of Track Maintenance and Engineering Instructions is effective February 12, 2009, and remains in effect until the Director of Engineering and Construction cancels, revises, or otherwise supersedes all or any part. These guidelines, procedures, and policies can be superseded by instruction 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 shall be complied with at all times. FRA Track Safety Standards supersede any practice or guideline in these Instructions if these Instructions are less restrictive than FRA Track Safety Standards.

This document includes information confidential and proprietary to the Southern California Regional Rail Authority. The content of this manual will be revised periodically and the latest revision may be found through the Director of Engineering and Construction office. If technical data included is found to be inaccurate or displayed with typographical errors, please notify the office of the Director of Engineering concerning the necessary corrections and follow up notification with a fax or email to transmit the information.



Richard Walker
Assistant Director, Maintenance and Rehabilitation

TABLE OF CONTENTS

SECTION 1	GENERAL INSTRUCTIONS	17
1.1	SAFETY	17
1.1.1	REGULATIONS.....	18
1.2	ENVIRONMENTAL CONCERNS.....	18
1.2.1	POLLUTION	18
1.2.2	HEALTH.....	19
1.2.3	SCRRRA PROPERTY	19
1.2.4	HANDLING AND DISPOSAL OF TREATED WOOD.....	19
1.2.5	TRANSPORTATION OF HAZARDOUS MATERIAL	19
1.3	ON TRACK MAINTENANCE OF WAY EQUIPMENT	20
1.3.1	INSPECTION	20
1.3.2	LOADING OF MATERIALS AND TOOLS.....	21
1.3.3	MOVING MATERIAL ON PUSH CARS AND HI-RAIL TRAILERS	21
1.3.4	SHOVING TRAILERS, CARS, OR CARTS	21
1.3.5	PROTECTING CARS AND ON-TRACK EQUIPMENT.....	21
1.4	TOOLS AND SUPPLIES	21
1.4.1	CARE OF TOOLS AND SUPPLIES	22
1.5	PORTABLE TRACK GRINDING WHEELS AND ABRASIVE SAWS.....	22
1.5.1	HANDLING, CARE, AND STORAGE OF GRINDING WHEELS AND ABRASIVE SAWS.....	22
1.5.2	GRINDING AND ABRASIVE SAW WHEEL MOUNTING	22
1.5.3	OPERATION OF GRINDERS AND ABRASIVE SAWS	23
1.6	SMALL MACHINES AND POWER TOOLS	23
1.6.1	GENERAL RULES FOR OPERATION OF POWER TOOLS.....	24

1.7	HIGHWAY MOTOR VEHICLES	25
1.7.1	FIRE HAZARD – CATALYTIC CONVERTERS	25
1.7.2	FIRE EXTINGUISHERS	25
1.7.3	ADDITIONS AND ALTERATIONS.....	25
1.7.4	CROSSING PRIVATE PROPERTY AND PROPERTY DAMAGE...	26
1.7.5	TRUCK MOUNTED CRANES	26
1.8	UPDATING TIMETABLE AND RULEBOOK	27
1.9	USE OF ELECTRONIC DEVICES	27
1.9.1	DEFINITIONS.....	27
1.9.2	RESTRICTIONS	27
1.9.3	USE OF SCRRRA APPROVED DEVICES.....	28
1.9.4	HIGHWAY VEHICLES AND USE OF ELECTRONIC DEVICES ...	29
1.10	VEHICLE TRACK INTERACTION SYSTEM PROCEDURES	29
1.10.1	DATA COLLECTION AND REPORTING	29
1.10.2	MONITORING AND RESPONSE	31
1.10.3	INSPECTIONS, POST-INSPECTION REPORTING AND FOLLOW- UP	32
SECTION 2 RAIL.....		34
2.1	RAIL AND FASTENINGS	34
2.1.1	ORDERING.....	34
2.1.2	UNLOADING.....	34
2.1.3	STORAGE	34
2.1.4	RAIL LENGTHS	35
2.1.5	TRANSPORTING RAIL.....	35
2.1.6	SPIKING.....	35

2.1.7	COMPROMISE JOINTS AND COMPROMISE THERMITE WELDS	35
2.1.8	BOLTING	36
2.1.9	EXTEND MAIN TRACK RAIL SIZE THROUGHOUT TURNOUT.	36
2.1.10	CHANGING OUT RAILS - INSPECTION	36
2.1.11	CHANGING OUT RAILS – REPORTING AND MARKING	37
2.1.12	NEW, SECONDHAND (SH), SCRAP RAIL, AND OTHER TRACK MATERIAL (OTM)	37
2.1.13	CUTTING RAIL	38
2.1.14	DRILLING RAIL	38
2.1.15	RAIL ANCHORS	38
2.1.16	SPECIAL FASTENERS	39
2.1.17	RAIL TESTING AND IDENTIFICATION	39
2.2	CONTINUOUS WELDED RAIL (CWR)	39
2.2.1	DEFINITIONS FOR CWR	40
2.2.2	MAINTENANCE OF CWR	40
2.2.3	PREFERRED RAIL LAYING TEMPERATURES FOR CWR	46
2.2.4	INSTRUCTIONS FOR TAKING RAIL TEMPERATURES	47
2.2.5	MAINTAINING CWR TRACK	49
2.2.6	DISTURBED TRACK	49
2.2.7	REPORTING DISTURBED CWR TRACK	51
2.2.8	INSPECTING JOINTS IN CWR	54
2.3	RAIL DEFECTS	55
2.3.1	DEFINITION	55
2.3.2	REPORTING AND REMOVAL	55
2.3.3	REMEDIAL ACTION	56

2.4	REPLACEMENT OF RAIL	56
2.5	MATCHING RAIL WEAR CONDITIONS	56
2.6	FREQUENCY OF RAIL TESTING	56
SECTION 3 TRACK WELDING AND RAIL GRINDING.....		58
3.1	TRACK WELDING	58
3.1.1	WELDING SAFETY.....	58
3.1.2	COORDINATION WITH SIGNAL DEPARTMENT	58
3.1.3	APPROVED WELDING PROCEDURES	59
3.1.4	PROHIBITED WELDING PROCEDURES	59
3.1.5	MANGANESE FROGS AND CROSSINGS.....	60
3.1.6	WELDING CARBON RAIL FROGS AND CROSSINGS	61
3.1.7	WELDING RAIL ENDS	62
3.1.8	WELDED REPAIRS TO BONDED INSULATED JOINTS	62
3.1.9	SLOTING INSTRUCTIONS	63
3.1.10	MAINTENANCE OF SWITCH POINTS.....	64
3.1.11	WELDING “A” AND “B” PLATE STOPS ON FROG GAGE PLATES	64
3.1.12	LOCATION AND PREPARATION FOR THERMITE WELDS	67
3.1.13	THERMITE WELDING PROCESS	68
3.1.14	ADJUSTING CWR RAIL TEMPERATURE.....	69
3.1.15	MARKING FIELD WELDS	69
3.1.16	COMPROMISE WELDS	70
3.2	RAIL GRINDING	70
3.2.1	RAIL GRINDING PROGRAM.....	70
3.2.2	VISUAL INSPECTION FOR RAIL GRINDING.....	71

3.2.3	OPERATION OF RAIL GRINDERS	71
SECTION 4 TURNOUTS, DERAILS, AND RAILROAD CROSSINGS..... 73		
4.1	TURNOUTS	73
4.1.1	TURNOUTS - GENERAL	73
4.1.2	INSPECTION, MAINTENANCE, AND INSTALLATION	74
4.1.3	QUARTERLY JOINT SWITCH INSPECTION.....	76
4.1.4	UNUSED SWITCHES	78
4.1.5	COMPLETELY WELD IN TURNOUTS	78
4.1.6	SWITCH SECURITY.....	78
4.1.7	SWITCH POINTS AND STOCK RAILS – ORDERING	78
4.1.8	SWITCH POINT LOCKS	79
4.1.9	SPECIAL CONSIDERATION FOR CURVES	79
4.2	DERAILS.....	80
4.2.1	WHERE REQUIRED	80
4.2.2	LOCATION AND SIGNAGE.....	80
4.2.3	DERAIL TYPES.....	80
4.2.4	INSPECTION	81
4.2.5	MAINTENANCE	82
4.3	RAILROAD CROSSINGS – (DIAMONDS).....	82
4.3.1	ORDERING.....	82
4.3.2	SPEED RESTRICTIONS	82
4.3.3	INSPECTION OF NEW DIAMOND CROSSING.....	82
4.3.4	WALKING INSPECTIONS	83
4.3.5	BOLTS.....	85

4.3.6	REVERSIBLE INSERTS	85
4.3.7	MAINTENANCE/INSTALLATION OF DIAMOND CROSSINGS ..	85
4.3.8	DIAMOND CROSSINGS MAINTAINED BY OTHER RAILROADS	86
SECTION 5 SIGNAL FACILITIES AND INSULATED JOINTS ...		87
5.1	PRECAUTIONS IN SIGNALLED TRACK	87
5.2	SHUNTING	87
5.3	NOTIFY SIGNAL MAINTAINER OF TRACK CHANGES	87
5.4	DISTURBING SIGNAL EQUIPMENT.....	87
5.5	INSTALLATION, MAINTENANCE OR REMOVAL OF SWITCH	87
5.6	CARE OF INTERLOCKINGS DURING STORMS	87
5.7	FLAGMEN AT ROAD CROSSINGS.....	88
5.8	INSTALLATION AND MAINTENANCE OF INSULATED JOINTS.....	88
5.8.1	GENERAL	88
5.8.2	TESTING	88
5.8.3	PREPARATION FOR INSTALLATION	88
5.8.4	INSTALLATION	89
5.8.5	WELDING AND INSTALLING RAIL	89
5.8.6	RETIRED INSULATED JOINTS.....	89
SECTION 6 CURVE RAIL REPLACEMENT		90
6.1	ANNUAL CURVE INSPECTION.....	90
6.2	TRANSPOSING RAIL.....	90
6.2.1	WEAR.....	90
6.3	CONDEMNING LIMITS.....	92
6.3.1	FATIGUE	92

6.3.2	RAIL SURFACE CONDITIONS.....	92
6.4	ELEVATION.....	92
6.5	CURVE RAIL INSPECTION	92
6.6	RE-LAYING RAIL ON CURVES.....	93
6.6.1	PREMIUM RAIL.....	93
6.6.2	WALKING INSPECTIONS.....	93
6.7	RAIL/FLANGE LUBRICATORS.....	93
6.7.1	PLACEMENT.....	93
6.7.2	LUBRICANT.....	94
6.7.3	INSPECTION AND MAINTENANCE	94
6.7.4	DISPOSAL	94
6.7.5	CONTAINMENT OF EXCESS GREASE.....	94
SECTION 7 CROSS TIES AND SWITCH TIES.....		95
7.1	ORDERING.....	95
7.2	DISTRIBUTION.....	95
7.3	FIRE PRECAUTIONS	95
7.4	OPERATION OF TIE GANGS.....	95
7.4.1	PROJECT MANAGER	95
7.4.2	GANG LEADER (“FOREMAN’S”) RESPONSIBILITY.....	97
7.4.3	GENERAL TIE GANG OPERATION	97
7.4.4	TIE REPLACEMENT IN CWR TRACK	98
7.4.5	RESTORING TRACK FOR TRAIN OPERATION AFTER TIE GANG WORK	98
7.5	HANDLING TREATED TIES.....	99
7.6	SWITCH TIES.....	99

7.7	MARKERS ON TIES	99
7.8	TIE PLATES.....	99
7.9	TIE PLUGGING MATERIAL	100
7.10	TOP OF TIE.....	100
7.11	END OF TIE ALIGNMENT	100
7.12	SCREW SPIKES	100
7.13	INSTALLATION AND MAINTENANCE OF CONCRETE TIES.....	100
	7.13.1 GENERAL INSTALLATION AND MAINTENANCE.....	100
	7.13.2 CONCRETE TIE INSPECTION	102
	7.13.3 CONCRETE TIE CLIPS	103
	7.13.4 TRANSITION PATTERNS	104
7.14	INSTALLATION AND MAINTENANCE OF STEEL TIES	104
7.15	REPORTING AND ACCOUNTING	104
7.16	TIE MARKING	104
SECTION 8 PREVENTION OF TRACK BUCKLING.....		105
8.1	THERMAL STRESSES IN TRACK	105
8.2	TRACK BUCKLING PREVENTION – TRACK INSPECTION REQUIREMENTS.....	105
	8.2.1 INSPECTION REQUIREMENTS	105
	8.2.2 INSPECTIONS – INDICATIONS OF THERMAL EXPANSION	106
	8.2.3 PLACEMENT OF HEAT RESTRICTIONS.....	106
8.3	DESTRESSING CONTINUOUS WELDED RAIL.....	108
	8.3.1 REQUIREMENTS.....	108
	8.3.2 RECORDING ADJUSTED RAIL TEMPERATURES (ART).....	110
	8.3.3 DESTRESSING STEPS	110

SECTION 9	TRACK GEOMETRY	113
9.1	SURFACE.....	113
9.1.1	DEFINITIONS.....	113
9.2	OPERATION OF SURFACING GANGS	113
9.2.1	MANAGER, TRACK AND STRUCTURES MAINTENANCE’S, RESPONSIBILITY.....	113
9.2.2	SURFACING GANG LEADER’S (FOREMAN’S) RESPONSIBILITY	114
9.2.3	GENERAL SURFACING GANG OPERATION.....	115
9.3	TRACK SPEEDS FOLLOWING SURFACING WORK.....	116
9.3.1	SURFACING - RAIL TEMPERATURE	117
9.3.2	SURFACING - SUPERELEVATION STANDARDS	118
9.3.3	SURFACE IRREGULARITIES.....	119
9.3.4	USE OF TRACK LEVEL.....	119
9.3.5	REPETITIVE SURFACE PROBLEMS.....	119
9.3.6	TRACK JACKS.....	120
9.3.7	BALLAST REQUIREMENTS.....	120
9.3.8	SPIRAL LENGTH.....	120
9.4	ALIGNMENT	121
9.4.1	ALIGNMENT IRREGULARITIES	121
9.4.2	LINE RAIL	121
9.4.3	ENGINEERING DEPARTMENT ASSISTANCE	121
9.4.4	REMEDIAL ACTION.....	121
9.4.5	TURNOUTS NEAR CURVES.....	121
9.5	CLEARANCES	121
9.6	TRACK GAGE.....	122

9.6.1	GAGE WIDENING	122
9.6.2	CORRECTING GAGE.....	122
9.6.3	TRACK GAGE.....	122
9.6.4	ADZING	122
9.7	TRACK GEOMETRY CAR.....	123
9.7.1	PLANNING FOR GEOMETRY CAR OPERATION	123
9.7.2	GEOMETRY CAR OPERATION	123
SECTION 10 STRUCTURES – BRIDGES, CULVERTS, AND OTHER LOAD BEARING STRUCTURES.....		124
10.1	DEFINITIONS.....	124
10.2	PERSONNEL QUALIFICATIONS	124
10.3	INSPECTION OF BRIDGES, CULVERTS, TUNNELS, RETAINING WALLS AND OTHER STRUCTURES	124
10.3.1	EMERGENCY/SPECIAL INSPECTION	125
10.4	DOCUMENTATION OF INSPECTIONS.....	126
10.5	INSPECTION OF CULVERTS AND DRAINAGE DITCHES	127
SECTION 11 EMBANKMENTS AND DRAINAGE.....		128
11.1	THE RAILROAD EMBANKMENT	128
11.2	CONSTRUCTION OF EMBANKMENTS.....	128
11.3	REPAIRS AND MODIFICATIONS TO EMBANKMENTS.....	128
11.4	IMPORTANCE OF GOOD DRAINAGE.....	129
11.5	INTERCEPTING DITCHES	129
11.6	KEEP WATERWAYS CLEAR	129
11.7	EROSION	129
11.8	DRAINAGE AT ROAD CROSSINGS, RAILROAD CROSSINGS AND SWITCHES.....	129

11.9	HIGH WATER MARKS	129
11.10	CONCRETE TIE	129
SECTION 12 BALLAST AND OTHER ROCK PRODUCTS.....		130
12.1	ORDERING BALLAST	130
12.2	MAIN TRACK BALLAST SPECIFICATIONS.....	130
12.2.1	APPLICATION	131
12.3	UNLOADING BALLAST.....	131
12.4	BALLAST SECTION.....	132
12.5	STONE FOR RIPRAP	132
12.5.1	PLACING RIPRAP	133
12.6	BALLAST AND RIPRAP DELIVERY REPORTS	133
SECTION 13 ROAD CROSSINGS.....		134
13.1	POLICY	134
13.2	GOVERNMENT AGENCIES AND COMMUNITY RELATIONS.....	134
13.3	SURFACE MATERIAL.....	134
13.4	METHOD OF CONSTRUCTION	135
13.5	HIGHWAY CROSSINGS – CLEANING OF DIRT LEFT ON RAILS	136
13.6	HIGHWAY CROSSINGS - SAFETY	136
SECTION 14 MAINTENANCE-OF-WAY CARS.....		137
14.1	HANDLING OF AIR DUMP CARS	137
14.2	HANDLING CARS WITH MAINTENANCE EQUIPMENT	137
14.3	DAMAGE TO BALLAST CAR DOORS.....	138
14.4	MATERIAL UNLOADING.....	138
14.5	FLAT CARS – HANDLING TRACK PANELS	139

SECTION 15 TRACK INSPECTION	140
15.1 TRACK INSPECTION FREQUENCY.....	140
15.2 TRACK INSPECTION REPORTING PROCEDURES	140
15.3 ADDITIONAL INSPECTIONS	140
SECTION 16 VEGETATION, GRAFFITI, AND TRASH CONTROL	141
16.1 HERBICIDE APPLICATION.....	141
16.1.1 GENERAL.....	141
16.1.2 SPRAY TRUCKS.....	141
16.1.3 GRANULAR APPLICATION SPECIFICATIONS	142
16.1.4 NOTIFICATION	142
16.2 VEGETATION CONTROL LIMITS.....	142
16.2.1 TRACK AREA.....	142
16.2.2 LANDSCAPE AREAS.....	142
16.2.3 RIGHT OF WAY OWNERSHIP	142
16.2.4 URBAN AREAS	142
16.2.5 RECOLLECTABLE AREAS.....	142
16.2.6 RURAL AREAS.....	142
16.3 GRAFFITI.....	143
16.4 TRASH	143
16.5 BRUSH CUTTING.....	143
SECTION 17 EARTHQUAKE RESPONSE	145
17.1 GENERAL.....	145
17.2 DEFINITIONS.....	145
17.3 EARTHQUAKE INSTRUCTIONS	146

17.4	EARTHQUAKE INSPECTION.....	148
17.4.1	GENERAL.....	148
17.4.2	INCIDENT COMMAND.....	149
17.4.3	EARTHQUAKE TRACK INSPECTION.....	149
17.4.4	STRUCTURE INSPECTIONS.....	151
17.4.5	SIGNAL INSPECTIONS.....	151
17.5	INSPECTION REPORTS.....	152
17.6	MAINTENANCE-OF-WAY COMMAND CENTERS.....	152
SECTION 18 TSUNAMI RESPONSE.....		154
18.1	GENERAL.....	154
18.1.1	DEFINITIONS.....	154
18.2	TSUNAMI INSTRUCTIONS.....	155
18.2.1	LESS THAN TWO HOURS TO IMPACT INSTRUCTIONS.....	155
18.2.2	TWO OR MORE HOURS TO IMPACT.....	156
18.3	UPDATING INFORMATION.....	156
18.4	FIELD OBSERVERS.....	157
18.5	POST-TSUNAMI INSPECTIONS.....	157
18.5.1	GENERAL.....	157
18.5.2	NO TSUNAMI IMPACTS.....	158
18.5.3	INSPECTION OF TSUNAMI DAMAGE.....	158
18.5.4	NOTIFICATIONS.....	158
18.5.5	INSPECTION REPORTS.....	159
18.6	PUBLIC AND PASSENGER INFORMATION.....	159
APPENDIX A – SYSTEM MAP (AS OF 2007).....		1
APPENDIX B - GLOSSARY.....		1

APPENDIX C - SUMMARY OF SPEED RESTRICTIONS FOR TRACKWORK	1
APPENDIX E – UNBALANCE (E.S. 2302 – 2 THROUGH 7).....	1
APPENDIX F – UNUSUAL OCCURRENCE REPORT	1

LIST OF TABLES, FIGURES, AND FORMS IN TEXT

FIGURE 1-1 - THRESHOLD ACCELERATIONS AND LOADS ¹	30
FIGURE 2-1 - RAIL WEAR LIMITS	37
FIGURE 2-2 - RECORD OF RAIL INSTALLATION TEMPERATURES	48
FIGURE 2-3 - SCRRA CWR STRESS ADJUSTMENT / DISTURBANCE REPORT - FORM	53
FIGURE 2-4 - CWR JOINT INVENTORY LIST SAMPLE.....	55
FIGURE 3-1 - SWITCH GAGE PLATE.....	65
FIGURE 3-2 - FROG AND GUARD RAIL GAGE PLATES	66
FIGURE 3-3 - SAMPLE - RAIL GRINDER DAILY REPORT	72
FIGURE 4-1 - QUARTERLY TURNOUT AND DERAIL INSPECTION REPORT	77
FIGURE 4-2 - FLANGEWAY	84
FIGURE 6-1 - MANAGER'S ANNUAL CURVE INSPECTION	91
FIGURE 8-1 - HEAT RESTRICTION TABLE	107
FIGURE 8-2 - CWR MOVEMENT CHART - INCHES	112
FIGURE 12-1 - BALLAST GRADING	130
FIGURE 12-2 - STONE FOR RIP RAP GRADING	132
FIGURE 13-1 - CPUC G.O. 72-B, STANDARD NO. 8*.....	134
FIGURE 18-1 - TSUNAMI ZONE CHART	160

SECTION 1 GENERAL INSTRUCTIONS

1.1 SAFETY

Safety is always the first priority. It is responsibility of all employees/contractors working on or around Southern California Regional Rail Authority (SCRRA) Right of Way to perform their duties in a safe and proactive manner and to prevent and correct any unsafe conditions that they observe in the discharge of their duties. The importance of employee and public safety is directly related to the quality workmanship and productivity on any railroad project or job. Efficiency, quality, and safety are closely related. An efficient, high quality job is a safe job, and a safe job is an efficient, high quality job. It is both possible and imperative to safely perform every job in compliance with all safety rules.

A. Job Briefing

1. Conduct a job briefing before any roadway worker fouls a track. A job briefing is not complete until each roadway worker acknowledges understanding of the method of on-track safety that will be applied and the procedures that will be followed and has signed the Job Briefing.

B. Fouling the Track

1. SCRRA's General Code of Operating Rules of MofW Employees (MofW OPR Rules) (Sec 2.0) and specifically the Roadway Worker On-Track Safety Instruction (Glossary) in the MofW OPR Rules explains when authority is required on a main track and controlled sidings. It also explains how protection is provided and how a lone worker or employees protected by a lookout may perform minor work or a routine inspection without proper authority.
2. On-Track Equipment: Only qualified employees may operate on-track equipment including hi-rail vehicles. On-track equipment shall be inspected daily before use and must comply with FRA (CFR 214 Subpart D) On-Track Roadway Maintenance Machines and Hi-Rail Vehicles.

C. MofW OPR Rules

1. Assignments Requiring Maintenance of Way Operating Rules Qualifications.
2. Initial Training Required for Qualifications.

- D. Contractor Qualification Requirements: Contractors directly employed by SCRRA Engineering, Maintenance of Way (MofW) work groups, subcontractors of such contractors, and contractors involved in SCRRA projects, public projects, or utility projects who will be performing work activities on SCRRA property within 20 feet from the nearest running rail are responsible for developing and implementing a roadway worker protection/on-track safety program. This program must provide roadway worker protection/on-track safety training (RWP Safety Program) for their employees. This training is reinforced at the job site through job safety briefings.

1.1.1 REGULATIONS

- A. Employees/Contractors performing maintenance-of-way or new construction work are also governed by Federal Railroad Administration Track Safety Standards, railroad workplace safety standards, and OSHA and shall immediately report to their supervisors any conflicts between those standards and those instructions received from their supervisors. In general, the standards of SCRRA prescribed by these instructions, engineering standards, and rules meet or exceed Federal Track Safety and Railroad Workplace Safety Standards. Employees/Contractors are required to fully understand and comply with the SCRRA “Maintenance of Way Safety Instructions” and the “Roadway Worker On-Track Safety Manual”.
- B. Maintenance-of-Way and new construction work must also conform to SCRRA’s Engineering Standards and the California Public Utilities Commission (CPUC) standards for walkways, clearances, and other general orders, including engineering design and construction specifications.
- C. Employees/contractors shall confirm regulations with their supervisors. Employees/contractors shall review and clarify any instructions in the Contract Documents, which appear to not be in compliance with the above regulations. Any discrepancies with the regulations must be reported in writing to the Manager, Track and Structures Maintenance.

1.2 ENVIRONMENTAL CONCERNS

1.2.1 POLLUTION

SCRRA’s effect on the environment is a high priority issue. Many railroad maintenance activities affect the environment, and employees/contractors are responsible for any actions resulting in excessive air pollution, water pollution, noise pollution, waste disposal problems, or other environmental impact. Check with the appropriate supervisor or Contract Documents before beginning an activity, which may cause excessive pollution.

1.2.2 HEALTH

Job-related health concerns are also a priority issue for employees/contractors. Often an employee's/contractor's own action may affect his/her health. Many railroad job-safety precautions require the use of respirators and other protective equipment. Protective equipment requires special training on use and care. Those assigned special protective equipment must receive the required training on the use of the equipment. Do not use the equipment or perform work requiring such equipment until receiving this special training.

1.2.3 SCRRRA PROPERTY

Employees/contractors observing unusual situations that in any way affect SCRRRA'S property shall report the situation to the responsible supervisor. Such situations may include out of place or unusual items, illegal waste disposal, unusual liquid drainage or runoff, trash dumping, adjacent construction, encroaching construction, and trespassing.

1.2.4 HANDLING AND DISPOSAL OF TREATED WOOD

- A. Disposal of treated wood shall be in accordance with state and Federal regulations. Do not burn treated wood in open fires, stoves, or fireplaces.
- B. Avoid skin contact with creosote. If accidental contact does occur, remove creosote from skin as soon as possible with waterless cleaner or with mild soap and water. Never eat, drink, or smoke before removing creosote contamination from skin.
- C. Avoid the inhalation of dust when sawing or machining treated wood. Wear an approved dust-type respirator when necessary.
- D. If any creosote liquid or creosote-wood sawdust contaminates clothing, launder before re-use. Wash work clothes separately from other household clothing.

1.2.5 TRANSPORTATION OF HAZARDOUS MATERIAL

- A. Comply with Federal regulations which require proper description on the waybill of any hazardous material shipped by rail and the placement of appropriate placards on the car. Some of the commodities covered are propane, butane, oxygen, acetylene, and gasoline and diesel fuel.
- B. When transporting hazardous materials on the highway, the driver must carry written documentation of the type and quantity of hazardous materials on the truck in accordance with all Federal CDL, state, and local regulations.

1.3 ON TRACK MAINTENANCE OF WAY EQUIPMENT

- A. These instructions apply to hi-rail vehicles and material handling car (push cars). Refer to Section 14, Maintenance-of-Way Cars, for instructions pertaining to railroad cars.
- B. An operator's manual must be carried on the equipment. Keep repair parts catalogue and assigned tools within the car.
- C. Before operating on-track equipment, operator shall first:
 - 1. Receive training to qualify on on-track roadway equipment and receive relevant certification.
 - 2. Be informed of the safety procedures that apply to persons working near equipment.
 - 3. Be familiar with all aspects of information in the operator's manual. Contact the proper supervisor for assistance in understanding the instructions.
 - 4. Follow the manual's instructions for safe operation.
 - 5. Fully understand the safety procedures for the specific equipment to be operated.

1.3.1 INSPECTION

- A. Hi-rail vehicle operators shall make a walk around visual inspection every time the vehicle is placed into service on the tracks to ensure that the vehicle is properly lined and the hi-rail equipment is properly secured and ready for use.
- B. Operators must be familiar with the safe operation of the rail gear and the manufacturer's operations and maintenance requirements. Operators of this equipment shall inspect the vehicle and rail gear thoroughly and frequently to see that all bolts, nuts and cotter pins are in place and tight; that rail sweeps are in place and properly adjusted; that wheel wear is within safe limits; that wheel gage is correct; and that all safety appliances are in place and in good working order.
- C. Operator shall immediately remove any hi-rail vehicles from service that are found to be unsafe to operate. Operator shall report hi-rail vehicles removed from service to the appropriate supervisor.

1.3.2 LOADING OF MATERIALS AND TOOLS

Load and secure all material and tools before moving or operating any vehicle or equipment. Do not overload cars.

1.3.3 MOVING MATERIAL ON PUSH CARS AND HI-RAIL TRAILERS

- A. Use only push cars or trailers of adequate capacity to transport material such as ties, rails, and frogs. When moving loaded push cars or trailers, assign a person to watch the load to ensure that tools or material remain secure.
- B. Do not ride on push cars or trailers.
- C. When a load projects more than four feet beyond the bed of a trailer or a push car operating across or over public roads or streets, display a clearly visible red flag by day and red light by night at the protruding load end.

1.3.4 SHOVING TRAILERS, CARS, OR CARTS

- A. Do not push trailers, cars, or carts to material storage areas and work sites until load is properly secured. Shuttle push cars and trailers at speeds of less than ten miles per hour and for only short distances; otherwise, couple them behind the motorized unit. Do not shuttle push cars and trailers on descending grades, unless totally unavoidable.
- B. Equip all push cars and trailers with approved coupling devices. Coupling devices must be secured by a latch or clamp to resist loosening during operation. Assign only experienced employees/contractors to handle brakes on push cars or trailers.

1.3.5 PROTECTING CARS AND ON-TRACK EQUIPMENT

Exercise care in the protection of track cars and on track equipment. Following the use of the equipment, operator shall arrange to secure the equipment giving ample consideration to the location and general area where equipment is to be stored. Doors and compartments shall be locked and windows closed. Trailers or push cars shall be secured with a locked chain passed through the wheels and around the rail when left unattended.

1.4 TOOLS AND SUPPLIES

- A. Use tools only for the purpose for which they are intended. Always follow the manufacturer's safety, care, and instructions for each tool.
- B. Only employees qualified for the use of that particular power tool may use them. Each employee is responsible for the proper use and care of power tools used on SCRRRA property. The employee must be familiar with the

manufacturer's instructions for care, use, and safety before operating any power tool.

1.4.1 CARE OF TOOLS AND SUPPLIES

- A. Take care of all tools and supplies as they represent a large investment. Collect surplus tools and supplies along with defective tools and scrap, and ship them in accordance with instructions from the proper supervisor.
- B. Each work unit shall be equipped with sufficient tools for planned and routine tasks; spare and excess tools shall be stored and secured against theft, damage, and weather.
- C. Separate defective tools from serviceable tools, equipment, and material and tag them "Defective-Do Not Use". Do not use defective straps or belts; discard as directed by appropriate supervisor.
- D. At the start of each work shift, before using and as often as necessary while using, visually inspect tools, straps, rope, jacks, and all other items of equipment and material. If defective or showing signs of fatigue or wear, remove from service until repaired or replaced.
- E. Tools with striking surface cracked or mushroomed are defective.

1.5 PORTABLE TRACK GRINDING WHEELS AND ABRASIVE SAWS

1.5.1 HANDLING, CARE, AND STORAGE OF GRINDING WHEELS AND ABRASIVE SAWS

- A. All abrasive grinding wheels are breakable. Do not drop, bump, or roll wheels.
- B. Protect abrasive grinding and abrasive saw wheels when not in use. Do not expose grinding/saw wheels to water, high humidity, or any solvent, including gas and oil.

1.5.2 GRINDING AND ABRASIVE SAW WHEEL MOUNTING

- A. Carefully inspect abrasive wheels before and after mounting and before each use. Do not use wheels showing any evidence of cracks, chips, or abuse.
- B. Check abrasive wheel spindle speed with a tachometer and compare this speed with the speed shown on wheel. If no speed is shown, do not use the wheel. Also, NEVER PERMIT ANY OVER-SPEED. Do not use the equipment until speed is properly adjusted.

1.5.3 OPERATION OF GRINDERS AND ABRASIVE SAWS

- A. Employees/contractors operating a rail grinder/saw guide must wear foot and shin protector, goggles, and face shields. Employees/contractors shall not operate grinder/saw if the guards or shields have been removed or are not functioning as intended.
- B. All employees/contractors not directly involved with the grinding/cutting operation must keep clear in order to avoid injury from steel and stone fragments.
- C. Grinding on the sides of wheel intended for peripheral grinding may be dangerous. Only a limited amount of side grinding, such as shoulder or form grinding, is permissible. Never use excessive side pressure during permissible side grinding.
- D. Take every precaution to prevent fires when using grinder or abrasive saws.

1.6 SMALL MACHINES AND POWER TOOLS

- A. Each track or bridge gang leader (foreman) shall maintain a record of each small machine assigned, noting all repairs and other necessary information for each machine.
- B. Keep machines and power tools clean at all times. When using the machine/power tool, keep all safety devices and guards in place.
- C. Operate air-operated tools with manufacturer's recommended pressure and a maximum of 100 psi set on the air compressor. If a tool does not operate properly at 100 psi, clean and re-lubricate it. If it still does not operate properly, remove from service and report it to the appropriate supervisor.
- D. To properly cool air-cooled engines, keep all shrouds in place whether in use or in storage, and keep the area under shrouds clean.
- E. Provide pneumatic machines with safety cables or another approved safety lock to prevent disconnected air hoses from whipping (whip checks).
- F. Level air compressors and other two-wheel machines with towing hitches with a dolly jack or wheel before operating them, and operate them only in a level position.
- G. Use only the proper proportions of pre-mixed fuel in small machines requiring an oil-gas mixture for lubrication.
- H. Comply with the manufacturer's instruction on the storage, use, transport, and maintenance of hydraulic power tools.

- I. Protect hydraulic power tool lines from damage: do not drop material on them, drive equipment over them, or place them where they present a hazard to other employees. Wipe all connections clean before coupling tools or extension lines. Lines showing abrasions, cuts, or heat damage shall be removed from service.
- J. Check the pressure output at the power pack at the start of each day. Do not operate hydraulic equipment at pressures in excess of the manufacturer's rating.
- K. Transport lines and tools in secure compartments. These compartments must be capable of protecting the lines and tools from impact by other material being carried and must be capable of securing tools against impact against the compartment walls and other tools.
- L. To prevent damage, properly load and store all small machines.
- M. To prevent theft, lock air compressors, trailers, and other towed equipment to a permanent structure, such as a telephone pole, when not in use.
- N. Get authorization for local repairs by outside firms from the appropriate field supervisor.

1.6.1 GENERAL RULES FOR OPERATION OF POWER TOOLS

General rules for operation of power tools are:

- A. Wear safety shoes, safety glasses, hearing protection, respirators, face shields, shin protectors, and other required protective equipment.
- B. Keep hands off throttle lever until ready to start operation.
- C. Maintain a steady balance at all times.
- D. Never put your face close to the tool.
- E. Never rest the tool on your foot.
- F. Never point the tool at anyone.
- G. Never start a tool when it is lying on the ground, except when manufacturer's instructions indicate that is the proper method.
- H. Never use the body to control an active tool.
- I. Never indulge in horseplay.
- J. Never point an air hose at anyone.

- K. Tighten all hose connection. Note, a loose hose may not only leak, but also may disengage from the tool, whip around, and injure the operator.
- L. Check and tighten all bolts, screws, and other connections before using a machine because ordinary vibration shakes parts loose and can cause breakage and other damage.
- M. Do not operate the power tool without a proper tool in the chuck or front head.
- N. Hold the tool firmly against the work, and always keep both hands on the handle while operating.
- O. Maintain and use handles when provided.
- P. Do not straddle a tool with one leg over the handle.
- Q. Only qualified personnel may make adjustments to carburetors on abrasive type rail saws.
- R. Do not crowd to try to speed up drilling with rail drills; they have automatic feed.
- S. Do not override governors on machines so equipped.
- T. Maintain any log books provided with machines.

1.7 HIGHWAY MOTOR VEHICLES

Only qualified, approved employees may operate SCRRA's motor vehicles. Such employees are required to maintain a valid driver's license.

1.7.1 FIRE HAZARD – CATALYTIC CONVERTERS

Converters get hot enough to ignite dry weeds and grass; be careful not to start a fire when it is necessary to drive in off-road situations.

1.7.2 FIRE EXTINGUISHERS

Vehicles in routine use on SCRRA property must be equipped with an approved type fire extinguisher. Keep them charged and properly inspected.

1.7.3 ADDITIONS AND ALTERATIONS

Do not make additions and alterations to any vehicle without proper authorization.

1.7.4 CROSSING PRIVATE PROPERTY AND PROPERTY DAMAGE

- A. If necessary to drive on private property, obtain permission from the owner. When driving on private property, do not damage anything and close all gates.
- B. Report any damages to private or public property to the appropriate supervisor.

1.7.5 TRUCK MOUNTED CRANES

- A. General rules for operation of truck-mounted cranes are:
 - 1. THE AREA OF CRANE OPERATION IS TO BE CLEAR OF OBSTRUCTIONS AND PERSONNEL.
 - 2. Do not operate crane unless the truck is level.
 - 3. Set outriggers at all times when using cranes.
 - a. EXCEPTION: It may be necessary to lift or lower loads between the rails when the truck is on the track and there is no practical way to set the outriggers. However, to carry this kind of load, place it on the bed of the truck or on a push car. Do not carry it on the load line of the crane, except for short distances in a working area.
 - 4. Prevent overload at all times. Never exceed the load limit in the diagram posted on the crane. If the load diagram is missing, report it to your supervisor for prompt replacement. Use extreme care to prevent overload.
- B. Never use the crane for side pulling. The crane is not designed or intended for side pulling.
- C. Inspect cable frequently for signs of fraying or kinks. A damaged cable is a hazard, and shall be replaced.
- D. Do not load the cable with boom in full down position. Always raise boom slightly so relief valves will bypass and thus prevent overloading of the crane.
- E. Never repair or weld booms without proper authorization.
- F. Arrange work so that one designated employee transmits signals to crane operator.
- G. When traveling, put the boom on the boom rests.

1.8 UPDATING TIMETABLE AND RULEBOOK

When a general order amends the timetable, note the changes in your MofW OPR Rules timetable. If you cannot note the changes, write, "See amendment" across the affected portions and attach a copy of the general order or instructions to the timetable. When a general order cancels or amends another general order, mark the affected order to indicate the changes.

1.9 USE OF ELECTRONIC DEVICES

1.9.1 DEFINITIONS

- A. Electronic device means a mobile (cellular) telephone or another electronic or electrical device used to:
 - 1. Conduct verbal communications or send or receive electronic mail or text message.
 - 2. Play games.
 - 3. Listen to or view music, play video.
 - 4. Navigate the internet.
 - 5. Perform data gathering or computational tasks.
- B. In addition to cellular telephones, electronic devices include items such as:
 - 1. Any accessories associated with electronic devices.
 - 2. Personal digital assistants (PDA).
 - 3. Lap-top computer.
 - 4. Devices that can receive or send radio signals.

1.9.2 RESTRICTIONS

- A. While on duty, electronic devices, as defined herein, shall not be used for personal purposes at anytime within 25 feet of any track, roadway, signal house, signal equipment, or Railroad shop.
- B. Any device that can receive or send any radio signal (excluding cellular) that is not broadcast, received, or recorded on a Railroad frequency is prohibited from use on SCRRA right of way.

1.9.3 USE OF SCRRRA APPROVED DEVICES

- A. Only SCRRRA provided or approved electronic communication devices may be used on SCRRRA right-of-way in the performance of duty.
- B. Refer to MofW OPR Rules (Sec. 2.0) for instructions concerning radio use.
- C. Company cellular phones may be used for official communication along the right of way as long as such phone is used outside of the foul distance of track, whether the track is in service or not.
- D. Company cellular phones and railroad radios may be used in the operators cab only for official railroad communication. At no time shall the operator be distracted from operating the equipment or vehicle.
- E. Hi-rail vehicle and equipment operators shall, whenever practical, stop the vehicle or equipment to use either company cellular phone or railroad radio.
- F. Hi-rail vehicle operators shall stop vehicle whenever using a company provided lap-top computer.
- G. At no time, shall any passenger (railroad employee or contractor) riding in a train's operator cab, locomotive, on-track equipment, or hi-rail vehicle, use any electronic device, unless assisting in handling an emergency situation.
- H. At no time shall cellular phone or railroad radio use place the user or anyone else in an unsafe situation.
- I. Do not use cellular phones in areas where inattention could result in being struck by tools or equipment.
- J. Digital thermometers may be used in the performance of railroad duties.
- K. Electronic testing equipment shall be used in accordance with CFR 49 parts 213 and 214.
- L. Digital time pieces that do not receive or transmit any signal are permitted for use on SCRRRA right of way.

1.9.4 HIGHWAY VEHICLES AND USE OF ELECTRONIC DEVICES

The following rules apply for use of electronic devices while operating any highway vehicle.

- A. All state and local laws shall be obeyed concerning the use of cellular phones in highway vehicles.
- B. When initiating or receiving cellular phone calls, the driver shall utilize hands-free equipment. If practical, driver shall bring the vehicle to a safe stop until the call is completed.
- C. Conversations should be as brief as possible.
- D. Lap-tops or navigational equipment shall not be operated while driving any vehicle.
- E. Cellular phones shall not be used while re-fueling.

1.10 VEHICLE TRACK INTERACTION SYSTEM PROCEDURES

1.10.1 DATA COLLECTION AND REPORTING

- A. 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.
- B. 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.
- C. The Vehicle Track Interaction (VTI) System (also known as ACCELEROMETER) is an autonomous instrumented system located on select SCRRRA rolling stock that transmits information regarding forces under live loaded conditions. These forces are measured at three key points on the locomotive – the carbody, the axle, and the truck. On the carbody, vertical and lateral forces of the train are measured and assist in providing vital information concerning the condition of the track structure and geometry. On the axle, forces are measured at the wheel/rail interface to identify impacts from the moving train that can cause further wheel damage to rolling stock and cause damage to or break rail joints. On the truck, lateral forces are measured to identify issues with truck hunting or the vehicle suspension system that could create a safety condition or adversely influence the readings from the other sensors. This information

is transmitted wirelessly to a central server. Information autonomously collected from the VTI system is compared to preset event thresholds (see Figure 1-1, Threshold Accelerations and Loads). The central server will screen all incoming information and document event conditions (which are categorized as priority, near urgent, and urgent) with a location including milepost, GPS coordinates, and subdivision.

- D. The following Reported Exception Events are developed from mounted sensors on locomotive:
1. CBV - Carbody vertical exceptions
 2. CBL - Carbody lateral exceptions
 3. TRL – Track lateral exceptions
 4. AXV1 – Axle vertical 1 exceptions (Engineer’s side)
 5. AXV2 – Axle vertical 2 exceptions

FIGURE 1-1 - THRESHOLD ACCELERATIONS AND LOADS¹			
Exception Events	Event Categories		
	Priority	Near Urgent	Urgent
Carbody Vertical (CBV)	0.5 – 0.74 G	0.75 – 0.99 G	1.0 G and greater
Carbody Lateral (CBL)	0.4 - 0.54 G	0.55 – 0.74 G	0.75 G and greater
Axle Vertical 1 (AXV1)	45 – 64 KIPS	65 – 79 KIPS	80 KIPS and greater
Axle Vertical 2 (AXV2)	45 - 64 KIPS	65 - 79 KIPS	80 KIPS and greater
Truck Lateral (TRL)	0.3 G	0.35 G	0.4 G

Note 1: These numbers are recommended by ENSCO and are based on proposed numbers from the Rail Safety Advisory Committee’s High Speed Track Safety Standards (for non-passenger carrying equipment) as well as an analysis of Metrolink VTI data since the VTI System has been installed.

- E. The central server will store this information in a web-based database that can be viewed by pre-established end-users. The associated graphic interface will report the severity of the event for visual evaluation.
- F. Events will trigger an email to designated MofW SCRRRA and Contractor employees for their inspection, investigation, repair, and remedial action

reporting. However employees with access to the web-based site shall review the published database daily.

- G. When SCRRA's Maximus system is implemented, will receive email reports of all events and create a viewable database for designated employees to review. These designated employees shall be responsible to investigate event reports and report back their findings noting in Maximus what was found and what remedial action was taken. Some events and their location may become repetitive in nature, but all events shall have a follow-up report in Maximus indicating what was found and remedial action taken.¹

1.10.2 MONITORING AND RESPONSE

The maintenance contractor shall monitor daily the VTI data collection information and ensure the following events are addressed as listed.

- A. **Priority Events:** The Maintenance Contractor Supervisor shall review and monitor the progress of Priority events. The Maintenance Contractor Supervisor shall determine if action is required. Each contractor track inspector shall be aware of all Priority events logged on his assigned territory.
- B. **Near Urgent Events:** The Maintenance Contractor Supervisor shall review and monitor Near Urgent events. The Maintenance Contractor Supervisor shall determine what action is required and schedule corrective work as necessary. Each contractor track inspector shall be aware of all Near Urgent events logged on his assigned territory and shall verify track condition with each scheduled inspection.
- C. **Urgent Events:** The Maintenance Contractor Supervisor shall review Urgent events and shall direct the contractor track inspector to inspect all Urgent events within 24 hours. The Maintenance Contractor Supervisor shall determine what action is required and schedule corrective work.
- D. The Maintenance Contractor Supervisor shall follow up on corrective actions and review the Near Urgent and Priority event logs monthly with the Manager, Track and Structures Maintenance.
- E. **Truck Lateral (TRL) Events:** Truck frame lateral exceptions are most likely caused by problems with the vehicle, not track. Once a vehicle starts to experience truck frame lateral exceptions they typically do not go away until vehicle maintenance is performed. If this event is recorded over a large area, the mechanical supervisor shall be notified so that vehicle maintenance can be performed.

¹ Maximus system is not currently available. Once the system is implemented, these Instructions concerning it shall be followed.

1.10.3 INSPECTIONS, POST-INSPECTION REPORTING AND FOLLOW-UP

- A. Individuals directed to respond to an event location for inspection must be qualified per FRA Track Safety Standards Part 213.7 and have the knowledge and ability to make a judgment on the conditions found and either direct remedial action, place slow-order, or determine that no event occurred.
- B. When responding to a location for inspection, the qualified individual shall be equipped with sufficient tools to evaluate location, GPS locator, track gage and level board, tape measure, and string line.
- C. Location shall be inspected for gage, cross-level, line, and surface. Location shall also be evaluated for pumping ties, anchor movement, rail cant, and movement.
- D. Locations within or approaching turnouts shall inspected with consideration for facing and trailing movement.
- E. Rail shall be inspected closely for wheel-burns, low welds, and corrugation.
- F. In all cases, the qualified individual making the inspection must take into consideration that the data collected by the VTI system was developed under loaded track conditions.
- G. Following the assessment of a location reported as an event, the individual shall report the findings immediately to the individual's supervisor and/or the Manager, Track and Structures Maintenance, and proceed to create a follow-up report in the Maximus system.² Whether the individual reports to a supervisor or the Manager, Track and Structures Maintenance, will be determined. Findings shall dictate the nature of remedial action. Such action shall be carried out in accordance with requirements for safety of operations and in compliance with FRA requirements.
- H. Some locations may need immediate attention and other may be determined to be programmable for another day; in either case, remedial action remains at the discretion of the qualified individual making the inspection.
- I. Periodically these documented alarm reports in Maximus and the remedial action taken shall be reviewed on an overall basis to establish locations

² Maximus system is not currently available. Once the system is implemented, these Instructions concerning it shall be followed.

that continue to create ride-quality exceptions in order that they may be addressed in maintenance and rehabilitation programs.³

³ Maximus system is not currently available. Once the system is implemented, these Instructions concerning it shall be followed.

SECTION 2 RAIL

2.1 RAIL AND FASTENINGS

2.1.1 ORDERING

Rail for new construction, rehabilitation, and maintenance must be ordered through the Manager, Track and Structures Maintenance, or designated Project Manager. Keep inventory levels to a minimum for inventory and to support capital and re-habilitation programs. Contractors may be provided rail in the quantities and locations stated in the Contract Documents.

2.1.2 UNLOADING

Unload rail and fastenings from cars under the supervision of a qualified person in charge using the pre-approved method. Unload rail in a safe manner to prevent loss and damage to material and danger to personnel.

2.1.3 STORAGE

- A. Neatly arrange rail and fastening storage areas. Arrange rail and fastenings by weight and class, and stack them to permit easy access. When it is necessary to store rail and fastenings adjacent to the track, take care to prevent movement from vibrations and to avoid poor footing. Contractor shall obtain approval of all storage and lay down sites within the SCRRRA's Right of Way from the Manager of Maintenance of Way or Project Manager specific to the work site.
- B. New or used rail in lengths up to 82 foot shall be stored on blocks (not in contact with the ground). If stacked more than one tier high, slats at least 1 inch thick shall be placed at 25 foot spacing to keep each tier separate.
- C. CWR may be stored on the ballast or ground if it is programmed for installation within 12 months of unloading. If not programmed for installation, CWR shall be placed on blocks spaced at 25 feet apart and away from the toe path if possible and clear from Right of Way roads. Except as provided in 2.2.2.1 G, CWR shall not be covered or buried by ballast, soils, or debris. CWR shall be protected from impact by or operation over by any vehicle. Ends of CWR strings shall be placed at least 8 foot away from the nearest operating rail in order to prevent impact by dragging equipment.
- D. If it is impossible to avoid poor footing conditions, report this to the SCRRRA Dispatcher requesting a footing order. When unloading welded rail along the main track, place it outside the ends of the ties. Also, do not obstruct the ends of welded rail strings; otherwise expansion can cause buckling and in turn, foul the main track. Wood spacers should be placed

between the ends of welded rail strings so that ends may by-pass and not buckle against each other from expansion.

2.1.4 RAIL LENGTHS

Use no rail less than 30'-0" long in the main track, with the following exceptions:

- A. At turnouts (as permitted by Standard Plans)
- B. Between railroad crossings.
- C. As a temporary expedient (minimum 19' – 6") *
- D. Where a short rail is used with field welds (Minimum 19'-6") *

* In curves of 2 degrees or more, use 30'-0" minimum length for all installations.

2.1.5 TRANSPORTING RAIL

Transport rail in compliance with outstanding instructions and state laws. Do not drag rail behind trucks.

2.1.6 SPIKING

- A. New construction or rehabilitation of rail and ties shall conform to E.S. 1404. When a rail re-lay dictates complete re-spiking, plug the old holes with approved tie plugs or other approved method and re-spike to the new spiking pattern. In other rail replacement, plug the spike holes and re-drive spikes in the same pattern. When using two spikes per tie plate, never drive line spikes opposite each other on either side of rail.
- B. Start drive spikes vertically, square and snug against the rail. Do not strike the base of the rail. Do not drive spikes in holes of slotted joints or against the rail within 3 inches of any joint.

2.1.7 COMPROMISE JOINTS AND COMPROMISE THERMITE WELDS

- A. Use only compromise joints (step joints) or compromise thermite welds of approved design for connecting different rail sections. A set of compromise joints has two joints and four bars. The four bars of the set are right gage, right out, left gage and left out.
- B. Do not directly support a compromise joint with a cross tie. Instead, suspend it in the middle of the crib between two cross ties. This will provide good support at the joint for both weights of rail.
- C. Compromise welds are preferred over comp joints for connections between differing rail sizes. Compromise welds or joints shall be

designed and manufactured specifically for the sizes of rail to be connected. If available from a manufacturer, compromise rails (factory welded) shall be used in all new work.

2.1.8 BOLTING

Fully bolt joints, using the outer four bolts only on six hold joint bars to connect rail ends which will be field welded within 60 days. Keep nuts tight. Put the flat side of the nut against the spring washer. Remove frozen bolts with a cutting torch or a chisel.

2.1.9 EXTEND MAIN TRACK RAIL SIZE THROUGHOUT TURNOUT

Turnouts shall be constructed wholly of one size of rail. Compromise joints or molds shall be located beyond the limits of the turnout.

2.1.10 CHANGING OUT RAILS - INSPECTION

- A. Rail in curves shall be inspected periodically to determine whether it shall be replaced due to wear and to determine the actual length of rail to be replaced. Actual wear conditions shall be determined for each curve. Do not rely on rail date information or curve length information in the track chart. The wear rate of rail shall be considered in planning for rail replacement. Generally, rail should be planned for inclusion in the following year's capital maintenance program when the wear reaches a point of about 3/16 inch less than the limits in Figure 2-1, Rail Wear Limits. Rail should be transposed, or replaced, when it reaches the limits in Figure 2-1.
- B. Rail may be replaced as high side and discard old high side rail; replace high side and set high rail to low and discard old rail; or replace low rail, as indicated by the conditions in each curve. The condition of both rails should be considered when recommending the transposition of a particular curve. This decision will be made by the Manager, Track and Structures Maintenance or as required in the Contract Documents.
- C. Replacement rail shall be 136 lb. rail unless specifically authorized by the Manager, Track and Structures Maintenance. Premium rail (alloy or head hardened) shall be used for curves of three degrees or more and in special trackwork.
- D. When 6-inch base rail is installed to replace 5-1/2 inch base rail, or when rail is being replaced on wood ties with curvature of four degrees or more, tie plates shall be elastic fastener 16-inch plates per E.S. 1406 or as stated in the Contract Documents.

FIGURE 2-1 - RAIL WEAR LIMITS				
RAIL WEIGHT	WEAR LIMIT TO TRANSPOSE	SIDE WEAR LIMIT TO REPLACE	HEIGHT WEAR LIMIT TO REPLACE	GAGE FACE ANGLE
136 LB.	1/4" to 1/2"	5/8"	11/16"	18 degrees
119 LB.	1/4" to 1/2"	5/8"	1/2"	18 degrees
115 LB.	1/4" to 1/2"	5/8"	3/8"	18 degrees

- E. Measure side wear at a point 5/8 inch below top of rail.
- F. When replacing rail, or renewing switch points or frogs, carefully inspect the rail ends and bolt holes in the remaining rail before applying angle bars. If cracks or signs of stress are visible in the rail end, or if the bolt holes are excessively deformed or elongated, replace the rail or cut the remaining rail back to a location where sound bolt holes can be drilled. Also replace chipped rail ends with more than a 1 inch chip comprising more than twenty-five percent of the railhead. Be sure that the gage and running surface of rail ends match (CFR49 p213.115). Control of thermal expansion of rail requires that there be no net addition of rail. Following replacement or repairs rails, rails shall be thermally adjusted. When necessary, use a rail expander to close gaps at joints. In all cases of changing rail, the foreman or supervisor shall submit reports required under Section 2.2.7 entitled "Reporting Disturbed CWR Track" herein.

2.1.11 CHANGING OUT RAILS – REPORTING AND MARKING

- A. In order to ensure proper accounting, inventory adjustments, and chain of custody, all rail removed from service must be ultrasonically tested for internal defects and marked with date of test. The track repair leader must submit the appropriate rail transaction report for any rail changed out. Refer to Section 2.3 entitled "Rail Defects" for marking, reporting, and disposal requirements for defective rails.
- B. Any rail that is removed from service that has been tested within the last six months and is defect free and planned for re-use must be clearly marked per the Section 2.1.17 entitled "Rail Testing and Identification" herein.

2.1.12 NEW, SECONDHAND (SH), SCRAP RAIL, AND OTHER TRACK MATERIAL (OTM)

- A. Track supervisors and track repair crew leader (foreman) must clearly mark all rail in inventory, showing length, weight, and class. Load and

ship surplus new and secondhand rail as the Manager, Track and Structures Maintenance, instructs or as directed in the Contract Documents. Slat loaded rail (wood slats between rail levels), and submit the proper rail transaction report in order to maintain proper rail inventory accounting.

- B. The Manager, Track and Structures Maintenance, will determine the disposition of defective rail removed from the track. Stack rail so it can be loaded with a magnet crane. Do not slat load scrap rail. Submit the proper rail transaction report to SCRRA Material Control Manager.
- C. Classify surplus track material as either unsorted scrap or as salvageable secondhand material. All fit for re-use rail (salvageable and secondhand rail) returned to inventory shall be clearly marked “fit for re-use” with the date of the last rail test. After classifying the material, advise the Manager, Track and Structures Maintenance, who will handle scrap material in accordance with SCRRA procedures. Ship scrap switch points and frogs separately from rail.

2.1.13 CUTTING RAIL

- A. When it is necessary to cut a new or second hand rail, make a square and accurate cut using a rail saw. Refer to Section 1.5.3 entitled “Operation of Grinders and Abrasive Saws” herein. .
- B. In an emergency, a cutting torch may also be used (and may only be used) in an emergency. In this case, carefully clean the rail end. If it is necessary to torch-cut rail, protect the track with a 25 MPH slow order and change it torch-cut rail within 24 hours.

2.1.14 DRILLING RAIL

Except at turnouts (as required by Standard Plans) and at field welds, drill rail so that there will only be the holes required in the rail end to fully bolt the joint. Do not torch cut holes in any track under any circumstances. Do not drill holes through the joint bar.

2.1.15 RAIL ANCHORS

- A. Apply and maintain rail anchors as outlined in Engineering Standards (E.S. 1101 and 1102). When placing anchors or increasing the number of anchors, consult with the Manager, Track and Structures Maintenance, on what pattern to use. Keep anchors snugly against the ties or tie plates, or they are useless. When it is necessary to move anchors, remove and reapply them (except when using an anchor adjusting or squeezing machine).

- B. Do not drive anchors along the rail. Use anchor applicator and squeezer machine when available. For hand application, use the proper wrench. Apply drive-on anchors with a sledge-hammer. Place the anchor snugly against the tie or tie plate. Seat it first with a light blow, striking the heel of the anchor squarely with the hammer. Then strike the anchor with a hard blow. Make sure that the anchor fastens properly to the base of rail. To avoid deforming the anchor and reducing its holding power, do not overdrive. Do not strike the base of the rail.

2.1.16 SPECIAL FASTENERS

- A. Use special fasteners approved by the Director of Engineering and Construction or required in the Contract Documents on concrete ties and on curves and in other areas where rail turnover or frequent rail change-out is a problem. Fasteners shall be removed and applied according to manufacturer's instructions.
- B. Fasteners for angle bars and insulated joints shall conform to the manufacturer's recommendations. Use of inappropriate fasteners can short circuit the signal system.
- C. Elastic fastener clips shall be galvanized per E.S. 1407 and 1409. Shoulder insulators shall be steel insert type for curves in excess of four degrees. Base pads and insulators shall be replaced whenever out-of-face rail replacement or transposition is performed. Use 3-piece pads (polyethylene/steel/polyurethane) for all new construction and programmed rail replacement.

2.1.17 RAIL TESTING AND IDENTIFICATION

Second hand rail shall be ultrasonically tested and the test documented to establish a chain of custody before it can be placed into service in class 3 or higher track. Rail that is removed from service and planned for reuse shall be ultrasonically tested and marked with the month and year of the last test date and clearly marked "fit for reuse". If the second hand rail chain of custody cannot be verified, the rail must be ultrasonically tested and marked with the date of the test and "fit for reuse." If the ultrasonic test has not been performed within the past 6 months, the second hand rail must be ultrasonically tested again and marked with the date of the test and "fit for reuse."

2.2 CONTINUOUS WELDED RAIL (CWR)

This section covers CWR installation and maintenance. Refer to Section 8, Prevention of Track Buckling, for additional instructions on procedures for prevention of track buckling. Refer to Federal Track Safety Standards 213.119 for regulations governing work on CWR.

2.2.1 DEFINITIONS FOR CWR

The following terms are used in reference to CWR:

- A. **Continuous Welded Rail (CWR):** Rail that is welded into lengths in excess of 400 feet.
- B. **Neutral Rail Temperature (NRT):** The temperature at which the rail has no thermal stress due to expansion or contraction, this is the actual rail temperature if the rail is free to expand or contract as when the anchors are removed and the rail is vibrated.
- C. **Preferred Rail Laying Temperature (PRLT):** The temperature that the rail is to be installed at, or adjusted to, in order to balance the thermal expansion and contraction forces for optimum track maintenance practices.
- D. **Pull-Apart:** A track defect caused by excessive contraction of the rail when cold, it may be the rupture of all bolts in a joint or a rail fracture that pulls apart the rail.
- E. **Rail Temperature:** The actual temperature of the rail as measured by rail thermometer(s).
- F. **Track Buckle:** A kink in the track caused by excessive thermal expansion of the rail, insufficient lateral strength, or both -- often called a "sun kink"
- G. **Destressing:** A maintenance procedure that makes the longitudinal thermal stress in the rail the same as, or as close as possible to what it would be, if the rail was laid and anchored at the PRLT -- sometimes called "adjusting" CWR.

2.2.2 MAINTENANCE OF CWR

- A. Proper maintenance of CWR will result in a high ride quality and extended rail service life.
- B. It is a requirement of the FRA (49CFR 213.119) that each railroad manage the maintenance of CWR to maintain thermal forces within safe limits. This Section 2, Rail, and Section 8, Prevention of Track Buckling, are a part of the SCRRA program to maintain CWR.
- C. Employees responsible for the maintenance, inspection and installation of CWR must receive annual training in CWR practices.

- D. For the proper maintenance of CWR, the neutral rail temperature, ballast section, drainage, cross ties, anchors, and rail head wear/profile must be maintained to the highest quality.
- E. Newly installed CWR rail shall be ground as soon as possible (during the next scheduled rail grinding program) after laying to correct any surface irregularities in the railhead. If irregularities are excessive, corrective measures other than grinding may be necessary.

2.2.2.1 RESPONSIBILITIES OF MANAGER, TRACK AND STRUCTURES/ CONSTRUCTION PROJECT MANAGER⁴ FOR THE INSTALLATION OF CWR

- A. The Project Manager must be qualified per CFR 49 part 213.7; is responsible for the overall safe passage of trains' and must inspect track frequently behind CWR gang to ensure safe operating practices, proper rail temperature adjustment, and appropriate temporary speed restrictions.
- B. The Project Manager is responsible for the quality of field welding, rail pickup, and OTM pickup behind the CWR gang.
- C. The Project Manager is responsible for the reporting and documentation of rail installation temperatures.
- D. The Project Manager shall verify that the following requirements are met in regard to CWR installation:
 - 1. The roadbed shall be properly prepared prior to distributing material. This includes:
 - a. Installing ties if required.
 - b. Surfacing.
 - c. Verifying that ballast is properly regulated and broomed.
 - 2. Turnouts shall be evaluated prior to installation to verify that:
 - a. Those not required are removed.
 - b. Those to be replaced are completed.
 - c. Those to be relocated are completed.

⁴ The Manager of Maintenance of Way or Construction Project Manager may function as the Project Manager or may delegate these functions to another authorized person. In either case a definite understanding of who will function as Project Manager will be provided by the Manager of Maintenance of Way or the Construction Project Manager.

- d. Those that are not replaced are rehabilitated, as required.
 3. If practical, all crossings through which CWR is to be installed should be rehabilitated ahead of rail installation.
 4. All open deck bridges on which CWR is to be installed must have the following preparation work done prior to rail installation:
 - a. Ties renewed as necessary.
 - b. Alignment corrected, if necessary..
 - c. Hook bolts or boat spikes installed to comply with SCRRRA standards.
 - d. Support for unloaded CWR.
 - e. Inner guard rails removed.
 - f. Tie pads available as necessary.
- E. The Project Manager shall consult with the Manager, Signals and Communications, to arrange for signal support. They will determine status of insulated joints: whether existing joints can be removed and whether new joints will be required. Plan rail relay to include prefabricated insulated joints installed contiguous with CWR.
- F. Consideration should be given to completing any other functions to improve quality or productivity of project.
 1. Repair of previous derailment areas with damaged spikes and other damage.
 2. Operating Brush Cutter
 3. Operating Shoulder Ballast Cleaner
 4. Cut widening with Dozers
- G. Unload CWR giving special consideration to productivity gains such as minimizing thermite welds and eliminating the need to lay jointed rail to fill in gaps around turnouts and crossings. If possible, CWR shall be unloaded through secondary crossings by trenching through the roadway and backfilling with ballast and covering with temporary asphalt road surface. Refer to Section 2.1.3.C.
- H. The Project Manager shall ensure that OTM is properly distributed in proper quantities. It is as wasteful to over distribute as it is to under distribute. All OTM should be distributed on one side of the track only.

2.2.2.2 RAIL GANG LEADER (“FOREMAN’S”) RESPONSIBILITY⁵

- A. The Foreman is responsible for the overall operation of the gang. The Foreman shall constantly evaluate the gang’s performance and ensure that all work is being performed to the highest standard in a safe manner and according to standard practices.
- B. The Foreman must have a rail thermometer, tape measure, string line, level board, and a track gage available at all times.
- C. The Foreman shall check gage, spiking, anchoring, general quality, and production. The Foreman is responsible for checking ahead of the gang so there will be a uniform flow of work; advising the Project Manager of any shortages of material or appropriate corrective action.
- D. The Foreman shall coordinate all work with the Signal Support Personnel. All Work Windows arranged for the work shall include ample time for restoration of the signal system.
- E. The Foreman is responsible to ensure the CWR is being laid at the proper temperature and the rail is being properly adjusted. The Foreman is responsible to take, record, and report rail-anchoring temperatures per Section 2.2.3 entitled “Preferred Rail Laying Temperatures” and Section 2.2.4 entitled “Instructions for Taking Rail Temperatures for CWR” herein, using sample form shown as Figure 2-2.
- F. Cutting and drilling of rail should be done under the direction of the Foreman to ensure correct workmanship.
- G. Before track is released for train operation, the Project Manager or Foreman shall inspect the work to ensure that is accordance with the Section 2.2.2.4 entitled “Restoring Track for Train Operation after CWR Gang Work” and meets all the requirements of CFR 49 part 213

2.2.2.3 GENERAL GANG OPERATION

- A. CWR must be installed and anchored at the Preferred Rail Laying Temperature. (NOTE: When rail heater is required, it shall operate in front of spiking operation if rail temperature can be maintained for anchoring.)
- B. Track gage for CWR installation shall be as follows:
 - 1. **Timber Ties:** 4’ – 8 1/2” for tangent track and curve.

⁵ The Rail Gang Leader may be the employee of a construction contractor, maintenance contractor, SCRRRA, or a consultant. Whoever is directly in charge of installing rail shall be governed by these instructions.

2. **Concrete Ties:** 4' – 8 1/2"

- C. When removing scrap and usable OTM from track, it should all be piled on one side, and on the opposite side of the new OTM to be installed. Make piles of removed OTM as large as practicable.
- D. Jointed rail to be removed shall be center marked before removing from track and shall be set out head of the ball up.
- E. Stub spikes shall be marked and then driven down with a stub punch to avoid injury or damage to the adzer.
- F. Tie adzing shall only be of sufficient depth to allow for a full level seat for the new tie plate. Adzer shall be properly adjusted and checked periodically. Over adzing reduces the life of the tie. Adzer bits shall be of the right size. Maintain adzer bits sharp at all times to avoid fraying the tie or breakage of bits.
- G. Tie adzing shall not be done on open deck bridges.
- H. Spiker gage, Dunrite gage, and tie drills must be properly set. Frequent checking of the setting shall be made to avoid improper gage.
- I. Rail temperature shall be taken immediately behind anchor application totaling a minimum of four times each one-quarter mile CWR string. Determine the rail temperature in accordance with the Section entitled 2.2.4 "Instructions for Taking Rail Temperatures" herein.
- J. When automatic spiker is not available, spikes shall be set and driven straight. Do not over drive spikes.
- K. Anchor machines must be properly adjusted. Inspections shall be made checking to ensure the anchors are fully applied and fit flush against the tie.
- L. CWR must be laid in tension; it must be stretched at regular intervals from a location close enough to ensure longitudinal movement at the spiking and anchoring operation.
- M. A minimum of two spikes (cut or screw) or as required in the Contract Documents must be in place to secure each tie plate at end of each work shift. All cut or screw spikes must be installed by end of second work shift.

2.2.2.4 RESTORING TRACK FOR TRAIN OPERATION AFTER CWR GANG WORK

- A. Refer to Appendix C, Summary of Speed Restrictions for Trackwork.

- B. If surfacing work has been performed and the rail is properly adjusted and/or the ballast has been disturbed without being properly compacted by a dynamic track stabilizer, limit speed of first train over the newly installed rail to 10 MPH for passenger trains and 10 MPH for freight trains and maintain this speed for any track that does not have the full complement of anchors per E.S. 1102 and does not have a minimum of two spikes per tie plate unless otherwise directed. After the passage of the first train, the track shall be inspected and then, under the authority of the qualified person-in-charge (qualified under CFR 49Part 213.7), the speed may be increase to 40/30 MPH for the period of 24 hours with the minimum of 12 trains.⁶ Then after another track inspection, the speed may be restored to the Timetable Speed.
1. Before removing any speed restrictions, the abutting rail's anchor pattern and rail end gap condition shall be inspected.
 2. Review grades and curves in Track Chart so consideration is given when placing speed restriction to prevent buckled track.
 3. Inspect track to ensure the track is safe to return to the correct track class for operation.
 4. Following CWR installation, the Foreman shall inspect the track. If the Foreman determines that there are no exceptions and ballast has not been disturbed, the maximum speed for the first train shall be 15/10 MPH. After the passage of the first train and after another track inspection, the speed may be restored to the Timetable Speed.
- C. Prior to increasing speeds, the following criteria must be met:
1. Before removing 10/10 MPH speed restriction abutting rail shall be inspected for rail anchor and end gap condition.
 2. The opposite rail's anchor condition and cross level condition shall be inspected prior to removing 10/10 MPH speed.
 3. If more than 1/2 inch of change of elevation has occurred due to height of new rail or plates, limit maximum passenger speed to 50 mph on tangent or speed per E.S. 2302, whichever is slower.
 4. After the first train following CWR installation, the speed may be increased to Timetable Speed following inspection and determination that all back work is complete (i.e. Anchor patterns, spike patters, field weld or joint properly made, etc.)

⁶ When train speed is written as two numbers separated by a “/”, it shall be understood that the first number, in this case 30, applies to passenger trains and the second number, in this case 25, applies to freight trains.

- D. If track surfacing is to be or has been performed in conjunction with the installation of CWR, the track speed shall be limited to 10 MPH for passenger and 10 MPH for freight for the first train, then:
 - 1. Until surfacing is complete, the speed may be increased to 30/20 MPH until surfacing is complete provided that anchors, rail temperature adjustment, welds, and joints have all been properly installed, then:
 - a. When surfacing is complete, limit speed to 30/20 MPH for 24 hours of operation or:
 - b. If surfacing is completed with a Dynamic Track Stabilizer and all anchors, joints, welds, and spiking are complete, there is no mandatory speed restriction for any train; however supervisor in charge may limit speed in accordance with this supervisor's responsibilities under 49CFR213.7.

2.2.3 PREFERRED RAIL LAYING TEMPERATURES FOR CWR

- A. When laying welded rail, heat the rail if necessary so that the rail temperature will be at the Preferred Rail Laying Temperature (PRLT) listed below unless approved by Director of Engineering and Construction. Heated rail must actually move as it expands. Spike and anchor at the target temperature.
- B. Paint the actual average rail temperature achieved at the time of installation, as well as the date, on each end of each string in the web of the rail on the field side, and report rail installation and forward a copy to the Manager, Track and Structures Maintenance. Rail date and temperature shall be marked per the Section 3.1.15 entitled "Marking Field Welds" herein will satisfy this requirement.
- C. The rail length needs to be divided into four marks that indicate the required rail movements, making the first mark at 100 feet and then the last three equally spaced to the end of the rail using the chart in Figure 8-2, CWR Movement Chart - Inches. The marks shall be made with paint stick on the base of the rail; the match mark shall be made on the tie plate on wood ties and on concrete on concrete ties. When the rail is heated to PRLT, the marks will line up and then the anchors or clips shall be installed starting at the beginning of the rail. The marks shall be matched up on the rail and shall be considered distressed. The procedure shall be done by the foreman in charge of maintenance or by the construction inspector of a construction or maintenance contract.

- D. Preferred Rail Laying Temperature:
1. 110 degrees F on all tracks with the exception of tunnels.
 2. 70 degrees F inside tunnels.
 3. If rail is found to be in an adjusted temperature or Force Free Temperature more than 5 degrees F above or below the PRLT, it shall be distressed.

2.2.4 INSTRUCTIONS FOR TAKING RAIL TEMPERATURES

- A. Take rail temperature readings on the web of the shady side of the rail. Take a minimum of four readings: One at each end with two equally spaced in the middle. Take temperatures before and after all breaks in welded rail strings (i.e. road crossing, switches, insulated joints, etc.). Record rail temperature notes and data as shown in Figure 2-2, Record of Rail Installation Temperatures.
- B. If rail temperature is taken with either an optical or a contact thermometer, take two readings adjacent to each other. If the two temperatures are within 3 degrees Fahrenheit, take the average. If they vary by more than 3 degree Fahrenheit, continue to spot check until a stable temperature as measured.
- C. If magnetic thermometers are used, they must be left on the rail for five minutes to ensure that they have equalized to the rail temperature before recording the temperature.

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FIGURE 2-2 - RECORD OF RAIL INSTALLATION TEMPERATURES								
Date	Mile Post	Subdivision	Track No.	Rail N / S	String No. & Length	Air Temp.	Rail Temp.	Weather / Time

Submitted by: _____

Description: _____

Instructions:

Date: Date when rail is laid.

Rail – N / S: North or South rail, as defined by timetable direction.

String No.: Number the strings beginning with #1 and continuing in succession with each string laid in the course of the day. Each day the crew should start the numbering with #1. Indicate length of each string.

Air Temp: Air temperature in degrees Fahrenheit taken at the same time the rail temperature is taken.

Rail Temp: Rail Temperature in degrees Fahrenheit taken at the same time the rail is anchored.

Weather/Time: Weather conditions and time when the air temperature and rail temperature are taken.

Description: Notes about special items (i.e., weather, mile post locations, etc.).

Distribution: Deliver completed forms (FIGURE 2-2) to SCRRRA Manager of Maintenance of Way for filing by milepost order for each subdivision.

2.2.5 MAINTAINING CWR TRACK

- A. It is a requirement of the FRA (49CFR 213.119) that each railroad manage the maintenance of CWR as to maintain thermal forces within safe limits. This Section 2, Rail, and Section 8, Prevention of Track Buckling, are a part of the SCRRA program to maintain CWR.
- B. In welded rail track, frequently inspect the joints and bolts. Replace bent and/or distorted bolts and checked or cracked joint bars. In order to prevent excessively wide openings at rail ends in extremely cold weather, replaced defective bolts one at a time. Maintain proper rail end, anchor pattern at joints in accordance with E.S. 1102. If a pull-apart occurs in continuous welded rail or for any other reason it becomes necessary to saw in a short length of rail to restore service, use lengths between 19'6" and 39'. The length of the inserted rail should be the same length as the removed rail. Do not add rail, since this causes excessive stress and thus, kinks in hot weather. Field weld all rail cuts as soon as possible.
- C. Rail installation shall be in accordance with the Section 2.2.2.3 entitled "General Gang Operation".
- D. At joints in welded rail where numerous contraction openings occur, make adjustment of rail anchors when rail temperature is above the PRLT. If rail expander/puller cannot correct a contraction opening, saw in a section of jointed rail only as a last resort and only after notifying and consulting with Manager, Track and Structures Maintenance.
- E. Do not lay continuous welded rail using expansion shims. Do not bump or drive rail position in order to fill openings or in order to get rail into position to lay in track. (DO NOT ADD RAIL).
- F. When it is necessary to move continuous welded rail, do it by pulling; however, a rail expander may be used to secure proper openings for insulated joint end-posts.
- G. Ballast shall be maintained per E.S. 1801, including both shoulders and cribs.

2.2.6 DISTURBED TRACK

2.2.6.1 SLOW ORDER CHART REGARDING DISTURBED TRACK

- A. Refer to Appendix C, Summary of Speed Restrictions for Trackwork, for speed restrictions in regard to disturbed track.

2.2.6.2 AMBIENT TEMPERATURE BELOW 80 DEGREES F AND RAIL TEMPERATURE BELOW PREFERRED RAIL LAYING TEMPERATURE:

- A. When it is necessary to perform maintenance or construction on any component of track structure (including surfacing, tie replacement, and ballast cleaning) and the ambient temperature is below 80 degrees F or the rail temperature is below the Preferred Rail Laying Temperature, the Foreman completing the work shall check the cross-level and alignment of the disturbed track. If necessary, the Foreman shall place a speed restriction for the appropriate class of track per 49 CFR Part 213 to ensure the safe operation of trains.
- B. On CWR, a speed restriction of 30/20 mph must be in place until a full ballast section is restored and conforms to the standard ballast section. Refer to E.S. 1801.
- C. If a speed restriction is placed, do not remove it until the defect has been corrected and a qualified person in charge inspects the track and declares it safe for normal speed. Note; only a person qualified per 49 CFR Part 213.7 may remove a speed restriction.
- D. Refer to Section 8, Prevention of Track Buckling, for general discussion on preventing track buckles and the Section 8.3 entitled “Destressing Continuous Welded Rail” for procedure to destress rail.

2.2.6.3 AMBIENT TEMPERATURE 80 DEGREES F OR ABOVE OR RAIL TEMPERATURE ABOVE ADJUSTED RAIL LAYING TEMPERATURE:

- A. When it is necessary to disturb the ballast or any component of track structure (including surfacing, tie replacement and ballast cleaning) and the ambient temperature is above 80 degrees F or rail temperature is above the Preferred Rail Laying Temperature, provide the following slow order protection:
 - 1. On the main track, place a speed limit of no more than 30/20 MPH for at least 24 hours.
 - 2. On the main track, place a speed limit of 10 MPH for at least 24 hours if the Foreman/Supervisor determines the condition warrants a more restricted speed than 30/20 MPH.
- B. When using a Dynamic Track Stabilizer in conjunction with a surfacing operation and an inspection by the Foreman indicates that a standard ballast section exists, that alignment and surface are correct, and that the track is in full compliance with the class of track, the slow order as described in Paragraph A above may be removed after passage of the first

train and after the track has been re-inspected by the qualified person in charge.

2.2.7 REPORTING DISTURBED CWR TRACK

- A. A report “SCRRRA CWR Stress Adjustment/Disturbance Report” (Figure 2-3) shall be filled out by the qualified person-in-charge when work listed below which has the potential for disturbing the preferred rail temperature or the lateral resistance of the track is performed. These reports are required by FRA Track Safety Standards. These reports are for situations that may either raise or lower the Neutral Rail Temperature. These reports are required for both maintenance and construction activities.
- B. The qualified person-in-charge of work being performed on the track shall retain original of report and shall forward a copy to the Manager, Track and Structures Maintenance. If box marked “Corrective Action Required” is checked, a second report shall be submitted to indicate the corrective action and shall refer to the original report by date and milepost location.
- C. Reports will be reviewed and compiled by the Manager, Track and Structures Maintenance, or this Manager’s representative. They will be filed in milepost order, by Subdivision, in the same file as the rail installation reports. If a report overlaps a previous report of rail installation temperatures at the same location, the old report will be retained with a notation that it has been superseded by the new report. The Manager, Track and Structures Maintenance will examine these reports quarterly to confirm that corrective actions have been accomplished.
- D. Work requiring submittal of Form shown in Figure 2-3 includes the following:
 1. Additions/changes of rail:
 - a. Installation of repair rail
 - b. Installation/replacement of bonded insulated joint
 - c. Field weld of bolted joint
 - d. Removal/Replacement of Track Panel:
 - Road Crossing
 - Bridge Deck
 - Derailment/Washout
 - Turnout
 - e. Realignment of Curved Track

- f. Destressing
 - g. Repair of Track Buckle
 - h. Repair of Pull-Apart
2. Changes to track strength:
- a. Surfacing
 - b. Loss of ballast:
 - Construction Activity
 - Operation of roadway vehicles
 - c. Installation of ties:
 - Spot tie or production wood tie replacement
 - Change-out of wood to concrete ties
 - Subgrade subsidence repair/surfacing

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**FIGURE 2-3 - SCRRRA CWR STRESS ADJUSTMENT / DISTURBANCE
REPORT - FORM
SCRRRA CWR STRESS ADJUSTMENT /DISTURBANCE REPORT**

SUBDIVISION: _____ **REPORT DATE:** _____
DATE OF DISTURBANCE: _____ **REPORTED BY:** _____
CORRECTIVE ACTION REQUIRED? YES ___ **NO** ___

LOCATION:
MILEPOST: _____ **to** _____
TRACK NO.: _____
N or S RAIL: _____ (if applicable)

TEMPERATURES:
AIR: _____
RAIL: _____ (actual)
RAIL: (as adjusted, if applicable)

TYPE OF ADJUSTMENT/DISTURBANCE:
_____**REPAIR RAIL INSTALLED: BOLTED** _____ **WELDED** _____ **FT.** _____
_____**TRACK PANEL (S) INSTALLED FEET:** _____
_____**TURNOUT INSTALLED**
_____**ROAD CROSSING INSTALLED**
_____**TIES INSTALLED**
_____**SURFACING OF TRACK: INCHES OF LIFT:** _____
_____**REALIGNMENT OF CURVE**
_____**UNDERCUTTING**
_____**WASHOUT**
_____**BUCKLED TRACK**
_____**PULL-APART**
_____**DESTRESSING PERFORMED**
_____**OTHER** _____

CORRECTIVE ACTION:
DATE: _____ **AIR TEMP.** _____
RAIL TEMP. _____ (Actual) **RAIL TEMP.** _____ (Adjusted)
DESCRIPTION:

Report all CWR rail disturbances on this Form (Figure 2-3),
to SCRRRA Manager, Track and Structures Maintenance.

2.2.8 INSPECTING JOINTS IN CWR

A walking visual inspection of all joints including insulated joints in CWR shall be performed.

- A. The walking visual CWR joint inspection shall detect any excessive forces allowing vertical or longitudinal rail movement. The inspection shall include the track (rail, ties, fasteners, anchors, and ballast section) for the minimum of 20 feet each side of the joint.
- B. Inspectors must observe joint bars for visible or otherwise detectable cracks; loose, bent, or missing joint bolts; rail end batter or mismatch railheads; tie spacing; tie condition; disturbed ballast; surface deviations; hanging ties; and rail anchors.
- C. In CWR, each rail must be bolted with at least two bolts at each end used to connect CWR strings or CWR to conventional rail.
- D. Each joint bar must be held in position by track bolts or fasteners tightened sufficiently to provide firm support for abutting rail ends. In CWR, joints shall be tightened as much as possible to resist longitudinal expansion or movement.
- E. If a joint bar in CWR class 2 or higher shows signs of stress or excessive vertical or longitudinal movement of either rail end when all bolts or fasteners are in place and tight, the track shall be protected by a 30/25 MPH speed restriction until the joint is repaired or replaced.
- F. All Control Point (CP) joints are not included. These joints are inspected during the monthly switch inspection.

2.2.8.1 RECORD KEEPING OF CWR JOINT INSPECTIONS

A comprehensive SCRRA CWR Joint Inventory List (Figure 2-4) shall be maintained and periodically updated. CWR Joint Inventory records will be maintained by the Manager, Track and Structures Maintenance, who will issue new "Joint Identification" numbers as necessary.

- A. The CWR Permanent Joint Inventory List must contain: Subdivision, Date of Last Inspection, Mile Post, Rail Designation, GPS Location, Joint Identification Number, Type of Joint, Rail Size, and Track Number.
- B. The CWR Temporary Joint Inventory List must contain: Subdivision, Date of Installation, Mile Post, Rail Designation, GPS Location, Joint Identification Number, Type of Joint, Rail Size Track Number, and Date of Joint Inspection.

FIGURE 2-4 - CWR JOINT INVENTORY LIST SAMPLE									
SCRRA - CWR Joint Inventory List									Page 1
Line	Date	M.P.	Rail N-S	GPS - Location	Joint ID #	Type	Size	P/T	Tr.#
	11/11/2005	0.4	N	34-00-00N, 117-44-55W	VA0.4N	FG	119	P	1
		0.4	S	34-00-00N, 117-44-55W	VA0.4S	FG	119	P	1

2.2.8.2 TEMPORARY CWR JOINTS

Temporary CWR Rail Joints shall be inventoried on the Temporary Joint Inventory List using Figure 2-4 as the sample format. The date to be indicated on the Temporary CWR Rail Joint is to be the date that the temporary joint was placed into service.

- A. Temporary CWR Rail Joints shall not remain in-service on track Class 2 or higher for more the 30 Days without the written authorization of the Manager, Track and Structures Maintenance.
- B. Temporary CWR Rail Joints in Class 2 track or higher shall be visually inspected every 30 days and the inspection shall be recorded on the bi-weekly FRA inspection reports.
 - 1. Inspectors shall inspect temporary CWR joints for the following defects: Visible or otherwise detectable cracks in joint bars; loose, bent, or missing joint bolts; rail end batter or mismatch railhead; tie spacing; tie condition; disturbed ballast; surface deviations; hanging ties; and rail anchors.
- C. Upon removal of the temporary joint from an in-service track, it shall be removed from the Temporary CWR Rail Joint inventory list.

2.3 RAIL DEFECTS

2.3.1 DEFINITION

A defective rail is any rail that has failed in service or has a defect found by detector cars, audio-gage parties, visual inspection, or other means.

2.3.2 REPORTING AND REMOVAL

- A. Report all rail service failures and defects on main tracks and Centralized Traffic Control (CTC) sidings in writing on the SCRRA CWR Adjustment/ Disturbance Report - Form, Figure 2-3, and submit it to the Manager, Track and Structures Maintenance. Defective rail reports must reference the defect number in order to facilitate clearing of reports generated by the detector car.

- B. Mark each defective rail with red paint on the ball of the rail and with marking on both sides of the web and base. Cut into pieces less than six feet in length for immediate disposal. Send a Failed Rail Report, Figure 2-3, for all defective rail to the Manager, Track and Structures Maintenance.

2.3.3 REMEDIAL ACTION

- A. Refer to Part 213.113 of the FRA Track Safety Standards for the remedial actions required upon discovery of defects in rails.
- B. The whole length of any rail (from plant weld to plant weld or from joint to joint) that contains a longitudinal defect (e.g. Vertical Split Head) must be removed and handled as defective, whether or not the defect is visible or detected for the whole length.

2.4 REPLACEMENT OF RAIL

- A. When inserting second hand replacement rail (fit for re-use), track supervisors and track repair crew leader (foreman) shall ensure that rail is free of defects. The rail shall be visibly inspected and must be clearly marked “fit for reuse”. If the replacement rail (new or used) is to be welded in as CWR, do not drill the two center holes. Use only four bolts in each six-hole angle bar unless the rail already has a center hole. Thermite weld the replacement rail into the welded rail string as soon as possible.
- B. When a rail is changed, visually inspect the rail ends checking the condition of the bolt holes and of the rail ends for obvious defects before applying angle bars and the placing the track back into service. Also visually inspect angle bars for cracks or elongated bolt holes.

2.5 MATCHING RAIL WEAR CONDITIONS

When replacing rail with head or gage wear in excess of 1/8 inch, grind to match or select and install replacement rail, which provides the best possible match on both the gage side and running surface.

2.6 FREQUENCY OF RAIL TESTING

Testing of all main lines, sidings, turnouts, crossovers and railroad crossings and selected branch line turnouts shall be in accordance with the guidelines listed below:

- A. **Passenger Routes:** Three times per year, with at least three months, but no more than six months, between tests
- B. **Freight Only Routes:** Once a year, or as directed

- C. **Field Weld:** Once after completion of construction, then as directed.
- D. **Field welds (Flashbutt, Thermite) in Class 3 or higher:** Ultrasonically test within 3 to 14 days of the track being placed into service or as directed by the Manager, Track and Structures Maintenance.

SECTION 3 TRACK WELDING AND RAIL GRINDING

3.1 TRACK WELDING

3.1.1 WELDING SAFETY

- A. Welding contractor shall provide trained qualified track welders and their welding safety plan to SCRRA for approval.
- B. EIC/Welders shall be prepared to place temporary speed restrictions as necessary to protect any work in progress. The following are guidelines for various welding tasks:⁷
 - 1. Place a 10 MPH slow order for all trains over frogs or crossing diamonds while cutting or welding is in progress.
 - 2. Place a 20 MPH slow order for all trains over repairs in progress for rail ends.
 - 3. Thermite field welding shall comply with the Section 3.1.13 entitled “Thermite Welding Process” under 3.1.13C. “Thermite Welding Procedures” herein, and restrict first train to 10 MPH.
 - 4. When repairing turnout frogs and crossings in track, whether by electric or oxy-acetylene process, protect train movement with appropriate slow orders.
- C. Comply with safety rules and all other rules contained herein. Keep all vehicles and equipment used in welding procedures in good repair and in safe operating condition. Protect nearby persons (e.g. at crossings or stations) from sparks or other hazards associated with welding or grinding. Protect against fires by clearing vegetation (except for irrigated landscaping) for a minimum distance of 35 feet from welding or grinding.
- D. Regulators shall be removed from cylinders and stored in a clean dry compartment while traveling to and from the work site. If regulators are equipped with protective caps, such caps shall be installed. NEVER TRANSPORT A CYLINDER WITH A REGULATOR ATTACHED.

3.1.2 COORDINATION WITH SIGNAL DEPARTMENT

Track Welders shall coordinate with Signal Department maintainers or supervisors before taking any of the following actions:

- A. Use of arc welding on any track.

⁷ EIC refers to Employee-in-Charge who shall be qualified by SCRRA under FRA 49 CFR Parts 213 and 214.

- B. Removal and replacement of a section of rail that has track wires attached.
- C. Removal and replacement of a section of rail, or removing bond wires, within a crossing warning circuit.
- D. Grinding switch points and stock rails.
- E. Metal powder and grinding debris shall be removed from switch slide plates and insulated joints upon completion of work.

3.1.3 APPROVED WELDING PROCEDURES

Approved welding procedures are as follows:

- A. Repair of manganese steel track casting (except manganese tip switch points in main track) including cracks, casting defects, and batter or wear.
- B. Repair of chipped, battered and worn long point rails, short point rails and binder rails on rail bound manganese frogs and rail crossing diamonds (excluding cracked or broken rails).
- C. Repair carbon rail frogs and rail crossing diamonds (excluding spring wing rail on spring frogs).
- D. Repair chipped and/or battered rail ends.
- E. Repair chipped or worn switch points (yard and industry tracks only).
- F. Weld "A&B" plate stops on frog gage plates.
- G. Weld hold down boxes on spring frogs.
- H. Field weld rail (thermite weld).

3.1.4 PROHIBITED WELDING PROCEDURES

The following welding prohibitions apply:

- A. Do not weld clips, lugs, plates, or other fixtures on rail.
- B. Do not weld main track switch points (except joint at heel where block may be built up).
- C. Do not weld switch point protectors on main track.
- D. Do not weld or heat any main track switch operating mechanism, switch stand or switch connecting rod.
- E. Do not weld cracked or broken joint bars.

- F. Do not make compromise joint bars by welding portions of joint bars or different sized joint bars together.
- G. Do not make main track compromise thermite welds with nonstandard or field fabricated molds.
- H. Do not torch cut rail (except in emergencies, when protected by a slow order).
- I. Do not torch cut bolt holes in angle bars.
- J. Do not torch cut bolt holes in rail (except during rail loading/unloading operations).
- K. Do not place ground clamp on base of running rail, binder rail or guard rail.
- L. Do not weld tools, machines or vehicles without proper authority.
- M. Do not weld, heat or cut heat-treated hooks, steel alloy chains and associated rings, links or couplings.
- N. Do not weld cut or heat containers than contain or that have contained flammable or explosive materials.
- O. Do not make bond welds on base or web of running rails. Bond welds are permitted to the webs of wing and point rails on turnout frogs.

3.1.5 MANGANESE FROGS AND CROSSINGS

- A. Grinding: Grinding maintenance shall be performed on all newly installed manganese frogs and diamond crossings to improve quality and to extend the lifecycle of these components. Inspect new manganese turnout frogs and crossing castings or recently welded castings periodically, checking for any metal flow, which might have occurred during the work hardening process of the manganese. Grind off any bead or ridge from the top edges of the casting. Confine grinding to the top edges where the bead or ridge forms. Grind a radius of 3/8 inch to 5/8 inch. Do not leave any sharp edges or square corners. Perform this procedure a number of times until the unit is fully work-hardened.
 - 1. Slot grind at regular intervals. Include areas where manganese castings are in rigid contact with binder rails, the mating surface between long and short point rails, the heel of frog castings and rail joints at the ends of crossing and/or turnout frogs.

- B. Welding: Manganese turnout frogs and crossings need to be repaired in the following situations:
 - 1. Cracks have developed
 - 2. Depressions have developed
 - 3. Wear exceeds standards
 - 4. Spalling, cracking, chipping or casting defects have surfaced
- C. Prior to welding, tighten all loose bolts and correct all track conditions such as faulty ties, irregular surface, misaligned track, and incorrect guard rail flangeway width.
- D. Remove work hardened surface metal and defective material by grinding or with arc air before welding on casting. Weld using electric arc process only. Use only electrodes or wire feed welding metals designated for repair of manganese steel special trackwork. The temperature of a track casting must not exceed 700 degrees F in any area during a welding operation.
- E. Control thermal stress. Weld bead size shall be no more than 5/8 inch in width. Peen weld deposits in severely restricted areas.
- F. After completing the weld, check clearance and build up the carbon rail components, as necessary, to match level of the casting on such components as wing rails, long point rails, and short point.

3.1.6 WELDING CARBON RAIL FROGS AND CROSSINGS

- A. Repair battered or chipped areas of carbon rail frogs or crossings by building up worn or damaged areas to match the contour.
- B. Before doing any welding, tighten all loose bolts and check frog or crossing for gage, alignment, surface, and tie irregularities. If unsatisfactory conditions exist, correct them before proceeding.
- C. Check for worn or damaged areas with a straight edge to determine area to be built up. Grind to a depth of approximately 1/16 inch in order to remove work-hardened metal. Grind chipped, flaking, or spalled metal until reaching sound metal.
- D. Preheat head, web, and base of rail to 600 degrees F in areas to be welded. In point area of the frog, where filler blocks cover the web and the base of rail, pre-heat only the railhead.

- E. Grind the welded area (web and base) so that the surface is as level as possible and that it conforms to the contour of the entire unit.

3.1.7 WELDING RAIL ENDS

Repair chipped, battered or mismatched rail ends using the electric arc or oxy-acetylene process. Arc weld rail ends only on jointed rail and at ends of insulated joint rail. Use automatic wire feed machines whenever possible. Prior to welding, fully bolt all joints and tighten all bolts. Also, raise low joints and tamp them prior to welding.

A. Preparation:

1. Visually inspect rail ends for cracks, chips or other defects. Use a straight edge to determine the length of any low spots or the amount of build up needed. Examine each rail independently. Never weld rail past the last bolt hole in the angle bar.
2. If rails are mismatched in height, the low rail shall be built up to match the high rail.
3. Use a grinder to remove all chipped, spalled, work-hardened, defective, and excess flow metal before welding.
4. Use only electrodes, rods, or wire feed metals designated for restoration of rail ends.
5. Pre-heat rails to 600 degrees F.

B. Grinding:

1. Surface grind immediately after welding, using an angle head grinder mounted in surface grinding guide. Make sure the finished surface is free of any blemishes and gouge marks from the grinding wheel and grind it to conform to the contour of the rest of the rail.
2. Slot rail ends according to the instructions in the Section 3.1.9 entitled "Slotting Instructions" herein. After welding is complete, remove old bond wire, and grind the field side of the railhead until smooth. Finally, notify the Signal Maintainer so that the joint can be bonded.

3.1.8 WELDED REPAIRS TO BONDED INSULATED JOINTS

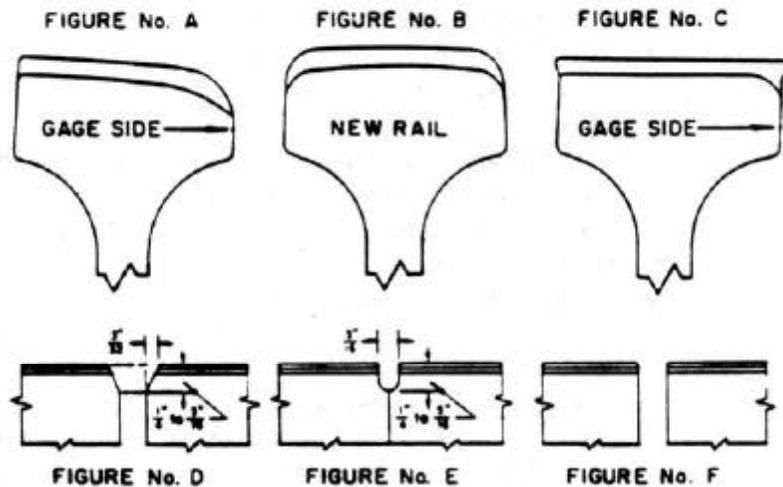
- A. Repair bonded insulated joints only in an emergency the same way regular angle bar joints are repaired; however, use only arc welds. Do not preheat

bonded insulated joints; this destroys the bonding material. Replace any defective or repaired insulated joint rail as soon as practical.

- B. Before welding, squarely slot both rail ends about 3/8 inch deep. Make sure no metal particles are left in the insulated joint as a result of slotting. Protect the end post during welding process. Weld the insulated joint slowly in order to help minimize damage to the end post and the angle bars from heat during welding. The side of the ball of the rail should not exceed 300 degrees F.
- C. Lightly oil the end post after slotting is complete.
- D. Coordinate all welding on insulated joints with the Signal Supervisor or Maintainer and be governed by the instruction of the signal representative. Do not weld on more than one insulated joint affecting any one track circuit at the same time.

3.1.9 SLOTTING INSTRUCTIONS

- A. Grinding Wheels 3/16" thick are standard for slotting and beveling of rail ends.



- B. FIGURES No. A, B, C are end views of railhead showing the slotting and beveling of rail ends.
 1. No. A is worn rail on the high side of curve.
 2. No. B is new rail before use or soon after being laid.
 3. No. C is worn rail on low side of curve. Note that slotting or beveling must always follow contour of the rail head. Rail ends at

closed joints shall be slotted. Rail ends at open joints shall be beveled.

- C. FIGURES No. D, E, F are side views showing the slotting and beveling of rail ends.
 - 1. No. D shows beveling rail ends, giving depth and width.
 - 2. No. E shows tightly closed joint after rail ends have been slotted, giving depth and width.
 - 3. No. F shows rail ends at insulated joint. The flowed metal shall be removed from rail ends leaving ends square or very slightly beveled on top corners of insulated joint. Particles of metal removed by grinding must not be left in insulated joint.
- D. NOTE: If weld deposit exceeds standard depth of slots, slot must be ground to bottom of weld deposit.

3.1.10 MAINTENANCE OF SWITCH POINTS

- A. The gage face of the tip of the switch point shall be maintained (by grinding) to an angle of 78 degrees (approximately 1:6), as shown in the Engineering Standards for the various turnouts; this is the “as manufactured” original shape of the point. This angle of the point will prevent a wheel flange from “riding up” onto the top of a point. This angle on the side of a switch point should extend down to 1-1/2 inches from the top of the stock rail so as to catch all wheel flanges and divert them to the intended route. This angle shall match the machined gage face of the switch point.
- B. Refer to the Section 4.1.9 entitled “Special Consideration for Curves” herein for instructions on maintenance of switches in or near curves.
- C. Main track switch points and stock rails shall be inspected regularly for indications of metal flow and shall be ground to remove metal flow before flow results in chips breaking off.
- D. Lightly round all sharp edges, and make sure that the switch point fits firmly against the stock rail.

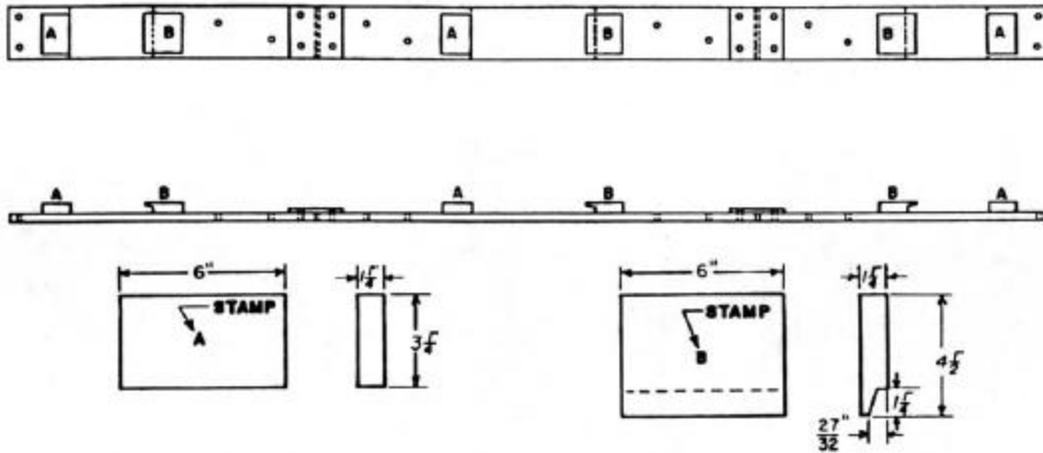
3.1.11 WELDING “A” AND “B” PLATE STOPS ON FROG GAGE PLATES

- A. Properly position and secure gage plates before welding. See Figure 3-2, Frog and Guard Rail Gage Plates.
- B. Check track for gage, and then beginning with one of the gage plates, field weld plate stops “A” and “B” to the track, one plate at a time while

simultaneously controlling the gage. If joints or guard rail ends interfere with positioning and/or welding plate stops, move the gage plate to the next tie. Place plate stop "A" field side, against the base of running rail, and place plate stop "B" on the gage side, against the base of running rail or guard rail. Refer to Figure 3.1.

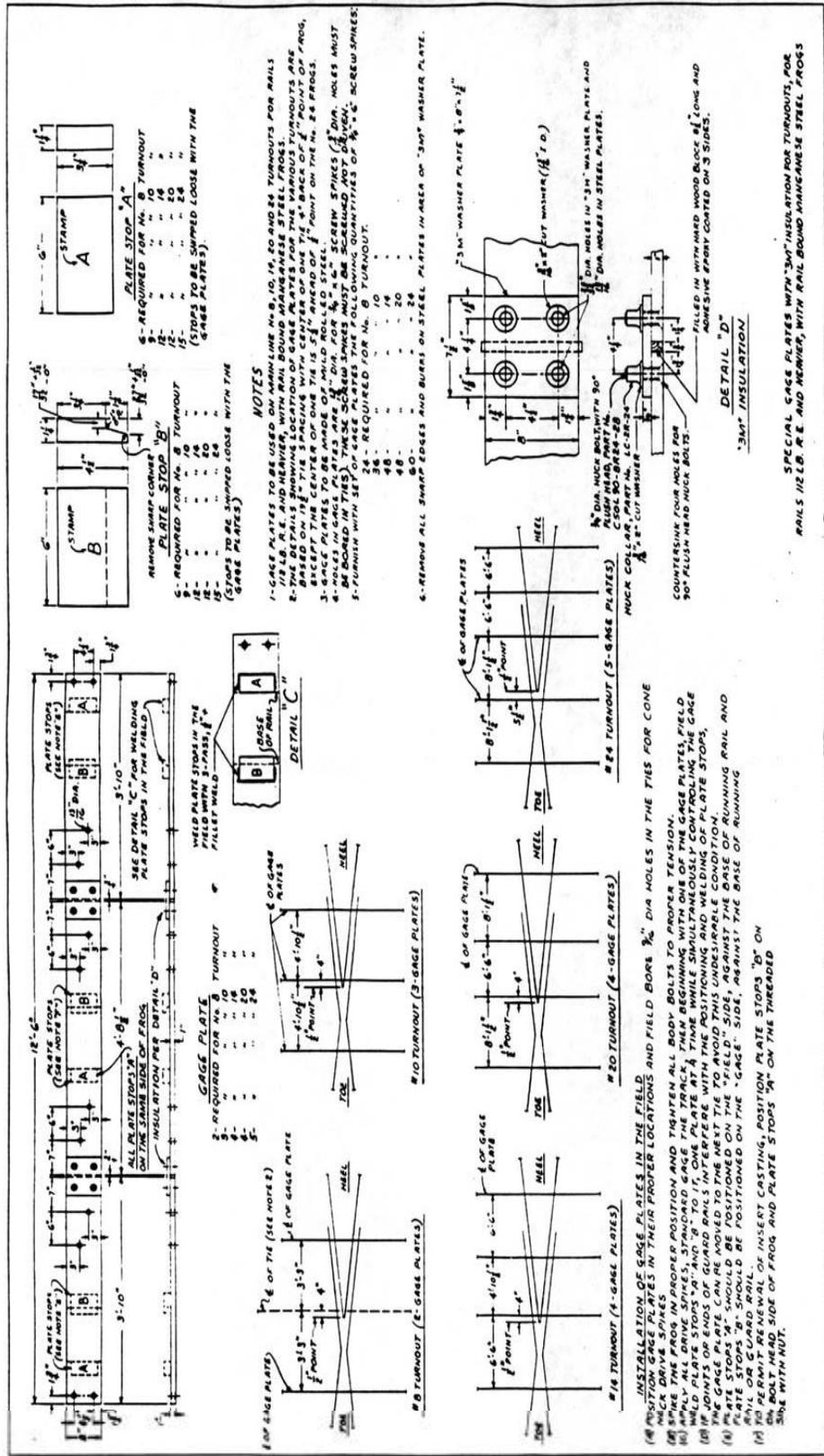
- C. To permit renewal of the insert casting, position plate stop "B" against the base of the wing rail connecting the toe end of the frog to the straight main line closure rail. Position plate stop "A" against the base of the wing rail connecting the toe end of the frog to the curves turnout side closure rail.
- D. Weld plate stops with 3 pass 1/2 inch plus fillet weld as shown in the drawing in FIGURE 3-1.

FIGURE 3-1 - SWITCH GAGE PLATE



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FIGURE 3-2 - FROG AND GUARD RAIL GAGE PLATES



3.1.12 LOCATION AND PREPARATION FOR THERMITE WELDS

- A. If the use of a cutting torch is required in the preparation for field welding, the rail shall be trimmed back a minimum of 3 inches with a rail saw before making the weld.
- B. When field welding is required, plan in advance to avoid welds being close to bolt holes, bond wire pinholes, plant welds or other field welds with the minimum restrictions specified in paragraph E. herein "Field welds shall not be made:".
- C. Restrictions regarding minimum length of rail to be welded into track:
 - 1. Rail less than 19'-6" shall not be welded in main track, except where designated in the Engineering Standards drawings for special track work or approved by Manager, Track and Structures Maintenance.
 - 2. 30 feet is the minimum length of rail than can be field welded in curves 2 degrees and greater.
- D. Track at the field weld shall be in proper surface and alignment before the weld is made.
- E. Field welds shall not be made:
 - 1. Within 6 feet from another field weld.
 - 2. Within 2 feet from a plant weld with a crown of 0.040 inch or less.
 - 3. Within 3 feet from a plant weld with a crown of more than 0.040 inch.
 - 4. Within 5 inches from bolt hole or bond wire pinhole.
- F. The rail ends to be welded shall be a minimum of 4-1/2 inches from the ties to permit the proper application and packing of the base plate and mold assembly. Flash butt welds shall be performed to the welding supervisor's design criteria.
- G. Each rail end must be properly prepared and have a square cut before field welding.

3.1.13 THERMITE WELDING PROCESS

- A. Only properly trained and qualified persons, as approved by the Manager, Track and Structures Maintenance, may make thermite welds.
 - 1. Welders so qualified shall follow manufacturer's recommendation for producing field welds and all other instruction contained herein. In case of conflicting instructions, the welder shall request clarification from the Manager, Track and Structures Maintenance, or the Engineer.
 - 2. Welder is responsible for maintaining the ADJUSTED RAIL TEMPERATURE of the rail when making a field weld. RAIL SHALL NOT BE ADDED DURING THE PRODUCTION OF FIELD WELDS.
 - 3. Welder shall be familiar with the safe operation of hydraulic rail jacks for use in adjusting the rail during the production of field welds.
- B. No thermite welding shall be performed when:
 - 1. Air temperature is below plus 32 degrees F.
 - 2. It is raining.
 - 3. Rail cannot be properly adjusted.
 - 4. Insufficient time exists to allow weld to cool to less than 600 degrees F before passage of trains.
- C. Thermite Welding Procedures:
 - 1. Thermite welds shall be located between ties, so weld is over tie crib.
 - 2. Rail shall be lined up, using wedges so that rail is straight, with a crown of not less than 0.065 inch or more than 0.080 inch when measured using a 3 foot straight edge and taper gage. Clean rail for a distance of 4 inches from end with a torch and wire brush until area is free of grease, rust, and other material.
 - 3. While the weld is still warm, finish grind the base and head of the weld to conform to the size and shape of the adjacent rail. After finishing grinding, re-space and re-spike ties so that ties are away from edges of the weld. Never place tie plates directly under a weld. Replace anchors no closer than 1 inch from weld. Note: Welds shall not be finished ground in the web area.

4. Handle molds and base bricks with care at all times in order to prevent breakage and to keep them dry. Store thermite charges only in dry places as recommend by the manufacturer. Never use a thermite oxide charge that is wet, has been wet, or is even suspected of containing moisture. Do not use weld charges or kits after their expiration dates.
5. When cutting in short rails on tangent track, do not use rail less than 19'-6" long. Follow minimum rail length instruction in the Section entitled "Rail Lengths".
6. **Visual Testing:** Visually inspect field welds immediately after grinding. Pinholes or slag inclusions are indications of a defective weld. Where pinholes or slag inclusions are observed, they shall be immediately removed from the track. Pin holes and slag inclusions less than 1/4-inch deep may be ground out of the head of the rail and repaired with arc welding, using rail end rod (not manganese frog rod).
7. **Ultrasonic Testing:** Field welds (Flashbutt and Thermite) in class 3 or higher shall be ultrasonically tested within 3 to14 days of the track being placed into service or as directed by the Manager, Track and Structures Maintenance. After a successful weld test is completed, the tester shall mark on the web of the rail as specified under Section 3.1.15 entitled "Marking Field Welds".
8. Dispose of slag, risers, and fragments of mold by burial outside of ballast section within SCRRA property. Mold fragments larger than one inch must be removed from the ballast section.

3.1.14 ADJUSTING CWR RAIL TEMPERATURE

- A. Refer to Section 8, Prevention of Track Buckling, for additional information about CWR thermal adjustments.
- B. Performing field welding may affect the thermal rail adjustment of the track. Welders shall ensure that the original rail temperature adjustment is not changed.

3.1.15 MARKING FIELD WELDS

- A. Upon completion of a thermite weld, the welder shall use a paint stick to mark the weld with the date, welder's initials, rail temperature, and air temperature on the field side of the rail, within 2 feet of the weld. The rail temperature shall be either the actual rail temperature or the adjusted rail temperature (if the rail was stretched with hydraulic jacks to achieve thermal adjustment).

- B. If the field weld is made with one free end, the word “FREE” shall be placed in lieu of the temperature information. This may occur if a track or switch panel is constructed outside the track or for the first weld of a piece of rail cut into the track.

Examples:4/25/00 RMM RT 115 AT 90 or 4/26/00 MLA FREE

- C. If a field weld is made within the destressing range (where rail anchors or clips are removed for destressing) of an older field weld, the welder shall mark out the rail temperature information on the older weld and put the new date and an arrow towards the new weld. This tells the track inspector that the rail temperature information is no longer valid and where to look for the most recent rail temperature adjustment.
- D. When field welds in track class 3 or higher are ultrasonically tested, the tested rail shall be painted with “U.T.” to indicate ultrasonically tested, the date when tested, and inspector’s initials.

Example:UT 4/25/00 RMM

3.1.16 COMPROMISE WELDS

Always use factory compromise molds to make compromise field welds.

3.2 RAIL GRINDING

3.2.1 RAIL GRINDING PROGRAM

- A. The Manager, Track and Structures Maintenance, or that Manager’s designated representative, shall perform an annual curve inspection and visual tangent track inspection to determine the requirements of the rail grinding program. After the initial inspection and/or electronic measurement using optical scanning data has been collected and evaluated, the Manager, Track and Structures Maintenance, shall prepare the recommended rail grinding program for funding and approval. Using the results of the database analysis, as well as the visual inspection, the Manager, Track and Structures Maintenance, staff shall then prepare an annual rail-grinding program consistent with budget conditions.
- B. Note, a comprehensive database of rail profiles shall be used for developing the curved rail rehabilitation program for each curve, developed by an optical scanning device and compared to the original rail profile.

3.2.2 VISUAL INSPECTION FOR RAIL GRINDING

In order to complete a rail-grinding program, obtain the following information during visual rail inspections or from optical rail scan:

- A. Side wear measurements.
- B. Plastic flows and lips with measurements.
- C. Top of rail wear measurements.
- D. Observed surface defects consistently described.

3.2.3 OPERATION OF RAIL GRINDERS

- A. Grinding trains shall have the capability of moving the angle of the grinding stones for any pattern change. These pattern changes accommodate particular railhead conditions. Grinding trains shall allow a contractor to grind a railhead in order to match it to the role it performs; thus, increasing the life of that rail. Therefore, pattern design and pattern scheduling are as important to the success of the rail-grinding program as the actual grinding.
- B. Additionally, information about the planned operation of the rail grinder shall be shared with the communities along the route in coordination with SCRRRA External Affairs office.
- C. Required daily reports include the following:
 - 1. A daily report of work performed, including the location and the chargeable time (see Figure 3-3 for sample of daily report)
 - 2. Verified daily work reports from the vendor
 - 3. A record of grinding patterns used on each pass and the speed at which the pass was made
- D. Forward copies of these reports to the Manager, Track and Structures Maintenance.
- E. The SCRRRA representative shall work closely with the rail grinding contractor. This representative shall check the quality of work, verify adherence to contract, and work with operations to maximize actual working times.

FIGURE 3-3 - SAMPLE - RAIL GRINDER DAILY REPORT

FAXCOM Manager, Track and Structures Maintenance
 Southern California Regional Rail Authority
 2701 North Garey Ave.
 Pomona, CA 91767
 Fax: 909-593-0187

A. Date: _____

B. Contract, Machine & Type of Operation: _____
 (i.e., (Contractor name) Rail Grinder)

C. Subdivision: _____

D. MP Limits Worked:

			<u>No. of Passes</u>	
MP _____	To MP _____	Track _____	Made _____	
MP _____	To MP _____	Track _____	Made _____	
MP _____	To MP _____	Track _____	Made _____	
MP _____	To MP _____	Track _____	Made _____	
MP _____	To MP _____	Track _____	Made _____	
MP _____	To MP _____	Track _____	Made _____	

E. Hours Contract Machine on Duty: _____
 (Hours/minutes)

F. Contract Machine Delays: _____
 (Hours/minutes)

F. Other Delays: (hours/minutes):
 Weather: _____ Travel: _____ Traffic: _____ Misc: _____

G. Non-Chargeable Travel (hours/minutes): _____

H. Chargeable Time (hours/minutes): _____

I. Production Time (hours/minutes): _____
 (i.e., cleaning time/grinding time)

J. Pass Miles Cleaned/Ground: _____
 Remarks: _____

K. Location Machine tied up: _____

L. Location Machine began days work: _____

 Foreman (or Other Authorized Individual)

SECTION 4 *TURNOUTS, DERAILS, AND RAILROAD CROSSINGS*

4.1 TURNOUTS

4.1.1 TURNOUTS - GENERAL

- A. Turnouts for new construction will follow standard drawings listed below. Standards not previously recognized by SCRRA have also been introduced for new construction and maintenance. These new standards consist of Caltrain Standard and Drawings and are available through the Office of the Director, Engineering and Construction,.

<u>Size</u>	<u>Standard Drawing No.</u>
No. 8 (RBM Frog)	E.S. 5300
No. 10 (Spring Rail Frog)	E.S. 5400
No. 10 (RBM Frog)	E.S. 5500
No. 14 (Spring Rail Frog)	E.S. 5650 (To be developed)
No. 14 (RBM Frog)	E.S. 5600
No. 20 (Spring Rail Frog)	E.S. 5750 (To be developed)
No. 20 (RBM Frog)	E.S. 5700
No. 24 (RBM Frog)	E.S. 5800

- B. The Director, Engineering and Construction, may approve other sizes of turnouts. Repair and maintenance of existing turnouts that were constructed to standards of the previous owner railroads shall be maintained to those standards unless the following situations apply. In these cases, a new turnout complying with SCRRA Engineering Standard Plans shall be installed:
- a. Replacement of all slide plates, points and stock rails.
 - b. Replacement of over 50 percent of switch timber.
 - c. Realignment of turnout.

- C. Spring Rail Frogs:
1. All spring rail frogs, No. 14 or greater, shall be equipped with a hydraulic retarder.
 2. No. 10 turnouts shall have spring rail frogs if the proposed use of the turnout complies with the following criteria:
 - a. Main track speed 20 MPH or greater
 - b. Turnout side used less than twice daily
 - c. Turnout side not used for meeting or passing of through trains
 3. New Number 14, 20, and 24 turnouts shall have spring rail frogs except at locations where traffic is approximately equal in both directions.
 4. Turnouts with Rail Bound Manganese (RBM) frogs shall have replacement spring rail frogs installed when the turnout meets these criteria and the RBM frog is deteriorated to the point it must be replaced.
- D. Turnouts shall be equipped with manganese tip switch points, with the exception of turnouts used less than once per day (e.g., industrial spurs) or as directed by the Manager, Track and Structures Maintenance.

4.1.2 INSPECTION, MAINTENANCE, AND INSTALLATION

- A. Turnout maintenance shall, at all times, conform to 49 CFR 213 parts 133-143, 233, and 235 for minimum inspection and maintenance regulations. Place and maintain all switches and frogs in accordance with Standard Plans. Track and signal personnel must inspect each main track turnout jointly each quarter using form Figure 4-1.
- B. The throw for power-operated switches shall be 4 - 1/2 inches, measured at the point. The throw for hand-operated switches shall be 4 - 3/4 inches, measured at the No. 1 head-rod. Throw dimensions are measured from the gage face of the stock rail to the back of the switch point.
- C. Maintain guard rail flangeways at 1 – 7/8 inches for standard gage.
- D. Space the guarding face of the guard rail 4' - 6-5/8" from the gage face of the frog. If this measurement varies more than 1/8 inch, correct it. If, because of curvature, the gage widens through the turnout, space the guarding face of the guard rail 4' - 6-5/8" from the gage line of frog.

- E. Inspect and make adjustments to switch points, bolts, frogs, switch rods, connection rods, switch locks, switch point locks, guard rail, and derails; check line and surface. Inspect all moveable parts to make sure they work easily and without excessive lost motion. See that all bolts and nuts are tight and that all cotter pins are in place and properly spread. Properly secure connection rods, and fit switch points closely against the stock rail, making sure they are in safe condition and gage. A Signal Maintainer must be present during any adjustment involving switch points.

- F. Use only the highest quality hardwood ties under the heel block, and maintain them so that there is no unusual pumping at this joint or location. In case of bolt failures, check the joint first to determine why bolts are breaking. If unusual stress is causing problems at the joint, correct the problem to ensure the joint and/or rail does not fail. When problems exist, renew the existing rigid heel block assembly with a floating heel block, especially if other measures cannot fix the problem. When it is necessary to replace a rigid heel block assembly with a new assembly, make a test for internal defects within sixty days after changing the assembly to determine whether the new assembly has placed any failure-producing stress on the rail.

- G. Change out switch points when unusual wear and/or chips reach the following limits:

11 foot point	6 to 8 inches
16' -6" point	10 to 12 inches
22 foot and over	14 to 16 inches

- H. Maintain switch points and stock rails so that the point will fit properly to the stock rail when lining the switch for either track. Refer to the Section 3.1.10 entitled "Maintenance of Switch Points" herein for instructions on welding and grinding of switch points. Change out switch points when the distance from the top of the stock rail to the top of the switch point is more than 7/8 inch.

- I. When switch point with manganese tip becomes worn, replace the tip before gage face wear of the point at the heel of the manganese tip exceeds 1/8 inch. After installation of new tip, grind tip to match the contour of the switch point. Replace entire switch point if wear exceeds 1/8 inch or if the Manager, Track and Structures Maintenance, directs perform complete replacement. Generally, replacement of tips only is recommended for slow speed tracks. If the switch point rail is to be replaced, the matching stock rail shall also be replaced to ensure a proper fit. Only under the direction of the Manager of Maintenance of Way may one rail be replaced without changing the other.

- J. Carefully inspect frogs, both rigid and spring rail, for defects. Keep all bolts tight in order to maintain a proper surface.
- K. Secure hold-down hoods on spring rail frogs with a clearance between horn and hood of no more than 1/4 inch.
- L. Change out rigid or spring rail frogs when headwear on wing rail reaches 1/4 inch:
- M. Power tampers shall not be allowed to lift spring rail frog wing rails or base plates. If a base plate or wing rail is bent or damaged during installation or tamping, the frog shall be immediately replaced or removed from service on diverging route.
- N. Maintain each spring rail frog so that the outer edge on the wheel tread cannot touch the gage face of the wing rail. During transport and installation in the track and during installation of panel turnouts, spring rail frogs shall be secured with blocks and clamping bars to prevent horizontal or vertical movement of the wing rail.

4.1.3 QUARTERLY JOINT SWITCH INSPECTION

- A. Track and signal maintenance personnel shall jointly perform a quarterly (90 day) inspection of all power turnouts and derails. They shall test and confirm that switch points close and point detectors function as intended (obstruction test and adjustments). Adjustments for rail movement, point closure, rail support, alignment, surface, and gage shall be made as required. Use the form shown in Figure 4-1, Quarterly Turnout and Derail Inspection Report, in connection with quarterly turnout inspection. Reports of joint switch inspections shall be made and forwarded to the Manager, Track and Structures Maintenance, and the Manager, Signals and Communication.

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4.1.4 UNUSED SWITCHES

- A. When track connected with the main track is out of service for an indefinite period of time and Manager, Track and Structures Maintenance, has received approval for the removal, remove the main track frogs, switch points, and lead rails in center of track.

4.1.5 COMPLETELY WELD IN TURNOUTS

Refer to Section 3, Track Welding and Rail Grinding, for instructions on welding. Standard turnout shall be completely welded except for frog joints on the turnout side of lightly used industrial spurs. Refer to the Manager, Track and Structures Maintenance, for other locations such as yard tracks.

4.1.6 SWITCH SECURITY

Any time a main line switch is temporarily disconnected from a switch-stand or an interlocked switch machine, or when a switch cannot be secured in place by the switch stand (or switch machine), as well as spiking a switch, use an approved switch point clamp to secure the switch. If a switch point clamp is unavailable, place a 10 MPH speed limit and protect the switch until it is properly secured.

4.1.7 SWITCH POINTS AND STOCK RAILS – ORDERING

- A. Refer to SCRRRA Engineering Standards.
- B. When ordering switch points, specify:
 - 1. Weight of rail
 - 2. Left or Right Hand
 - 3. Curved or Straight
 - 4. Nominal Length: Point of Switch to Heel block
 - 5. Actual overall length of point, including extension for field welding.
 - 6. Engineering Standard Number
- C. When ordering stock rails, specify:
 - 1. Weight of Rail
 - 2. Right or Left Hand
 - 3. Length of switch point

4. Length of Stock Rail
5. Engineering Standard Number

4.1.8 SWITCH POINT LOCKS

- A. Except for power operated switches, switch point locks approved by Director, Engineering and Construction, shall be applied on all main line switches.
- B. Safety switch point locks shall be provided for the protection at all main track hand operated switches within 50' of at-grade highway crossings and all other locations designated by the Director of Engineering and Construction.
- C. To operate the switch point lock, after removing switch lock, put foot on lever and push down, then operate switch stand in usual manner. The foot pedal shall remain in down position until switch point is closed. When the switch point is closed, the device should snap up and automatically return to its normal or locked position, as the base plate is made of spring steel.
- D. Switch locks shall not be inserted in switch point lock until switch has been restored to normal position.

4.1.9 SPECIAL CONSIDERATION FOR CURVES

- A. All standard turnouts are designed to have tangent alignment from the tip of the switch point to the ends of the stock rails (the "square joints"). Track surfacing and the passage of trains may result in the curvature of a nearby curve being extended into this tangent area. When this happens, the flanges of trains approaching the turnout in the facing point direction bear against the stock rail and wear it away, and they strike the switch point with this same lateral force, wearing the point, too. Track maintenance personnel must maintain the designed tangent alignment ahead of the points, as detailed in the Engineering Standards. (The minimum distance is about 7 feet for most turnouts).
- B. Turnouts shall not be constructed in curves unless approved by the Director, Engineering and Construction.
- C. Rail lubrication will reduce stock rail and point wear. If there is no automatic curve lubricator near a turnout, track inspectors and other maintenance personnel shall periodically apply lubricating grease with a stick and a pail.
- D. Refer to the Section 3.1.10 entitled "Maintenance of Switch Points" herein for instructions on grinding the point to maintain the original angle of the point. If the stock rail has gage face wear because there is a curve

immediately at the point of switch, it becomes difficult to maintain the 78-degree side angle on the point. When necessary to grind points in turnouts with gage face wear on the stock rail, metal shall be removed as needed to produce the 78 degree side slope of the point, and it must blend into the stock rail.

4.2 DERAIS

4.2.1 WHERE REQUIRED

Derails are required on all tracks where equipment may foul the main line or a controlled siding. The types of derails required are identified in Section 4.2.3 entitled "Detail Types" herein.

4.2.2 LOCATION AND SIGNAGE

- A. Locate derails so that cars derail away from the protected track and away from signal equipment. Where practicable, locate derails at least 30 feet ahead of the point where the track centers are 13' – 6". Where insulated joints are present, located details far enough ahead of the insulated joints so that equipment derails before fouling the track circuit. Place insulated joint at least 8 feet in advance of the derail where the track centers are 13' – 6".
- B. Locate derails on the outside rail of curves whenever possible, and place them on non-defective ties, however the first priority is to place them to deflect away from the main track.
- C. Newly constructed manual derails shall be operated by High Star Switch Stands or other type stand approved by the Director, Engineering and Construction, with derail target per Standard Drawing E.S. 4204; existing derails shall be upgraded to use High Star Switch Stands whenever the underlying track is rehabilitated.
- D. Set Derail Sign, per E.S. 4205, opposite the derail and 8' - 6" from the near rail to the side of the post.
- E. Derail shall be identified in the field by either a derail target on a High Star Switch Stand or derail sign per E.S. 4205.

4.2.3 DERAILED TYPES

- A. Refer to Standard Drawings E.S. 1701 and E.S. 1702
- B. Use an E.S. 1701 single point derail for installation in main tracks or sidings in the following situations:
 - 1.. Locations where grade descends toward the main track

2. Where past experience has shown that a properly installed and maintained sliding block derail was not sufficient protection
 3. At the discretion of the Director, Engineering and Construction, or Manager of Maintenance of Way.
- C. Use a 16' - 6" double point derail per E.S. 1704 at the following locations:
1. Where used to protect against remote controlled locomotives.
 2. Where used to protect against foreign railroad connections.
 3. Where used to protect against descending grades in excess of 1 percent.
- D. At other locations, a "Hayes" siding-block derail type shall be used, except that "flop over" or removable derails may be used to protect mechanical department employees/contractors or where track has not been rehabilitated.

4.2.4 INSPECTION

- A. Switch point derails E.S. 1701 and 1704 shall be inspected and maintained per Section 4.1 entitled "Turnouts" for turnouts.
- B. Follow the Hayes Derail Book, available from the Manager, Track and Structures Maintenance, for inspection, installation, and maintenance of sliding block derails.
- C. Inspect derails while making a switch inspection. If any of the conditions below are substandard, promptly repair, replace, or remove them from service, giving immediate notice to the Supervisor of Commuter Operations and the Manager, Track and Structures Maintenance, or Yard Master. Inspect derails for the following criteria:
1. Proper installation (make sure derail is locked as instructed and that it is not worn to the extent that it moves when it is locked).
 2. Proper size.
 3. Good quality, securely fastened ties.
 4. Derail is not damaged (i.e., exhibiting unusual wear, usage distortion, or fracturing).
 5. The sign is legible and visible.

4.2.5 MAINTENANCE

- A. Derails shall be inspected and maintained per Section 4.1 entitled “Turnouts”.
- B. Derail shall be identified in the field by either a derail target or derail sign as required under Section 4.2.2 entitled “Location and Signage” herein.
- C. Derails, clearance markers, and signs shall be maintained at all times in such condition that they can easily be seen. Distance from top of rail to top of open derail where flange passes over, must be greater than 1-5/8 inches to prevent derail from being thrown under wheels while movement is being made.
- D. Derails not in use shall be stored in a secure place to prevent vandalism.

4.3 RAILROAD CROSSINGS – (DIAMONDS)

4.3.1 ORDERING

- A. Refer to the specific engineering drawing for the design of each crossing showing the angle of the crossing, insulated joint location, curvature of track(s), tie layout, and other information required by current Engineering Standards with all requisitions for railroad crossings.
- B. Due to the long lead times in acquiring new railroad crossing material, consideration should be given to ordering sufficient replacement parts at the same time that the new replacement crossing is ordered.
- C. Crossing installations shall include civil engineering design that provides positive site drainage and engineered subgrade of hot mix asphalt or other impervious, impact resistant material. Communications and Signals (C&S) will need to review and approve all vital protection requirements and prepare or make changes if necessary to the circuit drawings.

4.3.2 SPEED RESTRICTIONS

The maximum speed at which a train or engine may operate over a main track manganese steel insert railroad crossing diamond is 70/50 MPH. The maximum speed for articulated manganese steel, solid manganese steel, and bolted railroad crossings is 30 MPH. Only the Director, Engineering and Construction, may authorize higher operating speeds.

4.3.3 INSPECTION OF NEW DIAMOND CROSSING

- A. Perform a complete inspection of the manganese crossing corners before installation; check for sand pockets, gas pockets, and irregular surfaces.

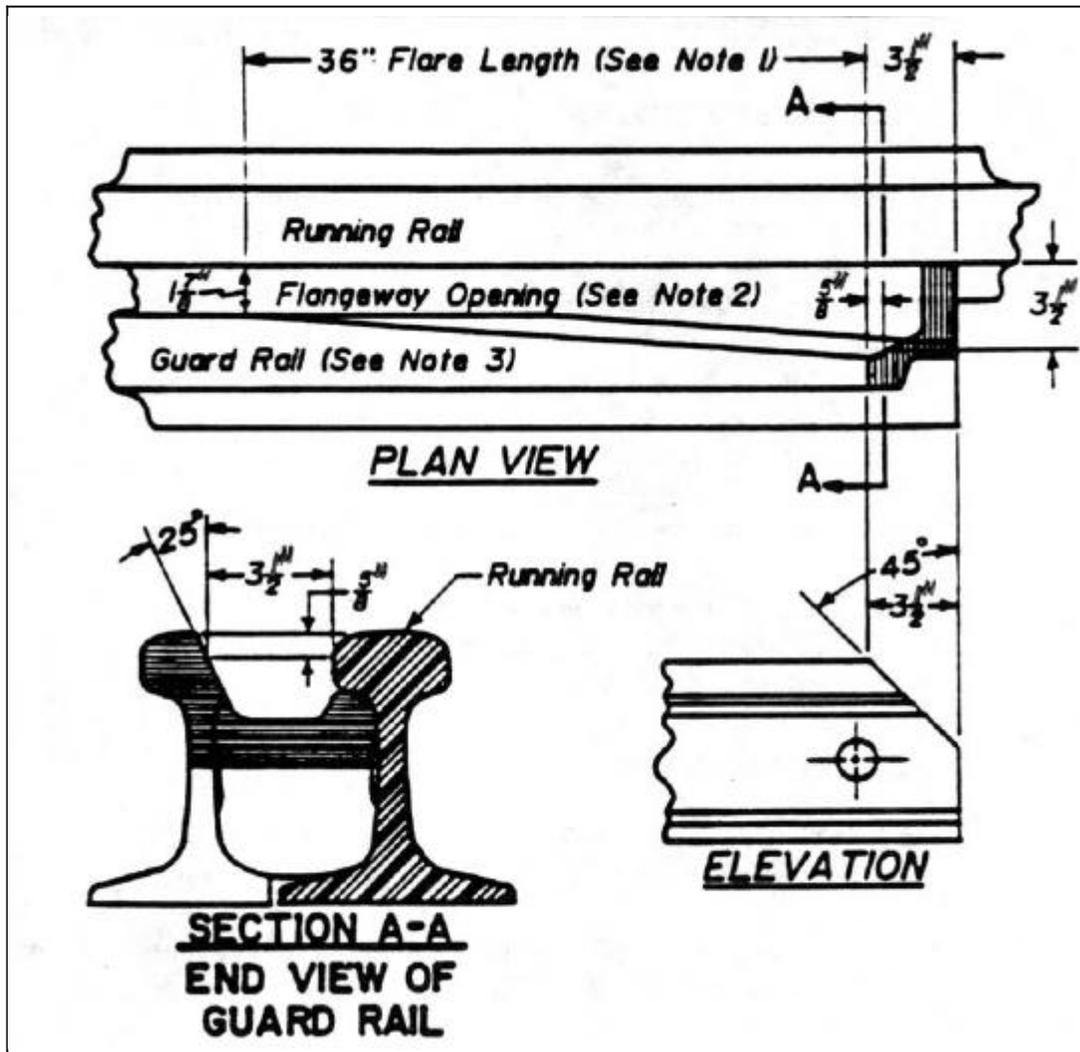
- B. A trial assembly of the crossing is recommended to be made prior to installation in operating track.
- C. Check all bolt holes in new replacement castings, running rails, and guard rails for location and hole size to enable proper installation of crossing bolts. Also, properly chamfer all end drilling holes by peening.

4.3.4 WALKING INSPECTIONS

- A. Track inspector shall make a monthly walking inspection of crossing diamonds. : Report any problems with the condition of any of the following items to the Manager, Track and Structures Maintenance, in writing. Properly identify any defect or condition on the track inspection report. Inspect crossings for the following:
 - 1. Any visual cracks in castings
 - 2. Wear on crossing rails and insert castings
 - 3. Batter on receiving corners and rail ends
 - 4. Wheel flange wear on guard faces of crossing
 - 5. Back of wheel flange marks where they strike close to the end of flares on crossing guard rails (See Figure 4-2 for proper flare specifications.)
 - 6. Flangeway width and depth
 - 7. Excessive metal flow or rollover on castings and rails, which causes tight gage
 - 8. Gage, surface, and alignment (Take measurements when conditions dictate.)
 - 9. Plate spikes, hold-down bolts, ties, and drainage

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FIGURE 4-2 - FLANGEWAY



NOTES REGARDING FIGURE 4-2:

- 1) SCRRR Crossing Standards specify 36 inch long flares.
- 2) The 3-1/2 inch flare opening shall be increased when flangeway is widened for curvature; the angle and length of flare shall remain constant.
- 3) Fabricated replacement guard rails must conform to the flare configuration shown on this drawing and the minimum flare length shall be 18 inches. Shop-made guard rails must be used, except in case of emergency. In some cases the crossing rail may be a combination of running and guard rail.

4.3.5 BOLTS

- A. Install new crossing diamonds with standard heat-treated carbon steel machine bolts. Field forces should inspect, tighten, and replace bolts as necessary. After the crossing has been in service from three to six months, other type fasteners authorized by the Director, Engineering and Construction, may be considered for use such as Huck Bolts. If bolts appear stressed or elongated, they shall be replaced.)

4.3.6 REVERSIBLE INSERTS

Where crossing design permits, reverse manganese insert castings periodically to prolong service life of crossing.

4.3.7 MAINTENANCE/INSTALLATION OF DIAMOND CROSSINGS

- A. Proper maintenance results in long service life for railroad diamond crossings. Good line, surface, and gage are essential; maintain them as follows:
 - 1. Construct and maintain effective drainage which diverts all water away from the roadbed. Also, provide adequate sub-drainage by using clean, good quality ballast, engineering filter fabric, and drainpipes.
 - 2. Use sound good quality cross ties, installed according to the Standard Plans or Contract Drawings for that crossing to provide full and adequate bearing support of the crossing structure. This also includes cross ties on crossing approaches for both tracks. Tamp cross ties to proper grade and provide good cross level.
 - 3. Lay the ties out according to the crossing design to provide good support (18 inches minimum and 22 inches maximum on center for 9 inch wide ties, unless other indicated on the Contract Drawings or approved by the Director, Construction and Engineering.)
 - 4. Check for broken crossing plates and for worn elongated fastener holes or elongated round holes used for fasteners.
- B. Make sure the plate stops on crossing plates bear against the rail base of the casting.
- C. Place rail anchors in boxed pattern for 120 ties or 200 feet on crossing approaches both tracks (home road and foreign road tracks). Maintain the anchors so they bear against the edge of either the tie or the tie plate.
- D. Remove the bead, rollover, or metal flow from tread surface into flangeway by grinding as it develops, particularly on the new manganese

steel crossings. Also, remove bead or metal flow on gage corners of the crossing running rails. Remove metal flow at joints by slotting.

- E. To prevent abnormal wear at insulated joints on diamond crossings, the flangeway openings shall not be less than 3/16" from the flangeway specified for that particular crossing. Also, good gage shall be maintained in area of insulated joints.
- F. Replace all broken crossing plates with new crossing plates. Also, check plates for worn elongated fastener holes or elongated round holes used for fasteners. If worn holes allow the plate to move, replace plate.

4.3.8 DIAMOND CROSSINGS MAINTAINED BY OTHER RAILROADS

Take proper action to ensure train safety when defects occur in railroad crossings maintained by other railroads. Immediately report an observed defect to the railroad involved and to the Manager, Track and Structures Maintenance. Place a speed restriction, if necessary, to protect train movement on both routes.

SECTION 5 SIGNAL FACILITIES AND INSULATED JOINTS

5.1 PRECAUTIONS IN SIGNALLED TRACK

- A. Do not allow dirt or ballast to remain in contact with rails. Inside guard rails shall be installed with insulated joints to prevent shunting. Keep metal plates between rails at least 1 inch away from the ends of tie plates. Unless approved for use and only under the direction of the Manager, Track and Structures Maintenance, and the Manager of Communications and Signal, do not place rail anchors on ties supporting insulated joints or adjacent to the joint.
- B. Where pandrol clip fasteners are used in insulated joint area, the correct pandrol e-clip must be applied at the toe-less insulated joint. Only toe-less insulated joints may be used with pandrol plate type fasteners.
- C. Keep flangeways at concrete crossing panels clear of metallic debris.

5.2 SHUNTING

Do not allow lining bars or any other metal to touch both rails at the same time because this will set signals against trains. Use only insulated track levels and gages. Also protect from shunting when using a metal tape measure.

5.3 NOTIFY SIGNAL MAINTAINER OF TRACK CHANGES

Notify the Signal Maintainer in advance when changing rail or raising the roadbed point where wires run from the track to signal equipment, when lining track at switches; when adjusting or removing switch points, or when doing any other work which might affect the operation of signals or of the interlocking.

5.4 DISTURBING SIGNAL EQUIPMENT

Do not disturb bond wires or other signal equipment. When a signal, signal box, case, or house incurs an impact from any source, notify the dispatcher immediately. Signal personnel must inspect the equipment as soon as possible.

5.5 INSTALLATION, MAINTENANCE OR REMOVAL OF SWITCH

When installing a switch or when undercutting, surfacing, or otherwise disturbing an existing switch, notify, in advance, the Manager, Track and Structures Maintenance, the Supervisor-Signals, and the Signal Maintainer.

5.6 CARE OF INTERLOCKINGS DURING STORMS

During snow, sleet, and sand storms, track repair crew leader (foreman) shall keep the connections, derails, and switches free from snow, ice, and sand to the extent

possible. Track repair crew leader (foreman) shall simultaneously assist signalmen in keeping interlockings in operation.

5.7 FLAGMEN AT ROAD CROSSINGS

When gates and/or flashers on highway crossings are inoperable, the track repair crew leader (foreman) (or other employee in charge) shall do the following:

- A. Place a flagman at each crossing until relieved by Signal Forces.
- B. Promptly notify the Signal Forces and the dispatcher in accordance with the MofW OPR Rules, 6.32.2.

5.8 INSTALLATION AND MAINTENANCE OF INSULATED JOINTS

5.8.1 GENERAL

- A. The Signal Maintainer will notify the track repair crew leader (foreman) or track supervisor when it is necessary to renew or replace joints. Spike carefully in order to prevent damage to insulated joints. When spiking bonded (glued) insulated joints, drive the spike with the heel next to joint bar or use approved fasteners.
- B. It is preferred that only new factory glued IJ's be installed in main line track.

5.8.2 TESTING

All insulated joints shall be resistance tested bi-annually. Report of test shall be provided to the Manager of Signal and Communications.

5.8.3 PREPARATION FOR INSTALLATION

- A. Before applying insulated joints, remove all scale, dirt and any other matter from the rail ends and joint parts. Obtain a good durable fit with clean, smooth bearing surfaces.
- B. Remove all burrs, lips and rough edges from rail's ends and bolt holes before applying an insulated joint. (taper/grind rail ends)
- C. Square End Rail
 - 1. Use only sawed rail ends at insulated joint locations. Accurately drill holes.
 - 2. Heat-treat the rail ends of new rail when installing a bolted insulated joint at a location in main track and in CTC sidings.

5.8.4 INSTALLATION

- A. Rail Gap: When necessary, use rail expanders to adjust rail gap.
- B. Rail Openings: Do not apply an insulated joint where the opening between rails is too great. (greater than 5/8 inch)
- C. Do not drive bolts through an insulating bushing. Position rails and joint parts, line bolt holes, and insert bolts by hand.
- D. If the end post projects beyond the top or side of railhead, trim it off before a train runs over it.
- E. Use a 3-M Fiberglass Insulated Joints only on 90# or lesser weight rail.
- F. Tie plates must not be located within 6 inches of the rail gap of an insulated joint.
- G. Use manufacturer's recommended elastic fasteners for insulated joints installed on concrete ties or on wood ties with elastic fasteners.
- H. Insulated joints installed or replaced shall be epoxy bonded six-hole joints per E.S. 1204.

5.8.5 WELDING AND INSTALLING RAIL

Refer to Section 3, Track Welding and Rail Grinding, for complete instruction on welding. Obtain Signal Maintainer support for track forces whenever track forces remove, replace, arc weld, or field weld rails or turnout components.

5.8.6 RETIRED INSULATED JOINTS

- A. Insulated joints rendered redundant by new track or signal configuration shall be removed from the main track and controlled sidings as soon as practicable by field welding replacement rail "plugs" at least 19'-6" long. Retired epoxy bonded insulated joints shall be tested and, if deemed acceptable, returned to inventory. Fit rail and insulated joints (IJ) shall be marked per Section 2.1.17 entitled "Rail Testing and Identification".
- B. Used epoxy bonded insulated joints in good condition may be used at the discretion of the Manger, Track and Structures Maintenance, provided that rail wear matches adjoining rail profiles within 1/8" and field welding and grinding produces a uniform rail head profile.

SECTION 6 CURVE RAIL REPLACEMENT

6.1 ANNUAL CURVE INSPECTION

- A. The Manager, Track and Structures Maintenance, shall make an inspection of all main track curves annually. The Manager shall examine optical rail scan reports in format(s) that will illustrate percent of rail head wear and size of rail over the entire length of each line segment in order to select the rail most in need of replacement. Unless an optical scan of rail profiles has been conducted within the previous five months, the inspection shall include rail wear measurements made by using gages. The Manager, Track and Structures Maintenance, shall submit a report to the Assistant Director of Engineering as directed on the prescribed form. (See Figure 6-1, Manager's Annual Curve Inspection.) This report will be used to prepare recommendations for the annual curve renewal and transposing program.

- B. Refer to Section 3.2.1 entitled "Rail Grinding Program" for related requirements.

6.2 TRANSPOSING RAIL

The Manager, Track and Structures Maintenance, with the approval of the Assistant Director Engineering may authorize transposing of rail, otherwise no rail shall be transposed. The following are some guidelines to aid in the preparation of an annual curve rail program and help with the decision to transpose.

6.2.1 WEAR

Refer to the Section 2.1.11 entitled "Changing Out Rails – Reporting and Marking" for wear limits for rail.

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6.3 CONDEMNING LIMITS

- A. When the wear on gage face of a high rail has reached 5/8 inch, it should be removed from the track. If this is not possible, the track shall be gaged, but track should not be gaged beyond the correct base gage. The annual curve program should be managed so as to remove rail from the track prior to it reaching these limits. Low rail should be removed from the track when the rollover reached 1/2 inch or greater. A review of geometry car or rail profile scan records can be of considerable value since excessive curve wear will be highlighted by gage irregularities in curves.
- B. When the gage face angle on curves exceeds 18 degrees the Manager, Track and Structures Maintenance, shall be advised immediately.

6.3.1 FATIGUE

- A. In addition to the above curve wear guidelines, curves that show evidence of excessive fatigue should be considered for the annual curve program.
- B. Fatigue is evidence by shells, which have relieved themselves, and, in most cases, is evident by a high failure rate. Detector car operators should be canvassed regarding which curves they feel have shells, or other surface defects, to the extent such defects prevent accurate testing.

6.3.2 RAIL SURFACE CONDITIONS

Rail surface conditions, consisting of large corrugations, may cause a curve to be considered for the rail program. Corrugation up to 0.060 inch can be removed by using a profile rail grinder.

6.4 ELEVATION

See Section 9, Track Geometry, including Section 9.3.2 entitled “Surfacing – Superelevation Standards” and Section 9.3.2.1 “Elevation on Auxiliary Tracks”.

6.5 CURVE RAIL INSPECTION

Particular attention shall be given during visual inspection of low rail on curves where very poor rail surface conditions exist. The potential of vertical split heads developing in such rails has increased, and being alert for visible appearances listed below will further ensure removal of these suspected defective rails:

- A. Dark streak on running surface of rail.
- B. Excessive bleeding or actual rust streak in upper fillet areas of rail on either gage or field side.

- C. A depressed head and/or widening of the head should not be misinterpreted by flowed metal on the head.
- D. In continuous welded rail, if any of the appearances in A, B, and C. occur, and the letter "A" is stamped in the heat number, this rail shall be removed and replaced immediately.
- E. Note, a mirror is useful to check for defects in the head-web fillet area.

6.6 RE-LAYING RAIL ON CURVES

When re-laying rail with heavier rail section on curves, the heavy rail must extend to end of curves and through the spirals, unless otherwise approved by the Manager, Track and Structures Maintenance. Field compromise welds may be used.

6.6.1 PREMIUM RAIL

Premium rail is high strength rail (alloy or head hardened). Premium rail must be used in the mainline tracks on curves of 3° and over and through turnouts. It can also be used in areas of extremely high tonnage when approved by the Manager, Track and Structures Maintenance.

6.6.2 WALKING INSPECTIONS

In addition to regular inspections, track supervisors shall make a walking inspection of all main line curves twice yearly, checking elevation, gage rail, and tie conditions. Inspect elastic rail fastening system for signs of wear. Loose fasteners are symptom of failed tie pads, crushed insulators, or plate shifting or sliding. The inspector shall also look closely for uneven plate cutting from one end of the tie plate to the other. When this condition exists, the rail will rotate which causes wide gage under traffic and increases the possibility of rail turnover by lateral forces. Inspection shall confirm that spiking patterns per E.S. 1404 are in place and that spikes are secure. A curve inspection report, on the prescribed form, shall be submitted to the Manager, Track and Structures Maintenance. Refer to Figure 6-1 for form.

6.7 RAIL/FLANGE LUBRICATORS

6.7.1 PLACEMENT

The location of rail lubricators is the responsibility of the Manager, Track and Structures Maintenance. Generally, lubricators, when required, shall be placed on tangent track between curves; at beginning points of spirals of curves 3° and over; and at any location where visible signs of rail wear have occurred. Lubricators shall be installed to provide grease to both high and low rails of curve. The length of effective lubrication (grease carry) will depend on actual train operations and an accumulation of variables; adjustments in lubricator location may be required.

Proper lubrication can be checked by wiping the gage side of the rail with a paper towel to see if grease is present. Regardless of method used to locate lubricators, such as the central angle or curve unit method, many variables exist that can ultimately affect lubrication.

6.7.2 LUBRICANT

Only use curve lubricant approved by the Manager, Track and Structures Maintenance.

6.7.3 INSPECTION AND MAINTENANCE

- A. All rail flange lubricators shall be inspected by a designated inspector and maintained on a basis. Track Inspectors shall observe lubricators during each inspection to ensure they are working properly. If a lubricator is noted as not working then immediate repairs shall be made. Lubricators must be adjusted so that excessive lubrication is not placed on the rail surface and so that the gage face of the rail is maintained in a lubricated state.
- B. A regular rail lubricator inspection and maintenance schedule shall be established. Scheduling should be based on local train operations, other maintenance considerations and manufacturer's recommendation. Inspection program shall be established by the rail maintenance and approved by the track and structures maintenance contractor. Lubricators shall be inspected monthly, recorded on the prescribed form, and submitted to the Manager, Track and Structures Maintenance. This program of inspection, refilling, and repair of lubricators is necessary to achieve the nominal service life from the rail and special trackwork.

6.7.4 DISPOSAL

Empty grease containers shall be disposed of properly at approved facilities. Full or partially full containers shall not be stored on the right of way. Excess, dirty, or waste grease shall be collected and removed from the right of way.

6.7.5 CONTAINMENT OF EXCESS GREASE

Provide a geotextile fabric covering over ties for a distance of 20 feet each side of curve lubricators, on inside and outside of rails. Secure covering with nail in wood ties, secure with adhesive on concrete ties. Replace geotextile periodically and disposing of the soiled covering in accordance with hazardous material regulations.

SECTION 7 CROSS TIES AND SWITCH TIES

7.1 ORDERING

Cross ties and switch ties shall be as directed by the Manager, Track and Structures Maintenance.

7.2 DISTRIBUTION

When unloading and distributing ties, do not leave any close to switches, close to sidings, or close enough to the track to endanger passing trains. Do not throw ties down high embankments; do not drop them on rail or other objects that may chip or fracture the concrete or splinter or damage the wood fiber; and do not leave them where they will obstruct drainage. To avoid excess handling of ties during the insertion process, conform as closely as possible to the tie inspector's marks while unloading. When 12 or more ties are stored within 200 feet of any residential property, they shall be covered with a well-secured impervious tarp or sheet plastic. Observe and comply with signs restricting placement of cross ties.

7.3 FIRE PRECAUTIONS

Remove vegetation from tie storage area prior to storage and keep vegetation clear from the vicinity of tie storage area.

7.4 OPERATION OF TIE GANGS

Production tie gangs normally function under contract compliance through a Job Order Contract (JOC) and fall under the direction of the Manager Track Rehabilitation. Guidelines and procedures are subject to all SCRRA Track Safety and Compliance criteria and all tie gang participants must be qualified prior to working on the SCRRA system.

7.4.1 PROJECT MANAGER⁸

The Project Manager is responsible for the safe and efficient operation of the tie gang. To accomplish this, the following areas must be addressed:

- A. The track designated for tie work shall be inspected to ensure proper equipment, manpower, and material are available for the work.
- B. Identify any existing track conditions which should be corrected such as wide gage location, additional rail anchors due to existing substandard

⁸ The Manager, Track and Structures Maintenance, may function as the Project Manager or may delegate these functions to another authorized person. In either case a definite understanding of who will function as Project Manager shall be provided by the Manager, Track and Structures Maintenance.

anchor pattern, additional ballast due to insufficient or poor shoulder ballast, poor drainage conditions, or a high number of road crossings in section to be tied.

- C. The Project Manager shall coordinate track availability with the chief dispatcher designee in order to optimize tie installation production.
- D. Ties to be replaced shall be marked prior to replacement tie distribution.
- E. The distribution of ties, spikes, and anchors shall be made, to the extent possible, according to need to reduce material handling and provide for an efficient operation of the tie gang.
- F. Equipment requirements, in addition to the normal tie gang consist, shall be identified and requested according to schedule needs.
- G. Procedures for clean up and notification of the SCRRA External Affairs office shall be identified and arranged for.
- H. The track chart shall be reviewed and updated to ensure that:
 - 1. Slow order procedures, limits, and locations are identified and established for proper implementation during the course of work.
 - 2. Rail weight, curve, and super elevation information is correct.
 - 3. Rigid track locations such as bridge ends, turnouts, railroad crossing, or grade sags are identified.
 - 4. After completion of the work, the Project Manager shall ensure that any changes required to the track charts are made and that they accurately reflect the conditions in the field.
- I. Prior to the start of tie gang work, the Project Manager shall review the above information (listed under Paragraph H.) with the tie gang foreman and key personnel to ensure their understanding and compliance.
- J. The Project Manager shall monitor the progress of the work to ensure that the operation is safe, is efficient, meets quality standards, and is properly protected by slow order. The Project Manager shall also monitor progress to determine whether slow orders are causing excessive train delays.
- K. The Project Manager shall ensure that all required reports are completed and submitted and that material inventory is properly updated.

7.4.2 GANG LEADER (“FOREMAN’S”) RESPONSIBILITY⁹

- A. The Foreman is responsible for the overall operation of the gang. The Foreman shall constantly be sure that the gang is performing all work in a safe, efficient manner and according to standard practice.
- B. .The Foreman shall have a radio, rail thermometer, tape measure, note pad, pen, gage, and track level available at all times while on the right of way.
- C. The Foreman shall check gage, spiking patterns, and general quality and production. The Foreman shall check ahead of the gang so that there will be a uniform flow of work, advising the Project Manager of any shortages of material for appropriate corrective action.
- D. Before the track that has been worked on is released for train operation, it will be inspected by the designated qualified supervisor in charge to ensure that the track meets class and that it is safe for the intended operating speed. Designated qualified supervisor will be responsible for placing appropriate slow orders as required.
- E. The Foreman is responsible for detailed coordination with Signal Department support personnel and must confirm that track wires and other signal devices are marked prior to work and then direct work activities to protect those signal devices. Notify the Signal Department at least two days prior to working through hotbox detector site.

7.4.3 GENERAL TIE GANG OPERATION

- A. Ties being removed from track should be piled as much as practicable for ease of disposal. Do not pile scrap ties in the ditch flow lines or under communication or signal lines.
- B. Tie bed scarifiers shall be adjusted to scarify only deep enough to allow insertion without skinning of the new tie and the application of rail anchors.
- C. Tie plates shall be properly placed, centered on the ties, with a flat level fit on the surface of tie; plates shall be placed with the cant inward.
- D. Tie plate shall be fastened using one side as the line rail side, then gaged off the line rail.

⁹ The Tie Gang Leader may be the employee of a construction contractor, maintenance contractor, the SCRRA, or a consultant or contractor. Whoever is directly in charge of installing ties shall be governed by these instructions.

- E. New ties being stored on the right of way shall be covered. Refer to Section 7.2 entitled "Distribution" for additional requirements for storage of ties.
- F. It is the responsibility of all employees/contractors to keep the work place clean and safe.

7.4.4 TIE REPLACEMENT IN CWR TRACK

- A. To the extent practicable, tie renewals shall be made in CWR without raising the track or distributing the line or surface.
- B. No more than ten ties in a 39 foot section of track and no more than three ties in a row at any one location shall be renewed during a single pass of the tie renewal operation.
- C. New ties shall be spiked, tamped, and anchored, and the ballast section, and line shall be restored before the passage of trains at speeds above 30/20 MPH. Shifting of track line and out of cross level conditions shall be avoided to the extent possible and shall be corrected immediately. Refer to Appendix C – Summary of Speed Restrictions for Trackwork.
- D. Report tie gang activity on Figure 2-3, CWR Stress Adjustment/ Disturbance Report - Form.

7.4.5 RESTORING TRACK FOR TRAIN OPERATION AFTER TIE GANG WORK

- A. Note: Continuous tie work is any section of the track where the ties have been installed or out of face work surfacing as been performed for a length of 200 feet or more.
- B. Maximum speeds for continuous tie installation until track is surfaced:
 - 1. After inspection of the work by the designated qualified inspector and in compliance with CFR49, part 213.7 the first train may operate at a speed of 15/10 MPH. Foreman designated qualified inspector may authorize a lower speed for passenger trains if conditions warrant, per authority under 49 CFR 213.7.
- C. Maximum speed for continuous tie installation upon completion of surfacing:
 - 1. If ballast section is restored, track is surfaced, and the fasteners and anchors are installed, the first train may be operated at 15/10 MPH (freight or passenger). Upon inspection, the speed may be raised to 30/20 MPH for 12 trains or 24 hours. Before removing the

restriction and restoring speeds to the maximum authorized speed for the class of track, the track shall be inspected again.

2. If the surfacing for continuous tie installation has been completed with a Dynamic Track Stabilizer and all of the trackwork is complete (all anchors or elastic clips installed, ties fully spiked, and ballast cribs and shoulders full to E.S 1801 dimensions), the first train may be operated at 30/20 MPH then at the maximum authorized speed. However, the qualified supervisor in charge may limit speed per his responsibilities under 49CFR213.7.
- D. Foreman and Managers shall control the surfacing and corrective work such that slow orders are within the limits specified in the contract documents. If delays to the train service have the potential or exceed the maximum delay, no new tie renewal work or other work requiring restrictions may be performed until the previous work is completed (surfaced, spiked, etc.) and temporary speed restrictions are removed or shortened to within acceptable limits.

7.5 HANDLING TREATED TIES

Smashing, splintering, or puncturing ties makes them significantly less durable. Do not puncture treated ties with picks or shovels, and do not drive ties into place with mauls or similar tools. Use only tie spacers, tongs, and other properly designed equipment when spacing or inserting ties.

7.6 SWITCH TIES

- A. In general, the rules covering cross ties apply equally to switch ties.
- B. Switch ties should not be bored or adzed. Field drilling ties is recommended when necessary.

7.7 MARKERS ON TIES

When removing a tie with bridge number or super-elevation mark or the curve number tag, attach the proper tag to the new tie installed at that location.

7.8 TIE PLATES

All ties shall be plated when inserted. In applying tie plates, care must be taken to see that they are centered on the tie, are properly canted, and have a firm and true bearing. Shoulders should fit snugly against the base of rail, and when possible, holes in plates shall match the bored holes in ties before they are spiked.

7.9 TIE PLUGGING MATERIAL

When it is necessary to pull spikes, fill the holes with either a treated timber tie plug or another SCRRRA approved material.

7.10 TOP OF TIE

Ties are to be installed with the “Kerf” mark (a shallow crosswise sawn notch) on the top of the tie. If there is no Kerf mark, install ties with the heartwood down.

7.11 END OF TIE ALIGNMENT

Ties shall be installed with one end true to the line side; the opposite end of the tie may vary due to production tolerances in the sawn length of the ties. The line side is:

- A. Outside edge for double track.
- B. Outside edge for curves.
- C. Right side in direction of increasing mileposts for tangent, single track.
- D. Straight side of turnouts (note that 10'-0" ties are centered, which may disrupt this line in turnouts).

7.12 SCREW SPIKES

All new ties shall be pre-bored 9/16 inch diameter by 5 1/2 inch deep. Screw spikes shall be installed with power wrench to full bearing against the plate. Elastic fastener plates may be temporarily secured with cut spikes. Cut spikes so installed, at the discretion of the Project Manager, will not be counted toward the four screw spikes required per plate; cut spikes, once installed shall not be removed.

7.13 INSTALLATION AND MAINTENANCE OF CONCRETE TIES

7.13.1 GENERAL INSTALLATION AND MAINTENANCE

- A. Only prestressed concrete ties, fasteners, pads, and insulators of the types approved by the Director of Engineering and Construction shall be installed.
- B. Do not operate rubber tire equipment on concrete tie track, unless the rail fastening system has been protected. Ensure that the rail fasteners are monitored and inspected because not all systems are designed to support the weight of such equipment suspended from the rail. Obtain approval of the Manager of Maintenance of Way of all temporary work crossings and rubber tired equipment staging plans prior to their implementation.

- C. Ballast regulator plows shall be shaped to prevent damage to the elastic rail fasteners.
- D. Operators of ballast regulators and other track machines shall observe the elastic fasteners for signs of unintended contact or damage to the track.
- E. New concrete tie sections (longer than 200 feet) shall be installed in a whole ballast replacement work process in order to establish a free-draining ballast section.
- F. Whenever rail on concrete ties is transposed or changed, new rail pads and insulation shall be installed.
- G. When new concrete ties are installed replacing wood ties, new concrete tie installation shall meet the following criteria:
 - 1. Installation locations approved by the Director of Engineering and Construction.
 - 2. On 24 inch centers.
 - 3. On a standard ballast section (see drawing E.S. 1801) with a minimum depth of 12 inches below the bottom of the tie.
- H. Concrete ties may be installed over ballasted deck bridges and through tunnels at locations approved by the Manager of Maintenance of Way.
- I. Concrete ties shall be installed at right angles to the rail.
- J. When rail heaters are used during rail laying or distressing, exercise care to keep the heater moving so as not to damage the pads and insulators.
- K. Whenever work is done requiring movement of the rail over the tie pads, such as distressing or transposing, risers shall be used between rail and tie pad to prevent pads from becoming displaced.
- L. Where clips are installed by hand, exercise care to prevent striking the cast-in-place shoulder or tie with the striking tool.
- M. Where clips are installed by machine, the operator shall ensure that the machine is adjusted to install the clip into the hole without binding.
- N. All field welds must be made centered between ties and in accordance with the instructions governing in-track thermite welding. Refer to Section 3.1.13 entitled "Thermite Welding Process" herein.
- O. The newly installed rail in concrete tie territory should be ground as soon as possible (during the next scheduled rail grinding program) after laying

to correct any surface irregularities in the railhead. If irregularities are excessive, corrective measures other than grinding may be necessary.

- P. Engine burns up to 1/8 inch in depth shall be inspected by a qualified person. Protection by slow order may be required until engine burns are repaired by welding. Weld repairs shall be scheduled as soon as possible. Engine burns 1/8 inch deep or more in depth shall be protected by 30/20 MPH slow order and removed from track as soon as possible.
- Q. If for some reason temporary joint bars are installed, they shall be replaced as soon as possible with field welds.
- R. When transposing or changing out rail, tie pads must be kept free of ballast.
- S. When mechanically surfacing the track, the tamping heads shall be adjusted for the increased width and depth of the concrete tie. Exercise care to prevent striking the tie or clips with the tamping tool.
- T. Special rail fasteners are required to clip rail joints and insulated joints. Tie gang shall install appropriate fasteners to joints when replacing wood ties with concrete ties. Use of improper fasteners may cause insulated joint failure or may create a “defective tie” per 49CFR213.
- U. Concrete and wood ties shall not be mixed. The track structure must either be 100 percent wood or 100 percent concrete ties. Exception: Special wood ties may be installed to support signal facilities (ATS Inductor, Safety Detector, Etc.) or may be installed in case of emergency. Steel ties may be used (mixed with concrete or wood) in turnouts and switches under the direction of the Directory, Engineering and Construction.

7.13.2 CONCRETE TIE INSPECTION

- A. Any abnormal behavior of the ties or fastenings shall be reported to the Director of Engineering and Construction.
- B. Inspectors shall report any locations of mud pumping or water standing in concrete tie track because these conditions lead to abrasion damage to the bottom of concrete ties.
- C. A concrete tie with a missing clip or missing insulator shall be considered a “defective” tie when considering ties required under FRA regulations Part 213.109. Inspectors shall give particular consideration of fasteners to determine tie requirements at joints and insulated joints.
- D. Defective ties must be replaced as soon as possible.

- E. The following defects shall be cause for removal:
1. Tie broken transversely under one or both rail seats.
 2. Tie broken transversely between the rail seats which also shows signs of further deterioration (loss of tension in prestressing wires, exposure of wires, crumbling, etc.).
 3. Tie broken longitudinally resulting in loss of ability to hold cast shoulder(s) in place.
 4. One or more shoulders are loose.
 5. Tie damaged by derailment or dragging equipment, which in the opinion of the Manager, Track and Structures Maintenance, should be replaced. Note that quite serious damage can be done to the tie ends without seriously affecting the performance of the tie.
- Note: Cracked ties should not be confused with broken ties. A tie is not broken until the crack extends through the entire depth of the tie.
- F. Ties must not be allowed to become center bound (transverse cracks in the middle third of the tie indicate a bound condition).
- G. Skewed ties must be straightened as soon as possible.
- H. Ties at bonded insulated joints must be kept tamped, and the track shall be kept in good surface and cross level.
- I. Rail slotting at bonded insulated joints shall be carried out as necessary.
- J. Particular attention shall be paid to the surface and cross-level at the transition zones between wood and concrete ties.

7.13.3 CONCRETE TIE CLIPS

- A. Conventional and insulated rail joints require special fasteners. The use of conventional fasteners with insulated joints may cause short circuits and signal failures. Persons in charge of work on track shall manage their material supplies to include the clips and insulators required to fasten concrete ties at rail joints.
- B. New and replacement elastic rail fasteners shall be galvanized or otherwise treated to prevent corrosion.
- C. Broken or missing clips shall be replaced as soon as possible.
- D. Defective or missing pads and insulators shall be replaced as soon as possible.

- E. Pads and insulators that have worked out of position shall be repositioned as soon as possible.
- F. Worn pads may cause loose clips; if this condition is detected, pads shall be replaced.

7.13.4 TRANSITION PATTERNS

Areas where concrete ties abut timber track shall have tie transition patterns as follows:

- A. Open track from concrete ties to timber ties shall transition through the use of 24 - 10'-0" wood ties with resilient fasteners spaced on 19.5 inch centers.
- B. At timber turnouts, no transition ties are required. Concrete ties may be used in track to both ends of the timber turnout panel.

7.14 INSTALLATION AND MAINTENANCE OF STEEL TIES

Steel ties may be installed when approved by the Director of Engineering and Construction.

7.15 REPORTING AND ACCOUNTING

Ties will be reported and accounted for when inserted in track. When cross ties are received, they will be placed in inventory until inserted and charged out. This inventory should be kept to a minimum and care taken to accurately account for all ties being held.

7.16 TIE MARKING

Tie to be changed out shall be marked with a paint dot. The marks shall be confirmed by the supervisor of the Tie Replacement Crew to ensure that they are visible and tie markers understood prior to beginning the replacement operation.

SECTION 8 PREVENTION OF TRACK BUCKLING

8.1 THERMAL STRESSES IN TRACK

- A. Prevention of lateral movement of track, buckling of track, or pull-aparts require that these instructions be complied with year round. It must be remembered that problems caused by thermal expansion or contraction can apply to rail of any weight or length. CWR is more susceptible to the forces created due to heat or lack of heat since there are fewer or no joints to allow for linear expansion/contraction. Thermal expansion of rail must be given full consideration by employees/contractors at all times, especially when the track structure is disturbed by transposing or re-laying rail, surfacing track, spacing or renewing ties, lining and surfacing curves, or replacing defective rails. When engaged in track work, care shall be taken to leave the rail in a neutral state at the local rail neutral temperature. 49CFR 213.119 (Federal Track Safety Standards) requires that each railroad to establish engineering standards and maintenance policies that control CWR thermal forces. SCRRRA Engineering Standards and this document comply with that Part of 213.119.

- B. All maintenance-of-way employees/contractors and others whose duties may involve track maintenance or inspection shall attend annual classes and demonstrate that they know and understand these instructions. Others whose duties require inspection of track and/or supervision of repairs to, or rehabilitation of, track must know the requirements established by the Engineering Standards pertaining to proper ballast sections and to proper application of rail anchors.

8.2 TRACK BUCKLING PREVENTION – TRACK INSPECTION REQUIREMENTS

8.2.1 INSPECTION REQUIREMENTS

- A. The required inspection as indicated below should be conducted between 11 AM and 7 PM. Inspectors shall have rail thermometers or pyrometers available for use and shall check rail temperatures at 10 mile or 30 minute intervals during hot weather inspections.

- B. Inspect CWR daily under the following conditions:
 - 1. When ambient temperature is, or is forecast to be, over 100 degrees F.
 - 2. When rail temperature is above 130°F.
 - 3. When ambient temperature is, or is forecast to be, over 90 degrees F for the first time in 60 or more days. (This is to cover the first hot days of summer.)

4. When rail temperature is above 125 degrees F for the first time in 60 days.

8.2.2 INSPECTIONS – INDICATIONS OF THERMAL EXPANSION

Inspectors performing routine or special hot weather inspections should be alert to:

- A. An unusual “wavy” appearance in track.
- B. Shifting of rail in plates or plate movement on ties.
- C. Any tie movement laterally, “charging”, or slewing.
- D. Rail lifting in plates.
- E. Areas, which have been recently retied, re-layed, re-ballasted, surfaced or lined, or any combinations of these functions.
- F. Areas with less than standard ballast sections or areas where ballast sections have been damaged by off-track equipment.
- G. Areas, which do not have current standard anchor pattern.
- H. Areas with weak ties or areas where track spikes are loose or raised.
- I. Location where rail would normally compress such as at or near the bottom of a grade or where a section is relatively restrained such as switches or grade crossings.
- J. Rail movement in and around switches, which could cause switch rods to bind or cause switch to be out of adjustment.
- K. During hot weather inspections, inspectors shall prepare and submit a report of temperature readings taken.

8.2.3 PLACEMENT OF HEAT RESTRICTIONS

- A. The track structure can absorb considerable stress due to thermal expansion if it is properly maintained. In order to reduce the stresses added by the passage of trains, the speed of trains shall to be reduced when CWR is in a high state of thermal expansion. This reduces the centrifugal force of trains in curves and the dynamic impact at turnouts, joints, and minor irregularities in the track.
- B. Speed restrictions for trains shall be issued as “Level One Heat Restriction” or “Level Two Heat Restriction”, as described under Rule 6.21.3 of the General Code Additions and Revisions. These restrictions shall be communicated by the track inspector to the SCRRRA dispatcher,

who will issue them to all trains to operate over a subdivision. These restrictions will expire at 10:00 PM of the day issued. Heat restrictions may be placed for all or for a portion of any subdivision. Inspectors or managers placing heat restrictions should monitor actual conditions wherever heat restriction are in effect and must inspect track during the restrictions. Restrictions should be removed if rain, wind, or cloud cover result in lowering of the rail temperature.

C. “Level One” restriction is required when:

1. When ambient temperature is to be over 100 degrees F for the first time in 60 or more days.
2. When rail temperature is above 140 degrees F.
3. When ambient temperature is to be over 110 degrees F.

Note: Level One restrictions will not be required on days of 100 to 105 degree air temperature if track has withstood five days of rail temperature of 140 degrees or more and five days of peak air temperature of 110 degrees or more provided that continual inspections are performed and that no work which may disturb the ballast, ties, or rail has been performed.

D. The inspector may place a “Level Two” restriction at any time conditions warrant a greater level of caution, as with higher temperatures.

FIGURE 8-1 - HEAT RESTRICTION TABLE			
HEAT LEVEL RESTRICTION	SPEED APPLICATION	PSGR (Passenger)	FRT (Freight) ¹
1	Do not exceed	60 MPH	50 MPH
	Speed on Curves	5 MPH Reduction ²	No Reduction
2	Do not exceed	50 MPH	40 MPH
	Speed on Curves	10 MPH Reduction ²	5 MPH Reduction ²
	Speed through Turnout	5 MPH Reduction	5 MPH Reduction

1. Light engines shall operate according to instructions for freight trains.
2. Speed reduction taken from highest speed authorized. When speed of curves does not exceed 20 MPH, no reduction is required.

- E. At any time, a separate speed restriction at specific location and at any speed may be placed by the inspector to protect trains against conditions due to CWR expansion.
- F. If there is any indication that a track buckle is developing, such a tie movement under pressure or poor line is developing, additional anchors and additional ballast shall be applied as an emergency safeguard. Trains shall first be protected under appropriate rules and action taken to safely maintain traffic. The Manager, Track and Structures Maintenance, must be notified as soon as possible.
- G. To retain the track structure's ability to resist forces created by rail temperature (or other causes of rail movement) it is very important to maintain rail anchors tight against the ties and an adequate ballast section. When adjusting anchors, do not remove or disturb long stretches of anchors at one time. Keep the area to the size in which the gang may work safely. When the ballast section has been disturbed or removed for any reason, it must be replaced or repaired before the gang or employee leaves the site.

8.3 DESTRESSING CONTINUOUS WELDED RAIL

8.3.1 REQUIREMENTS

- A. When destressing previously laid rail, care shall be taken to adjust the rail to the PRLT. The rail in track should be allowed to adjust to current temperatures by removing all anchors of restraints from that segment to be destressed or for a minimum distance of 400 feet each way, from the point the rail will be cut to distress.

Note: A match-marks shall be made on the rail base and tie plate on an anchored tie at least a rail length past the points where anchors have been removed to indicate if rail movement occurs in anchored segments after rail is cut.

- B. The adjustment from current rail temperature to the PRLT may be done by removing rail. The general procedure for destressing is to loosen the rail so that it is free of longitudinal restraint, then to adjust the rail to the PRLT. First, the rail is cut, next, anchors are removed, and the rail is then vibrated so that it is free to expand or contract. The temperature of the rail is taken. At this time the FFT is equal to the Rail Temperature. The difference between the Rail Temperature and the PRLT is determined and the length of rail being destressed is measured. The rail expansion chart is used to determine the amount that the rail must be expanded (by heating or by hydraulic puller) to make the rail conform to the PRLT.
- C. **Example 1:** A defective 30 foot rail is to be replaced at a time when the rail temperature is 65 degrees F, the PRLT is 105 degrees F and anchor

pattern is not adequate to prevent rail movement. Anchors are removed for 400 feet each side of defective rail, match-marks made, and rail is cut and removed, resulting gap is 39 feet. Replacement rail then would be length of gap less expansion length indicated in Figure 8-2 (800 feet, 50 F degrees differential), less 1 inch per weld to be made.

1. Note: Amount that rail opened when cut is not important.

2. Calculation for Example 1:

39'-0"	Length of gap resulting when defective rail removed
Less 3 1/8 inches	From Figure 8-2, 50 F Degrees Temperature Difference, 800 feet
Less 2 inches	Two welds to be made, 1 inch each
38'-6 7/8"	Length of repair rail

D. **Example 2:** A segment of track between two crossings 1400 feet apart is to be distressed. Current rail temperature is 90 degrees F; the PRLT is to be 110 degrees F. Anchors are removed between crossings, match-marks made, and rail cut. A total gap between rail ends should be the distance indicated by Figure 8-2 (1400 feet at differential of 15 F degrees), plus 1 inch (one weld).

1. Calculation for Example 2:

2 3/16 inches	1400 feet at 20 F degrees differential
Plus 1 inch	One weld to be made
Approx. 3 3/16 inches	Total gap between rail ends

2. NOTE:

- a. Rail puller/expander must be used whenever an in-field weld is made. When welding in insert rails less than 200 feet in length, rail pullers need not be used on the first weld but must be used on the second weld after the first weld has cooled to 700 degrees F or less.
- b. When distressing, both rails must be distressed.
- c. When making welds, initials of welder, date, current rail temperature and adjusted rail temperature must be painted

on rail in accordance with Section 3.1.15 entitled “Marking Field Welds”.

- E. When practical, maintenance work that disturbs the track structure should be performed on CWR at or below the temperature range at which it was laid or to which it was adjusted. Before work is started, a determination must be made if the rail is in compression, and if so, steps must be taken to destress the rail or defer work until rail cools to an acceptable figure.
- F. When making in-field welds or destressing previously laid rail, care shall be taken to determine the amount of rail to be removed (or added) in order to leave the rail at the PRLT. Figure 8-2 may be used to determine expansion of various length rails when temperature is increased.

8.3.2 RECORDING ADJUSTED RAIL TEMPERATURES (ART)

- A. A record of rail temperatures of installed rail will be maintained by the Manager, Track and Structures Maintenance, per Section 2.2.4 entitled “Instructions for Taking Rail Temperatures”. When the rail temperature difference between laying and current reading exceeds +40 F degrees, the rail shall be destressed. All rail laid must be constantly checked for temperature difference for the first two years after laying. Rail laid during the cold months of the year must be carefully monitored the following summer. Particular attention shall be paid to defective rail change out locations that are made during the cold months.
- B. A record of adjustments to CWR must be made and maintained per Section 2.2.7 entitled “Reporting Disturbed CWR Track”.
- C. Manager, Track and Structures Maintenance, will keep a record of all rail defects which required cutting in a piece of rail or requiring a weld. Record of all cold weather pull-aparts will also be kept. Each of these incidents as well as track alignments, accidental or intentional changes in rail continuity, will require summer destressing.

8.3.3 DESTRESSING STEPS

Following are correct steps to be taken when destressing CWR:

- A. Arrange for track occupancy.
- B. Conduct a Job Briefing.
- C. When track buckles occur where the rail is tight, cut the rail at least 100 feet from the buckled area. Do not attempt to work directly on the track buckle until rail is cut and destressed; there are large forces in the rails which if the rail is cut will result in violent movement of the rail. Do not remove anchors and spikes before the cut is made. Using a torch, first cut

out approximately 4 inches of the head of the rail, and then cut out the same amount of the base, leaving only the web. Next, cut slices through the web, letting the rail expand as the web is removed. Repeat this process until there is a gap, and then begin removing anchors and (if required) lining in the buckle, while continuing to remove the end of the rails to maintain the gap. With the gap open, anchors shall be removed for 250 feet in each direction; then line the track, and pull spikes in order to remove the kinked rail safely. After stress is relieved, ends of rail shall be cut with a saw.

- D. If it is necessary to drill holes for angle bars before cutting, accurately mark the location of holes according to where the saw cut will be made.
- E. Line one of the rail ends toward center and allow ends to pass each other.
- F. Remove all anchors both ways from the rail cut for a minimum of 200 feet in each direction for a total distance of not less than 400 feet.
- G. Cut excess from end of rail, which had been lined toward center of track with rail saw. Employees/contractors shall walk along unanchored rails striking plates or otherwise relieving binding points allowing rail to run freely. Exercise care to avoid damaging head or base of rail.
- H. Check temperature of rail with rail thermometer to compare actual rail temperature. If actual temperature is less than expected, use rail temperature chart to determine additional amount of rail to be removed.
- I. Remove additional rail necessary, plus 1 inch for weld gap from rail still in plates.
- J. Replace rail, which had been lined out back into plates.
- K. Place hydraulic rail expander on rail and pull together leaving 1 inch gap for welding.
- L. Set up welding equipment.
- M. Make a field weld.
- N. Begin re-applying anchors at ends opposite weld working toward new weld.
- O. After weld has cooled, remove rail expander.
- P. Grind the weld.
- Q. Complete the anchor reapplication.

- R. Re-drive spikes, which have been removed.
- S. Check all anchors to ensure they have been applied correctly and are snug against ties.
- T. Replace any missing or defective anchors.
- U. Replace missing track spikes.
- V. Repeat procedure on opposite rails.
- W. After all work is completed and inspected, return track to service after arranging for slow order changes.

FIGURE 8-2 - CWR MOVEMENT CHART - INCHES								
Temp. Diff. In Deg. F	CWR MOVEMENT CHART – INCHES Length of Unrestrained Rail							
	400 ft	600 ft	800 ft	1000 ft	1200 ft	1400 ft	1500 ft	1600 ft
5°	1/4	1/4	1/4	1/2	1/2	1/2	1/2	1/2
10°	1/4	1/2	1/2	3/4	1	1	1 1/4	1 1/4
15°	1/2	3/4	1	1 1/4	1 1/2	1 3/4	1 3/4	1 3/4
20°	1/2	1	1 1/4	1 1/2	1 3/4	2 1/4	2 1/4	2 1/2
25°	3/4	1 1/4	1 1/2	2	2 1/4	2 3/4	3	3
30°	1	1 1/2	1 3/4	2 1/4	2 3/4	3 1/4	3 1/2	3 3/4
35°	1	1 3/4	2 1/4	2 3/4	3 1/4	3 3/4	4	4 1/4
40°	1 1/4	1 3/4	2 1/2	3	3 3/4	4 1/4	4 3/4	5
45°	1 1/2	2	2 3/4	3 1/2	4 1/4	5	5 1/4	5 1/2
50°	1 1/2	2 1/4	3	4	4 3/4	5 1/2	5 3/4	6 1/4
55°	1 3/4	2 1/2	3 1/2	4 1/4	5 1/4	6	6 1/2	6 3/4
60°	1 3/4	2 3/4	3 3/4	4 3/4	5 1/2	6 1/2	7	7 1/2
65°	2	3	4	5	6	7	7 1/2	8
70°	2 1/4	3 1/4	4 1/4	5 1/2	6 1/2	7 3/4	8 1/4	8 3/4
75°	2 1/4	3 1/2	4 3/4	5 3/4	7	8 1/4	8 3/4	9 1/4
80°	2 1/2	3 3/4	5	6 1/4	7 1/2	8 3/4	9 1/4	10
85°	2 3/4	4	5 1/4	6 3/4	8	9 1/4	10	10 1/2
90°	2 3/4	4 1/4	5 1/2	7	8 1/2	9 3/4	10 1/2	11 1/4
95°	3	4 1/2	6	7 1/2	9	10 1/4	11	11 3/4
100°	3	4 3/4	6 1/4	7 3/4	9 1/4	11	11 3/4	12 1/2

SECTION 9 TRACK GEOMETRY

9.1 SURFACE

9.1.1 DEFINITIONS

The following definitions apply to the amount of raise when surfacing:

- A. **Out-of-face surfacing:** 2 inches and over
- B. **Skin lift or smoothing:** under 2 inches
- C. **Spotting:** raising various low spots

9.2 OPERATION OF SURFACING GANGS

9.2.1 MANAGER, TRACK AND STRUCTURES MAINTENANCE'S, RESPONSIBILITY

The Manager, Track and Structures Maintenance, is responsible for the safe and efficient operation of the surfacing gang. To accomplish this, the following areas must be addressed:

- A. Track designated for surfacing work must be inspected to ensure proper equipment, manpower, ballast, and material are appropriated for the work.
- B. Identify any track conditions, which should be corrected, such as locations of defective ties, anchor patterns that require adjustment or correction, addition of ballast due to insufficient or poor shoulder ballast, or high number of road crossing in the section to be surfaced.
- C. The distribution of ballast, anchors, and crossing material shall be planned in advance of surfacing operation to provide for an efficient operation.
- D. Equipment requirements: In addition to the normal surfacing gang consist, items such as anchor squeezers, ballast compactors, or crossing renewal equipment shall be identified and requested according to schedule needs.
- E. Procedures for surfacing gang operation shall be established, and SCRRA Office of Community Affairs shall be notified.
- F. The track chart shall be reviewed to ensure that:
 - 1. Track speed(s) in work location are correct as a guide for placing temporary speed restrictions following surfacing.
 - 2. Fixed track locations such as bridges, tunnels, stations, turnouts, and railroad crossings, and grades are identified.

3. Bridges and tunnels shall be evaluated to determine if:
 - a. Overhead clearance will limit the amount of track raise.
 - b. Whether guard rails must be removed or replaced.
 - c. Whether bridge ballast depth may be increased.
 - d. The amount of offset for curved track centerline in curved tunnels is sufficient.
- G. Prior to the start of surfacing work, the Manager, Track and Structures Maintenance, must review the above information with the surfacing gang Foreman and key personnel to ensure their understanding and compliance.

9.2.2 SURFACING GANG LEADER'S (FOREMAN'S) RESPONSIBILITY

- A. Prior to start of the work, the Foreman shall coordinate with the transportation department to schedule sufficient track time to effectively support the surfacing effort and coordinate with the Manager of Signals and Communications for signal support during the surfacing operation.
- B. The Foreman is responsible for the overall operation of the gang. Foreman must ensure that the gang is performing all work in a safe manner and according to standard practice at all times.
- C. Review track chart to ensure that curve and superelevation information is correct. Check curves to ensure that prescribed superelevation and spirals are proper for existing train movement. This information shall be gathered in advance and clarified with Manager, Track and Structures Maintenance, if any concerns are found in the field that could question published curve geometry.
- D. The Foreman must know track centers to be maintained when surfacing through crossovers and ensure that track centers are maintained through final surfacing.
- E. The Foreman must have a track gage, track level, and a rail thermometer to check the gang's work.
- F. Checking height of raise, cross-level, alignment, and general quality and production are the Foreman's responsibility. Foreman shall check ahead of gang to identify any conditions which must be corrected such as the removal of bridge guard rails and ensure that there will be a uniform flow of work. Foreman shall advise the Manager, Track and Structures Maintenance, of any material shortages or developing problems that require corrective action.

- G. Before the track that has been worked on is released for train operation, the Foreman in charge or Project Manager shall inspect the track in accordance with Section 2.2.2.4 entitled “Restoring Track for Train Operation after CWR Gang Work” and Section 8.2 entitled “Track Buckling Prevention – Track Inspection Requirements”.
- H. Before surfaced track is released for train operation, the Foreman shall inspect for broken bars and rails, arrange for corrective action, and verify that corrective action is successfully completed in accordance with CFR 49 Part. 213.
- I. Signal support personnel shall be present during surfacing in order to ensure that signal appliances are protected and operational prior to release of track.
- J. Communicate to the train dispatcher the temporary speed restriction(s) per General Order 9.1.1.4. Whenever possible, revisions to temporary speed restrictions shall be communicated in sufficient time to be included in track warrants and bulletins to avoid delay to trains caused by issuing “unforeseen” restrictions.
- K. Place yellow and green flags to protect temporary speed restriction, and relocate them as location of restriction changes.

9.2.3 GENERAL SURFACING GANG OPERATION

- A. Tamperers may cause signal failures by the breakage of track or bond wires. The Signal Maintainer shall examine track and bond wires after each days work.
- B. Use of too many insertions with a squeezing tamper may cause center-bound track condition. The rule of thumb that can generally be followed is: Two squeezes per tie up to 1-1/2 inch of raise with one additional insertion and squeeze for each additional 1 inch of raise. Joint ties shall be given one additional squeeze.
- C. In locations where squeeze tampers cannot fill and compact ballast, such as at frogs, guard rails, switch portions of turnouts and headblocks, and similar locations, provisions shall be made to manually tamp with hand held mechanical tampers.
- D. On curves the high rail shall be used as the line rail and the low rail used as the grade rail.
- E. When surfacing turnouts, the straight side should be used as the line rail.
- F. Carefully monitor the ballast regulator so that it does not:

1. Drag dirt or foreign materials into the ballast section.
 2. Overfill ballast between the rails so brooming operation cannot efficiently remove all ballast from top of ties, ties plates, and base of rail.
 3. Damage signal equipment, track connections, bond wires, hotbox detectors, concrete tie clips, and other items.
 4. Adversely affect walkways or embankment shoulders.
- G. After ballast regulating in turnouts and cribs for switch points, switch rods and guard rails shall be pocketed and the switch thrown to check for proper operation.
- H. Before raising jointed rail track in hot weather, ensure that the track will not buckle by:
1. Loosening bolts and tapping joint bars at “frozen” joints
 2. Providing adequate ballast for fully backfilling track
 3. When required, adjust tight track by cutting out excess rail
- I. Track shall not be raised under overhead bridges or in tunnels without the authority of the Director, Engineering and Construction.

9.3 TRACK SPEEDS FOLLOWING SURFACING WORK

- A. General:
1. Speed of trains will be limited by actual track structure, rail stress, alignment, and surface conditions as observed by the supervisor in charge per 49CFR213.7. The following speed specifications presume that all surface and alignment deviations have been corrected, all fasteners are in place, tie cribs and shoulders are full to the dimensions of E.S. 1801, and rail stress is within working limits. Do not perform Out of Face Surfacing if rail temperature is, or is expected to be, above the Actual Rail Laying Temperature (ARLT) unless authorized by the Manager, Track and Structures Maintenance. Refer to Appendix C, Summary of Speed Restrictions for Trackwork.
 2. In all cases, observe track alignment to guard against the tendency of curves to move outward if surfaced when the rail is in a state of thermal compression and to move inward if surfaced when the rail is in a state of thermal tension as these movements will alter the ARLT.

B. Out-of-Face Surfacing:

1. If the rail temperature is below the ARLT and is expected to remain below the ARLT for the next 24 hours, limit the first train to 15 MPH (passenger) and 10 MPH (freight), then raise the speed to 30 MPH (passenger) and 20 MPH (freight) for 24 hours, then remove the speed restriction. Note: If track has been dynamic stabilized, refer to Appendix C – Summary of Speed Restrictions for Trackwork.
2. If the rail temperature is above or is likely to exceed the ARLT within 24 hours and the rail is not adjusted, limit train speed to 15 MPH (passenger) and 10 MPH (freight) for 24 hours (or until rail temperature is reduced to below ARLT).

C. Skin Lift Surfacing:

1. If the rail temperature is below the ARLT and is likely to remain below the ARLT for the next 24 hours, limit the first train to 30 MPH (passenger) and 20 MPH (freight), then raise the speed to 40 MPH (passenger) and 30 MPH (freight) for 24 hours, then remove the speed restriction.
2. If the rail temperature is above or is likely to exceed the ARLT within 24 hours, limit train speed to 20 MPH (passenger) and 10 MPH (freight) for 24 hours, then raise the speed to 40 MPH (passenger) and 30 MPH (freight) for an additional 48 hours, then remove the speed restriction.

D. Surfacing with a dynamic ballast stabilizer:

1. Limit train speed to 50 MPH (passenger) and 40 MPH (freight) for the first 24 hours behind dynamically stabilized out of face surfacing, then remove the speed restriction, if the conditions of A. above are met.
2. There is no mandatory speed restriction behind dynamically stabilized skin lift surfacing if the conditions of paragraph A. above are met.

9.3.1 SURFACING - RAIL TEMPERATURE

Do not surface, skin lift, or spot when the rail is at a higher temperature than 10 F degrees above the adjusted rail temperature, except as follows: When absolutely necessary, track may be surfaced under the supervision of the Manager, Track and Structures Maintenance, or designee and only after provisions have been made for the adjustment of the rail to be surfaced. Take every precaution to provide for safe train movement. (Refer to Section 2.2.6 entitled “Disturbed Track”.)

9.3.2 SURFACING - SUPERELEVATION STANDARDS

- A. Maintain superelevation of the outer rail on curves in main tracks and CTC sidings at values provided in E.S. 2302. Only the Director of Engineering and Construction may approve any deviation from E.S. 2302 or from existing record curve data. Mark curves at the ends and at each 1/4" change in elevation by nailing or gluing metal tags to the tie between the rails. (See E.S. 2304).
- B. The design superelevation is indicated on the track charts (with some exceptions).
- C. The speed of train operation, amount of superelevation of curves, and lengths of spirals must at all times conform to E.S. 2302, and with FRA 213.57. If a speed and superelevation situation is discovered that is not in compliance with E.S. 2302 or FRA 213.57, train speed must be reduced and the Manager, Track and Structures Maintenance, notified.
- D. The Director of Engineering and Construction establishes train speeds to minimize running time for passenger trains consistent with engineering standards, signal spacing, economical track maintenance, and good train handling practice for all trains. Maintenance personnel who discover a condition requiring a reduction of speed shall take immediate action to place a (temporary) speed restriction into effect, and to then notify the Manager, Track and Structures Maintenance. Permanent changes to the authorized speed of trains will be decided by the Director of Engineering and Construction with consultation with the Manager, Signals and Communications, and the Manager, Track and Structures Maintenance.
- E. A track that is superelevated to the amount that the curving force is exactly balanced by the superelevation is defined as *equilibrium*. This is seldom done. Most curves are maintained at an amount of *unbalance*, which means that the superelevation is less than equilibrium, and the rails will force the train around the curve. To a train operating at the authorized speed, it "feels" like it is leaning on a track that is that amount out of level.
- F. There are three sets of speed/superelevation tables, refer to Appendix E, Unbalance, for several amounts of unbalance of superelevation. Those designated "standard" shall be used for all new construction and for maintenance wherever practicable. Those designated "minimum maintenance" have shorter spiral lengths that are for situations where SCRRRA purchased railroad lines with these shorter spirals and it is not practicable to realign the track to make longer spirals. Generally, "minimum maintenance" spirals are only found between Saugus and Vincent on the Valley Subdivision.

- G. The speed of freight trains is established to not exceed that for the 2-inch unbalance to avoid operation at speeds below equilibrium speed. In some cases with slow freight train speed and large amounts of superelevation, the speed of passenger trains may be reduced to avoid operating freight trains at an overbalanced superelevation. (Freight train speed is also controlled by braking distances and the need to avoid accelerations and decelerations, and, in practice, is limited by available horsepower.)
- H. Unrestricted passenger train speeds are set to be less than 3 inches of unbalance.
- I. Restricted passenger speeds are set to be less than 4 inches of unbalance. The Amtrak and SCRRRA passenger trains operating on our lines have been certified by the FRA per section 213.57 to operate at 4 inches of unbalance. Restricted speeds are indicated by Bold Italic numbers and the # sign in the timetable speed tables and on track charts. Refer to the current timetable for the restrictions applicable to trains operated with the 4-inch unbalance speed.

9.3.2.1 ELEVATION ON AUXILIARY TRACKS

Maintain elevation on curved auxiliary tracks at 1/2 inch, except as authorized by the Director of Engineering and Construction.

9.3.3 SURFACE IRREGULARITIES

- A. Surface irregularities must not exceed the limits of FRA Track Safety Standards 213.59.63. When such irregularities are discovered, trains shall be protected by reducing speed to the Class, with which it is in compliance. Corrective repairs and surfacing shall be accomplished promptly.
- B. Track surface irregularities shall be promptly corrected if they would be a defect for the next higher class. Example: In Class 4 track with a passenger speed of 75 MPH, a profile exception of 1-1/4 inches shall be corrected due to the fact that this is the defect level for Class 5 track.

9.3.4 USE OF TRACK LEVEL

Use a standard track level in all repair work disturbing surface of the track in order to ensure proper cross-level and elevation on curves. When raising track, check the cross-level frequently with a standard track level. Test track levels for accuracy each day prior to use.

9.3.5 REPETITIVE SURFACE PROBLEMS

- A. When a condition dictates repeated raises at the same location, a tight rail condition is possible. Take care to prevent structural kinks. Cut rail out if

necessary to relieve the stress. Report such locations to the Manager, Track and Structures Maintenance, who will analyze the problem for a permanent solution.

- B. In problem locations, always maintain proper ballast section.

9.3.6 TRACK JACKS

Place track jacks on the field side of rail in straight vertical position, unless impractical. Raise jacks on both rails at the same rate keeping the track as level as possible. When it is absolutely necessary to place jacks between rails, use proper protection and safety measures.

9.3.7 BALLAST REQUIREMENTS

- A. The following are the approximate amounts of ballast required per mile for surfacing based on 100-ton capacity cars. (Make allowances for various car types.)

<u>Raise</u>	<u>No. Of Cars</u>
1 inch	3
2 inches	5
3 inches	8
4 inches	11
5 inches	14
6 inches	30

- B. After surfacing and dressing a ballast section, verify that it conforms to E.S. 1801 and to any special instructions and safety measures.

9.3.8 SPIRAL LENGTH

- A. Superelevation shall be tapered uniformly in the spiral transition between the circular curve and the tangent. The length of spiral shall be maintained as shown on the track chart or engineering drawings during all track maintenance operations.
- B. The length of spiral is based upon train dynamics and the ability of railroad cars to adjust to changes of superelevation. In no case will a rate of change of elevation exceed one inch in 50 feet. This is the “minimum maintenance” length of spiral and is only used where sub-standard spiral lengths were in the track when the railroad was purchased by SCRRRA.

The standard length of spiral provides a change of not more than 1 inch in 62 feet. At speeds above 50 mph, spiral lengths shall be increased per E.S. 2302. These tables compute the spiral lengths based upon the distance to develop E_a , the actual superelevation, and E_u , the overbalance lateral forces.

9.4 ALIGNMENT

9.4.1 ALIGNMENT IRREGULARITIES

Good uniform alignment is essential to safe, good riding track and in preventing excessive wear of rail and other track components.

9.4.2 LINE RAIL

The line rail on curves is always the high rail. On tangents, use the most practical rail.

9.4.3 ENGINEERING DEPARTMENT ASSISTANCE

If there is any doubt as to proper alignment on curves or when there are unusual problems in lining a curve, request stakes and assistance from the Director of Engineering and Construction. Stake curves when undercutting or when using a mechanized tie gang on the track.

9.4.4 REMEDIAL ACTION

- A. Alignment irregularities that exceed 49CFR213.55 must be immediately protected by reducing the speed of trains to the Class that would be in compliance, and immediately thereafter performing repairs or adjustment.
- B. Track alignment irregularities shall be promptly corrected if they would be a defect for the next higher class.

9.4.5 TURNOUTS NEAR CURVES

Refer to the Section 4.1.9 entitled “Special Consideration for Curves” concerning the importance of maintaining the short segment of tangent track immediately ahead of switch points.

9.5 CLEARANCES

- A. Maintain required overhead and side clearances at bridges, tunnels, platform, and other overhead structures when surfacing or lining track. When surfacing or lining affects overhead or side clearance, the gang shall notify the Manager, Track and Structures Maintenance, giving the structure’s location and the approximate raise resulting from the work.

- B. Obtain permission before raising or lining track where there is any possibility of compromising clearance. Engineering Department records indicate the maximum raise or alignment change possible at a particular location. Have a qualified person check the limits. After a change in clearance (side or overhead), the Manager, Track and Structures Maintenance, must file a message with the Director of Engineering and Construction.
- C. Be sure to maintain a proper alignment across ballasted deck bridges. When automatic lining equipment indicates appreciable changes on a ballast deck bridge, consult the Manager, Track and Structures Maintenance. If the centerline of track is 6 inches or more from the centerline of a bridge, notify the Director of Engineering and Construction. Make no changes until the Director of Engineering and Construction issues plans for proper correction. Do not raise track on any through truss bridge or at any overhead obstruction if the vertical clearance would be less than 22'-6" from top of rail without the Director of Engineering and Construction's approval.

9.6 TRACK GAGE

9.6.1 GAGE WIDENING

When authorized by the Director of Engineering and Construction, widen gage as follows:

- A. From 12° 01' - 14° inclusive 4' - 8 - 5/8"
- B. Over 14° 4' - 8 - 3/4"

9.6.2 CORRECTING GAGE

When correcting wide gage, consider the gage on each side of the wide gage, and correct the wide spot gradually. When correcting gage on curve, the curve must be in correct alignment. The high rail is the line rail and low rail is the gage rail. Do not gage track on curve to accommodate curve worn rail, except when an emergency situation demands a temporary repair. The high side of curves must be inspected for Differential Plate cutting on wood ties and cutting and abrasion on concrete ties.

9.6.3 TRACK GAGE

Check track gage for accuracy. Do not force gage between rails.

9.6.4 ADZING

When gauging track, adze tie, if necessary, to provide a flat seat for the tie plate.

9.7 TRACK GEOMETRY CAR

9.7.1 PLANNING FOR GEOMETRY CAR OPERATION

- A. Geometry test cars shall operate over the railroad as directed by the Manager, Track and Structures Maintenance.
- B. The car shall test at intervals governed by the following criteria:
 - 1. **Passenger Routes:** 2 or 3 Times/Year, depending upon availability.
 - 2. **All Other Routes:** 1 Time/Year
- C. Track Geometry cars operated by Amtrak, FRA, Freight Railroads, or contractors may be used to fulfill this schedule.
- D. The car shall also test as soon as possible and no later than 120 days following major track undercutter and tie renewal projects or as directed by the Manager, Track and Structures Maintenance.
- E. The Manager, Track and Structures Maintenance, or Manager's representative and the Track Inspector must ride the Track Geometry Car.

9.7.2 GEOMETRY CAR OPERATION

The Track Geometry Car shall produce on-car printouts of exceptions found with priority designations. Priority 1 defects shall be checked as soon as possible, not to exceed 24 hours, and immediate action taken to repair or protect with appropriate slow order. After correction is made, report shall be submitted to the Manager, Track and Structures Maintenance. The office of the Manager, Track and Structures Maintenance, will update the computer log of Priority 1 repairs. On Class 4 track and above, Priority 2 defects trackage shall be checked as soon as possible, not to exceed seven days, and repairs shall be completed within 90 days. Provide continued spot inspections until repaired or provide slow order protection. All other priority items shall be repaired on a timely basis. The Track Geometry Car data should be utilized as a guide for planning corrective maintenance programs.

SECTION 10 STRUCTURES – BRIDGES, CULVERTS, AND OTHER LOAD BEARING STRUCTURES

10.1 DEFINITIONS

- A. **Bridges and Culverts:** Bridges have one or more spans ten (10) feet or longer in length. Culverts typically have spans under ten (10) feet.
- B. **Pipe Culverts:** Pipe culverts are normally circular or oval and can be pre-cast concrete, steel, PVC, and corrugated steel.
- C. **Box Culverts:** Box culverts are normally reinforced concrete boxes that can be either cast in-place or pre-fabricated. Box culverts may also include timber or stone structures.
- D. Other load bearing structures include retaining walls, sound walls, earth walls and drainage channels.
- E. **Under Grade Bridges:** Under grade bridges carries the Railroad over a stream/river, roadway or elevate the railroad over a depressed grade.
- F. **Overhead Bridges:** Overhead bridges typically carry a roadway or other utility over the Railroad.
- G. **Emergency/Special Inspection:** An inspection performed due to an incident which may have resulted in a change of condition of the structure, such as derailment, fire, flood, earthquake, or collision impact.
- H. **Flash Floods:** A flash flood is a rapid flooding of low-lying areas such as washes, rivers, and streams and is caused by the intense rainfall associated with a thunderstorm or multiple thunderstorms. Flash floods can also occur after the collapse of a dam, manmade or natural. Flash floods are distinguished from a regular flood by a timescale less than six hours.

10.2 PERSONNEL QUALIFICATIONS

- A. All personal working on or around SCRRRA’s bridges must be qualified on FRA’s Bridge Workers requirements.
- B. Structures Inspector shall be person qualified to perform structure inspections required herein. The designation of the qualified person shall be pre-approved by the Manager of Structures Maintenance

10.3 INSPECTION OF BRIDGES, CULVERTS, TUNNELS, RETAINING WALLS AND OTHER STRUCTURES

- A. Contractor’s Structures Inspector shall annually inspect all bridges, culverts, tunnels, retaining walls and other structures with the support of

other contractor personnel as such support may be required for access, staging, or other activities. The contractor shall develop and maintain a detailed list of Structures. Contractor shall perform any additional inspections as required and as authorized by SCRRA.

- B. When regulatory agencies perform inspections of the Service Property, contractor shall inform the SCRRA of the inspection, support such inspections by providing transportation, equipment, flag protection, inspection personal, and documentation of the inspection.
- C. Contractor shall (1) first perform repairs of any critical defects as determined by the inspector and discovered during inspection, and (2) then perform repairs in accordance with any repair priorities identified in the inspection reports.

10.3.1 EMERGENCY/SPECIAL INSPECTION

- A. The contractor shall maintain a list of all structures that may require special inspection due to weather, runoff, earthquake, vehicle strike, and other foreseen events. This list shall be coordinated with and cross-referenced to the list of all structures.
- B. Contractor shall perform Special Inspections of the track and structures or right of way to determine if there has been any damage to or alteration of conditions affecting the safety of trains. Contractor has the authority to initiate such inspections without specific authorization from SCRRA, and shall respond to requests for Special Inspections from SCRRA's C&S Maintenance, Train Operations, or Equipment Maintenance Contractors. SCRRA may request such Special Inspections at any time or for any reason, including for unusually high or low temperatures, heavy precipitation, high tides, winds, or suspected vandalism. Special Inspections may be made by hi-rail or other means generally accepted within the railroad industry. Special Inspections shall be coordinated with SCRRA staff in accordance with the applicable instructions set forth.
- C. The procedures to be used and intensity of Special Inspections shall be determined by the Manager of Structures Maintenance in direct relation to the severity of the incident. The following are responses to various emergency conditions:
 - 1. **Accidents / Collision Impacts:** In any event or upon receipt of notification of a vehicle strike to any railroad carrying structure, the contractor shall impose a temporary speed restriction of not more than 10 mph until the bridge has been inspected. Based on the results of the inspection, appropriate action shall be taken to protect service. This may require the contractor to provide additional inspection preformed by a California licensed engineer.

2. **Derailments:** Following any derailment involving a bridge, no further movement shall be permitted on said bridge until the Structures Inspector in consultation with the Manager of Structures Maintenance (or the Manager's designee) determines that it is safe to do so.
3. **Flash Floods and Floods:** After receipt of a warning of flooding which might damage bridges or their approaches, the contractor will alert the dispatcher who shall notify train crews operating on all track and bridges subject to damage from the flood. The speed of all trains and light locomotives shall be limited to that which will permit safe operation consistent with the potential water levels and visibility conditions. This limitation shall continue until a special inspection in accordance with 49 CFR 213.239 has been performed and it is determined that a hazard no longer exists.
4. **Fires:** In the event of a fire on or beneath a bridge, rail operations shall be suspended until a determination of structural integrity is made. Unless it can be determined that the fire was of such a minor nature that no primary load carrying structural components or systems were affected, the appropriate sections on the evaluation of fire damage in the AREMA Manual of Railway Engineering shall be consulted and an appropriate evaluation made.
5. **Earthquakes:** After an earthquake is reported to the Railroad, the Dispatcher, or the contractor, suspension of train operations or speed restrictions shall be implemented and an inspection of track, structures, and signal and communication systems shall be initiated in accordance with Section 17, Earthquake Response. When indicated in Section 17, Earthquake Response, or required by SCRRRA, measures such as speed restrictions or suspension of train operations shall continue until inspections have been completed and either appropriate speed restrictions established or repairs completed, as applicable.

10.4 DOCUMENTATION OF INSPECTIONS

- A. Contractor shall document each inspection on the form designated for such inspections. Refer to Appendix D for inspection report forms. Documentation shall include an inventory of conditions and a list of recommended repairs in order of recommended priority. All such inspection reports shall include multiple digital photos of each structure inspected.
- B. The contractor shall record, assemble, and maintain all structure inspection reports. Reports shall be kept on an approved server in electronic format with five hard copies and two electronic files of the

annual bridge, culvert, and structures summary inspection report forwarded to Manager of Structures Maintenance. Each of the five hard copies the summary inspection report shall be assembled in separate binders.

- C. All inspections shall be recorded in the prescribed format with a copy of the record of inspection provided to the SCRRA. The inspection report must be comprehensible without interpretation by the reporting Inspector. At a minimum, the inspection report shall show the date(s) on which the inspection was actually performed, the name of the Inspector, precise identification of the structure inspected, the items inspected, and the condition of those items. Any deficiency found by the Inspector to be a potential problem or actual defect shall be noted and supplemented, as appropriate with narratives, sketches, and photographs.

10.5 INSPECTION OF CULVERTS AND DRAINAGE DITCHES

- A. Unless SCRRA instructs otherwise, culverts, drainage ditches, and structures that have a history known to SCRRA or contractor of filling up with sediment or debris shall be inspected and maintained in the late second quarter and early third quarter of each year beginning in August and completed by October 15th of each year. This requirement does not relieve the contractor from performing routine and other required maintenance throughout the year.
- B. Once a month, the track inspector shall perform a visual inspection of all culverts and drainage ditches and forward a report to the Structures Supervisor and a copy to the bridge inspector. In addition, the track inspector shall look for and report any condition that may increase discharge or flow onto, through, or under any railroad structure or drainage system.
- C. Culverts shall be inspected for structural integrity, clear flow, and to verify flow capacity. Any observed back up of water shall be reported to Manager of Structures Maintenance. Where practical, the inside on the culverts shall be inspected.

SECTION 11 *EMBANKMENTS AND DRAINAGE*

11.1 THE RAILROAD EMBANKMENT

- A. The railroad embankment consists mostly of native soils and rock shaped and compacted to support the loadings from trains; in many cases the top of the embankment is augmented by a layer of crushed stone base material. To successfully carry railroad loads, an embankment must be constructed according to sound engineering and construction practice and maintained as described in this Section.

- B. The strength of soils, and therefore their ability to carry heavy loads is dependent upon two factors: compaction and moisture content. Adequate compaction is achieved when an embankment is constructed or repaired using good practice; moisture content is controlled by management of surface drainage and other sources of water.

11.2 CONSTRUCTION OF EMBANKMENTS

New embankments shall be constructed in accordance with the drawings and specifications of the construction contracts. New embankments shall conform to E.S. 1801 thru 1803 except as modified by project-specific documents.

11.3 REPAIRS AND MODIFICATIONS TO EMBANKMENTS

- A. Damage to embankments shall be repaired to the dimensions of the Engineering Standards or the original condition, using methods that achieve the original design strength of the soils. Examples of repairs or modifications include trenches to install conduits, cables, or culverts, backfill behind bridge abutments, washout repairs, and jacking pits and other excavations within the influence zone (slope of 1:1 down from end of top of ties). Restoration of embankments will include restoration of the ballast section if it was affected by the excavation.

- B. Small repairs (less than 3 ft. in width or depth) that are compacted in lifts not exceeding 6 inches using mechanical compaction (manual power tampers, sheepsfoot rollers, or pneumatic tired equipment), adding water to result in a visibly damp backfill material with no visible free water, using either the original embankment material or an AREMA Class 3 Crushed Aggregate Base, shall be presumed to match the original compaction of the embankment. Excavations or damages exceeding these dimensions, or within the influence zone for railroad loading, shall be restored as approved by the Project Manager or the Manager, Track and Structures Maintenance. Protection for trains is required for open excavations within the influence zone for railroad loading.

- C. Compaction by jetting will not be allowed on rail embankments.

11.4 IMPORTANCE OF GOOD DRAINAGE

Adequate roadbed drainage is imperative for good track maintenance. Keep roadbed and track properly drained at all times. Do not block drainage with any foreign objects or refuse. In all locations at all times, the roadbed shall be maintained to slope away from the ballast section.

11.5 INTERCEPTING DITCHES

When the natural drainage is toward the roadbed, provide suitable ditches, where practical, or other means to intercept and divert the water.

11.6 KEEP WATERWAYS CLEAR

Regularly inspect ditches and waterways leading up to and away from bridges and culverts. Keep them open to accommodate passage of water.

11.7 EROSION

Take immediate action to protect a roadbed endangered by erosion, and notify the dispatcher and the Manager, Track and Structures Maintenance, promptly.

11.8 DRAINAGE AT ROAD CROSSINGS, RAILROAD CROSSINGS AND SWITCHES

- A. When working on or near road crossings, railroad crossings or switches, be especially careful to ensure proper drainage. Proper drainage extends the life of these facilities. Always direct drainage away from all four corners of a crossing or into storm drains.
- B. When rebuilding or constructing a new facility, install an approved geotextile fabric where drainage or subgrade problems exist. This improves drainage and helps maintain a solid foundation. Refer to E.S. 2006.

11.9 HIGH WATER MARKS

Under high water conditions such as an overflowing stream caused by heavy rains or heavy snow melt; take measurements at bridges/culverts from the base of the rail to the surface of the water or to the high water mark.

11.10 CONCRETE TIE

Concrete ties are vulnerable to abrasive damage in wet, fouled ballast. To protect these ties, maintain well-drained ballast at concrete tie locations.

SECTION 12 BALLAST AND OTHER ROCK PRODUCTS

12.1 ORDERING BALLAST

Order ballast only from sources approved by the Manager, Track and Structures Maintenance, except when that Manager authorizes otherwise. When local purchase is authorized, test the ballast for conformance to specifications for its intended use.

12.2 MAIN TRACK BALLAST SPECIFICATIONS

Ballast produced shall meet the following specifications when tested in a laboratory designated by the Director of Engineering and Construction:

- A. **Size:** The recommended ranges of sieve analysis of ballast are shown in Figure 12-1, Ballast Grading.
- B. **Wear:** Percentage of Wear, tested in the Los Angeles machines, shall not exceed 27.5 percent for granite when tested under ASTM International, ASTM C535 (1000 Revolutions, Grading 3).
- C. **Soundness:** Weighted average loss shall not exceed 2.5 percent after five cycles when tested in the sodium sulfate soundness test under ASTM C88.
- D. **Absorption:** The percentage absorption shall not exceed 1.0 percent as determined under ASTM C127.
- E. **Contamination:** Deleterious substances shall not be present except that clay lumps and friable particles may compose up to 0.5 percent as determined by ASTM C142.
- D. **Elongated Particles:** The percentage, by weight, of flat or elongated particles shall not exceed 5 percent. Flat or elongated particles are defined as particles having a length equal to, or greater than, three times the average thickness.

FIGURE 12-1 - BALLAST GRADING								
AMOUNTS FINER THAN EACH SIEVE (SQUARE OPENING LABORATORY SIEVES)								
PERCENT PASSING BY WEIGHT								
Square Opening	#4	3/8"	1/2"	3/4"	1"	1-1/2"	2"	2-1/2"
4A (Track Ballast)				0-10	10-35	50-80	90-100	100
5 (3/4 Inch Ballast)	0-5	0-15	15-35	40-75	90-100	100		

12.2.1 APPLICATION

Ballast specification shall be used as described below:

- A. No. 4A Ballast shall be used for all track ballast to the limits of E.S. 1801-01 and E.S. 1801-02.
- B. No. 5 Ballast shall be used as a 3-inch nominal cover over track ballast in order to provide improved walking surfaces in areas where CPUC No. 6 walkway is specified

12.3 UNLOADING BALLAST

- A. Ballast cars shall be unloaded only by persons who have been trained in both the proper distribution of ballast and in the operation of the specific type of car.
- B. Unload ballast carefully. Do not unload excess ballast. (See Section 9.3.7 entitled "Ballast Requirements" for the required number of cars per mile). Check contents before unloading. Plan work to avoid passing empty cars over fresh dumped ballast.
- C. Make sure cars are completely empty with doors properly closed and secure before releasing. Unloading ballast on the high side only is prohibited on curves of more than 3 inch elevation. When unloading from the high side of the car only, take care on curves to avoid car turning over. No one shall be permitted to walk adjacent to the low side of a ballast car that is being unloaded on the high side only of a curve.
- D. Do not ride in cars while unloading ballast. Use a plow tie to prevent ballast from getting above the top of rail. Use only a new tie or a solid used tie as a plow tie, and place it against the leading wheels of the trailing truck of a loaded car.
- E. Before operation of radio remote ballast door cars, the charge on the batteries (both controller and car) shall be confirmed and corrected, if necessary.
- F. Ballast cars may be unloaded with either work train locomotive or car mover Maintenance of Way equipment as specified in Section 14.2 entitled "Handling Cars with Maintenance Equipment".
- G. Transportation, Dispatching, and Mechanical Departments require two weeks notice to arrange for crews and motive power for work trains. Scheduled ballast unloading operations by work trains shall be arranged through the Manager of Maintenance of Way. Emergency unloading may be arranged by the persons responsible for handling the situation.

12.4 BALLAST SECTION

- A. Refer to E.S. 1801 for typical ballast sections.
- B. Because drainage is imperative for good track maintenance, prevent the fouling of ballast with foreign material. Also, avoid excessive shoulder width, as well as ballast above top of the tie.

12.5 STONE FOR RIPRAP

- A. Order riprap by size and specification, and obtain it only from approved sources.
- B. Stone for riprap shall be quarystone and shall be angular. Stone shall be of such shape as to form a stable protection structure of the required section. Flat or elongated shapes will not be accepted unless the thickness of the individual piece is at least on-third of the length. Rounded shapes will not be acceptable.
- C. Stone shall be sound, durable, hard, resistant to abrasion and free from laminations, weak cleavage planes, and the undesirable effects of weathering. It shall be of such character that it will not disintegrate from the action of air, water, or the conditions to be met in handling and placing. All material shall be clean and free from deleterious impurities, including alkali, earth, clay, refuse, and adherent coatings.
- D. Grading Requirements: Stone for riprap shall be designated by class and conform to the following gradations (Figure 12-2):

FIGURE 12-2 - STONE FOR RIP RAP GRADING				
Rock Size	Percentage Larger Than			
	500 lb Class	375 lb Class	Light Class	Facing Class
1000 lb	0-5	-	-	-
700 lb	-	0-10	-	-
500 lb	50-100	10-50	0-5	-
200 lb	-	85-100	50-100	0-5
75 lb	90-100	95-100	90-100	50-100
25 lb	95-100	-	95-100	90-100
2.2 lb	-	-	-	95-100

Note Regarding Figure 12-2: The amount of material smaller than the smallest size shown in the table for any class shall not exceed the percentage limit as determined on a weight basis. Compliance with the percentage limits shown in the table for all other sizes of the individual

pieces of any class of rock slope protection shall be determined by the ratio of the number of individual pieces larger than the specified size compared to the total number of individual pieces larger than the smallest size listed in the table for that class.

12.5.1 PLACING RIPRAP

- A. Unless otherwise designated, for application greater than 200 tons, design parameters including filter, foundation, and gradation with supporting calculation by an Engineer, shall be submitted to SCRRA, Manager, Track and Structure Maintenance, for approval.
- B. Do not use riprap to repair slides except as the Manager, Track and Structures Maintenance, directs. After unloading riprap, make sure that there is enough clearance for passing trains.
- C. Place riprap immediately following unloading to prevent over-loading of side slope and accelerating slope failure. Any riprap placed in the San Clemente area shall conform to the existing agreement and E.S. 1803.

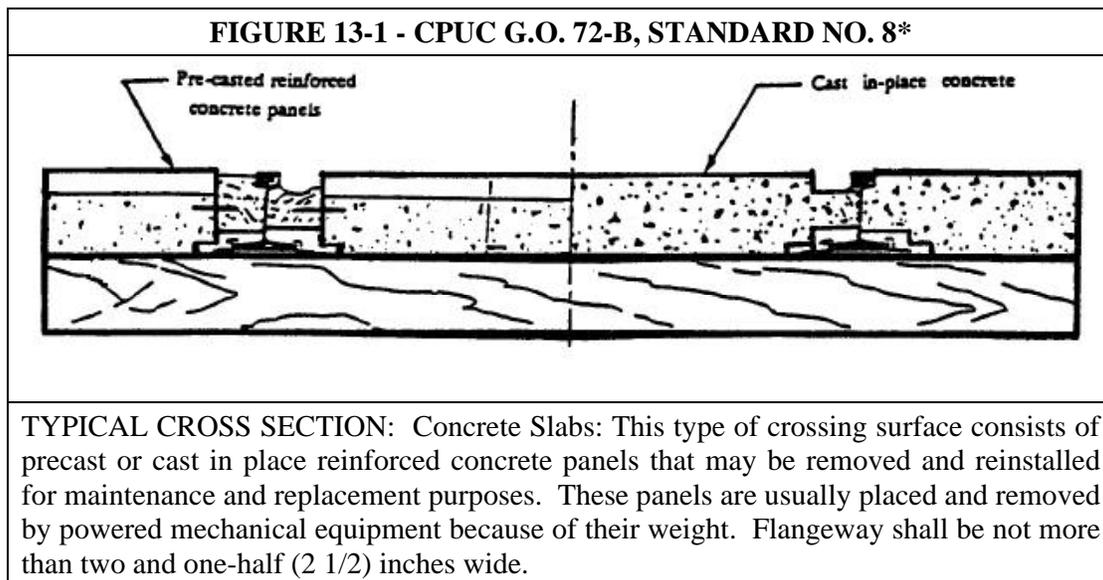
12.6 BALLAST AND RIPRAP DELIVERY REPORTS

SCRRA or contractor personnel who take delivery of rock products shall sign vendor's delivery forms and forward them to the Manager, Track and Structures Maintenance.

SECTION 13 ROAD CROSSINGS

13.1 POLICY

Maintain road crossings at grade so that regular car and truck traffic can travel across them safely at posted speed limits. Install private crossing signs, cross bucks, and other required signs in accordance with Standard Plans or with local laws. Refer to Figure 13-1, CPUC G.O. 72-B. Per CPUC regulations, railroads maintain only 2 feet out from centerline of rails. Local or county agencies maintain the approaches and sidewalks.



13.2 GOVERNMENT AGENCIES AND COMMUNITY RELATIONS

- A. Maintain good working relations with governmental agencies. Do not close or partially block crossings for maintenance or renewal without notifying the proper governmental agency. Whenever possible, notify the owners of private crossings, prior to start of maintenance activities.
- B. SCRRRA Office of Community Affairs shall be notified two weeks prior to scheduled crossing work.

13.3 SURFACE MATERIAL

Use only standard crossing material conforming to E.S. 2006 on crossings except when other material is specifically authorized. Install asphalt crossings only with authorization from the Manager, Track and Structures Maintenance.

13.4 METHOD OF CONSTRUCTION

- A. Construction of new crossings and reconstruction of existing crossings shall conform to E.S. 2006 and 2011.
- B. Work on highway crossings, public streets, and roads shall be done with the least possible inconvenience to vehicular and pedestrian traffic. Care shall be taken to protect the public in compliance with safety and applicable statutes. Closing of traffic lanes shall only be done after permission is obtained from the governing roadway agency.
- C. Highway approach grade shall not be increased as a result of rebuilding or resurfacing track through highway crossings, unless approved by the Manager, Track and Structures Maintenance.
- D. A full road closure shall be sought from the responsible public agency for crossing renewals. Crossing shall not be renewed half at a time, except if impossible to obtain a full closure, and then only if so authorized by the Manager, Track and Structures Maintenance.
- E. Traffic control devices shall be in place according to the approved traffic control plan.
- F. In placing and removing barricades, workmen shall place the barricade closest to the edge of the roadway first and work out, wherever possible. In removing barricades, the outer most barricades shall be removed first and work toward the edge of the roadway removing the remaining barricades, wherever possible.
- G. The following guidelines should be followed when renewing a grade crossing.
 - 1. Replace fouled ballast to a depth of 15 inches below bottom of cross ties.
 - 2. Place a 6 inch minimum layer of compacted hot mixed asphalt to a length of 10 foot either side of crossing along the track.
 - 3. Place suitable ditch, install drain and signal conduits or pipes as required.
 - 4. Replace rail and OTM as needed. Replace all ties. Extend reconstruction at least 40 feet beyond ends of crossing material along the track.
 - 5. Replace crossing surface material.

6. Clean up released crossing material and waste concurrently with crossing renewal.
7. Twenty-four 10 foot transition ties shall be installed on each side of the newly constructed crossing.

13.5 HIGHWAY CROSSINGS – CLEANING OF DIRT LEFT ON RAILS

Inspect road crossings frequently and keep flangeways clean of dirt and debris. During road construction or maintenance, dirt dumped on a crossing sometimes creates a hazard. Get rid of the debris at once, and make a full report to the Manager, Track and Structures Maintenance, indicating the milepost location of the crossing, and the name and address of the party doing the work, if known.

13.6 HIGHWAY CROSSINGS - SAFETY

Maintenance, construction, and rehabilitation managers and contractors are each responsible for the maintenance of crossings under their charge in a safe condition. Immediate correction is required for crossings discovered to have:

- A. Obstructions to sightlines at crossings.
- B. Obstructions to visibility of crossing signs or signals.
- C. Damaged or missing end ramps or deflectors.
- D. Depressions or holes in pedestrian walkways.
- E. Altered highway traffic that causes queuing of traffic over the crossing.
- F. Severely damaged roadway surface.
- G. Dislocated or raised crossing panels.

SECTION 14 MAINTENANCE-OF-WAY CARS

14.1 HANDLING OF AIR DUMP CARS

The Manager of Maintenance of Way shall plan the use of air dump cars with the Foreman handling the equipment. The following issues should be discussed prior to beginning the work and shall govern air dump car operations.

- A. The Foreman or person in charge shall check to see that all personnel are clear of the area before operating air dump cars.
- B. Due to that fact that cars can automatically dump at anytime, absolutely no one shall ride in air dump cars, either loaded or empty.
- C. Instructions for operating of some air dump cars are stenciled on the car. No one may operate air dump cars unless that individual is familiar with these instructions.
- D. Any individual handling air dump cars shall know thoroughly the procedures for proper air line connection, proper valve manipulation, and proper lock positioning. Individual handling air dump car shall make a second inspection before moving cars, double-checking that air dump cars are properly locked.
- E. Only one qualified person shall handle dumping of air dump cars; that individual shall be responsible for the complete operation. Fully protect trains on adjacent track when dumping cars. Faulty air dump cars can dump to the wrong side; be prepared to protect trains if this happens.
- F. When using any type of air dump car in ordinary maintenance work, do not use the multiple dumping feature, dump each car singly instead. Dump car operators shall never inject oil in the dump cylinder air line. Bad order defective cars, and send them for needed repairs.
- G. Care must be exercised when dumping on uneven track or with frozen or sticky material. Operator of dump car shall consider using engine chains to chain the drawbars at both ends of the car to the rail opposite the dump side. This will aid in preventing derailment of car or possible roll over of dump car.
- H. Before releasing car, the person in charge shall make sure that all locks are secure and in proper operating position. Make all necessary reports on unloaded material.

14.2 HANDLING CARS WITH MAINTENANCE EQUIPMENT

- A. Only equipment approved by the Manager, Track and Structures Maintenance, shall be used to move rail cars. Equipment must meet

glazing, power brake, and safety appliance regulations of the FRA. Train line (brake pipe) pressure must be 90 psi.

- B. Anytime cars are handled on main track, sidings, over railroad crossings at grade, or crossings using maintenance equipment as motive power, train line air hoses must be coupled between all cars. After brake system is charged, brake pipe reduction must be made to determine that the brakes are applied on each car before releasing and proceeding.
- C. Operator shall restrict the number of cars handled by the equipment to conform to equipment manufacturer's recommendations or individual performance capabilities of equipment, whichever is less, for pulling capacity of equipment.
- D. Operator or Foreman assigned to move rail cars shall inspect them before movement for these conditions:
 - 1. Wheels are on rail.
 - 2. Obstructions on track.
 - 3. Brake shoes on each wheel.
 - 4. Condition of steps and grab irons.
 - 5. Brake cylinder piston travel does not exceed 10 inches.

14.3 DAMAGE TO BALLAST CAR DOORS

- A. Close doors before cars are released for train movement. Work trains may move cars clear of main track for door closing, but make sure doors clear all obstructions.
- B. To prevent derailment or damage to the ballast car doors, place the cross tie against the wheels, not against the doors, to plow off unloaded ballast.

14.4 MATERIAL UNLOADING

Employees/contractors receiving SCRRRA material, tools, or machines shall unload and inspect them promptly, and return freight bills and packing slip at once to SCRRRA supervisory officer with statement of any discrepancies or defects. Release cars making delivery with the least possible delay and verify their movement.

14.5 FLAT CARS – HANDLING TRACK PANELS

- A. Flatcars loaded with panels must be carefully handled at all times. They shall not be kicked or dropped or other cars permitted to be kicked or dropped against them.
- B. Panels on flatcars shall not be handled in regular trains except in an emergency situation. Track panels on flatcars should be trained on head-end with a buffer between engine and panels, as well as, between caboose and panels. When handled in special work train service for derailments and washouts, other than derrick trains, the special train shall only handle cars of material required at point where the emergency exists.
- C. Panels shall be tied at both ends with chains and boomers or lead binders and further secured with locks.
- D. Prior to departure from the originating point, a Mechanical Department Supervisor must closely inspect panels to be sure that the tie-downs are in place and effective.
- E. These loads shall be watched closely while enroute, and inspected at all intermediate points where train stops are made to ensure no shifting has occurred and that loads are still tight.
- F. Panels loaded in gondolas need not be tied down, but shall not be loaded above top of car.

SECTION 15 TRACK INSPECTION

15.1 TRACK INSPECTION FREQUENCY

The track inspector is responsible for meeting the required inspection frequency as mandated by these instructions and the FRA.

15.2 TRACK INSPECTION REPORTING PROCEDURES

Track inspection records shall be filled out on the day of the inspection and submitted daily to the contractor's manager. At the end of each month, the Inspector will submit Track and Turnout Inspection Summary sheets to the Manager, Track and Structures Maintenance. The Manager, Track and Structures Maintenance, will review the records and file them at the end of each month.

15.3 ADDITIONAL INSPECTIONS

- A. Additional inspections shall be performed:
1. To protect track in times of high tide where sea waves may reach track.
 2. To protect track in extreme temperature as described in Section 8.2 entitled "Track Buckling Prevention – Track Inspection Requirements".
 3. To protect track in conditions of heavy rain or runoff.
 4. To inspect following earthquakes and tsunamis per Section 17, Earthquake Response, and Section 18, Tsunami Response.
 5. To protect against other conditions such as reports of fire, damage, vandalism, or adjacent construction.
 6. In advance of passenger trains if no operation over that route has occurred for 24 or more hours.
- B. Inspection reports for the above listed types of inspections shall be submitted to the Manager, Track and Structures Maintenance.

SECTION 16 *VEGETATION, GRAFFITI, AND TRASH CONTROL*

16.1 HERBICIDE APPLICATION

16.1.1 GENERAL

Comply with the following requirements of the Manager, Track and Structures Maintenance:

- A. Only licensed applicators are permitted to apply herbicides.
- B. Follow all safety precautions for handling and applying herbicides.
- C. Read and follow herbicide label directions.
- D. Do not apply herbicides close to desirable vegetation.
- E. Do not apply herbicides during high winds.
- F. Do not apply herbicides in or near bodies of standing or running water.
- G. Do not apply herbicides at a rate of exceeding the one recommended on the label.
- H. Herbicide shall be applied in accordance with Federal, State, and local regulations.
- I. Due to train traffic constraints, most applications will be done at night: pilots and applicators must be very familiar with the service territory.
- J. Report herbicide use to the Director of Engineering and Construction. Include the amount of herbicides used and the location it was used, and file the report by the first working day of each month.
- K. Forward questions regarding herbicide use to the Director of Engineering and Construction.

16.1.2 SPRAY TRUCKS

- A. Spray truck operators shall send a daily production message to the Manager, Track and Structures Maintenance.
- B. Weed and spray truck operations shall be performed only by a qualified pilot familiar with the territory.
- C. The truck operator shall keep an inventory of herbicides assigned to the spray unit.

16.1.3 GRANULAR APPLICATION SPECIFICATIONS

Apply granular herbicides in the early spring when plants are less than 3 inches tall and there is adequate moisture to get the herbicides into the ground. In arid regions, application should be made just prior to the rainy season.

16.1.4 NOTIFICATION

Manager of Maintenance of Way shall notify the SCRRA External Affairs office two week before beginning herbicide application.

16.2 VEGETATION CONTROL LIMITS

16.2.1 TRACK AREA

Vegetation shall be fully controlled within 20 feet of centerline of all tracks, except for landscape areas as defined under Section 16.2.1 entitled "Landscape Areas".

16.2.2 LANDSCAPE AREAS

Herbicides shall not be applied to landscape area.

16.2.3 RIGHT OF WAY OWNERSHIP

Portions of the SCRRA right of way are owned by other railroads. Generally the SCRRA will apply pre and post-emergent herbicides to these areas to minimize propagation to SCRRA owned land, but will not mechanically or manually remove brush from land in the ROW owned by others.

16.2.4 URBAN AREAS

Except for slope stabilizing vegetation and landscaping, vegetation shall be fully controlled in the right of way.

16.2.5 RECOLLECTABLE AREAS

Certain portions of the right of way are subject to agreements with local jurisdictions. Managers and supervisors shall account for vegetation and trash control within these areas as required to facilitate invoicing the responsible parties.

16.2.6 RURAL AREAS

Vegetation on natural slopes shall not be sprayed or cut unless cited as a fire hazard by local authorities.

16.3 GRAFFITI

- A. Painting over graffiti is limited by funding from member agencies. Some local jurisdictions will compensate SCRRRA for a “zero tolerance” level of control; managers and supervisors shall account for charges in these areas in sufficient detail to properly invoice the responsible parties.
- B. High priority shall be given to controlling graffiti on:
 - 1. Signals and Signal Enclosures
 - 2. Right of Way Signs
 - 3. Maintenance vehicles, equipment, and SCRRRA buildings
 - 4. Highway underpasses
 - 5. Locations at or near stations
- C. Graffiti on private property facing the right of way is generally the responsibility of the private property owner.

16.4 TRASH

- A. Track inspectors and repair crews shall remove small amounts of trash encountered in their inspection trips or work areas. Trash shall be disposed of in approved facilities.
- B. Note: Inspectors shall be particularly observant for trash or items that may be used in vandalism.

16.5 BRUSH CUTTING

- A. Vegetation within 150 feet of grade crossings shall be maintained to provide clear vision for trains, pedestrians, and vehicular traffic.
- B. For all right of way areas, bushes shall be selectively trimmed to provide some visibility through the right of way areas. Growth next to the ground shall also be removed. Brush shall be trimmed to provide clearance required by Public Utilities Commission, including removal of overhanging portions of privately owned plants or trees.
- C. In addition, trimming shall be carried out as required to protect bridges, trestles, culverts, SCRRRA buildings, and materials; pole and wire lines; and adjacent properties against fire hazard. Trimming of vegetation shall also be done as necessary to avoid the following: Obstruction of railroad signs and signals, interference with railroad employees/contractors performing normal trackside duties, preventing proper functioning of

signal and communication lines, and preventing railroad employees/contractors from visually inspecting moving equipment from their normal duty stations.

- D. Installation of new plant materials within SCRRA rights-of-way must be approved by the Director of Engineering and Construction.

SECTION 17 EARTHQUAKE RESPONSE

17.1 GENERAL

- A. Once an earthquake is reported or felt, advise all trains to stop until magnitude and location is determined, then all movement of train will be coordinated through dispatch center.

- B. The following are the general guidelines for any earthquake along SCRRA routes. If anything is unclear in the procedures, please contact the appropriate supervisor for clarification.

17.2 DEFINITIONS

- A. Earthquake: Any shaking of the earth's surface, whether minor or major, caused by underground tectonic forces.

- B. Aftershock: Tremors, minor or major, after an earthquake.

- C. Epicenter: The location determined to be the point where the earthquake actually originates and nearest to the point of highest intensity.

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17.3 EARTHQUAKE INSTRUCTIONS



Southern California Regional Rail Authority
2701 N. Garry Ave.
Pomona, CA 91767
(909) 593-7887 / Fax (909) 593-8187
ridensm@scrra.net

TRACK & STRUCTURES

MEMORANDUM

Date: January 09, 2009
To: Engineering and Operations
From: Rich Walker – Assistant Director, Maintenance and Rehabilitation
Subject: Track Maintenance and Engineering Instructions Revision:
Earthquake Response Procedures

Refer to page 126, Section 16 rule 16.3 Earthquake Instructions of the Track Maintenance and Engineering Instructions. Replace section in its entirety with the following:

When an earthquake is reported, the Metrolink Operations Center Supervisor of Commuter Operations must determine the area nearest the heaviest reports of ground movement. The Supervisor of Commuter Operations will take the following action:

1. Determine Location and instruct all trains within a 100 mile radius to immediately reduce to restricted speed as follows:

"DO NOT EXCEED RESTRICTED SPEED DUE TO EARTHQUAKE CONDITIONS."

NOTE: ON NIGHTS AND WEEKENDS CALL OFFICERS AT HOME AND PAGE IF NO ANSWER

2. Then notify the following:
- | | Name |
|-------------------------------------|--------------------|
| Superintendent-Dispatching | BAILEY _____ |
| Dir Engineering | MAXEY _____ |
| Asst. Dir. Engr. 213-219-6875 | WALKER _____ |
| Mgr MOW 213-305-8858 | RIDENS _____ |
| Dist. Signal Mgr. 213-305-6474 | COX _____ |
| Dist. Signal Mgr. 213-305-6468 | ROMO _____ |
| Genl Manager | MCDONALD _____ |
| Asst. Dir. of Operations | LETTENGARVER _____ |
| ALTA (if ML trains will be delayed) | _____ |
| Media 213-464-0030 | SAKACA _____ |
3. Use the cube system to verify the exact epicenter & magnitude of the earthquake. If Cube system is inoperative, contact cal-tech 620-395-0000 or 620-795-1200 (Hot Line) or call 510-642-3077 (Berkeley) or 303-273-8000 (Colorado)
 4. With this updated information, instruct all affected trains accordingly.

ABOVE MAGNITUDE 7.4: ALL TRAINS MUST STOP* UNTIL TRACK, STRUCTURES AND SIGNAL SYSTEM HAVE BEEN INSPECTED AND THE COMMAND CENTER RELEASES TRAINS.

MAGNITUDE 7.0 TO 7.4: ALL TRAINS WITHIN A 100 MILE RADIUS OF KNOWN EPICENTER MUST STOP* AND NOT PROCEED UNTIL TRACK, STRUCTURES AND SIGNAL SYSTEM HAVE BEEN INSPECTED.

MAGNITUDE 6.5 TO 6.9: ALL TRAINS WITHIN A 70 MILE RADIUS OF KNOWN EPICENTER MUST STOP* AND NOT PROCEED UNTIL TRACK, STRUCTURES AND SIGNAL SYSTEM HAVE BEEN INSPECTED.

MAGNITUDE 6.0 TO 6.4: ALL TRAINS WITHIN A 50 MILE RADIUS OF KNOWN EPICENTER MUST STOP* AND NOT PROCEED UNTIL TRACK, STRUCTURES AND SIGNAL SYSTEM HAVE BEEN INSPECTED.

MAGNITUDE 5.5 TO 5.9: ALL TRAINS WITHIN A 30 MILE RADIUS OF KNOWN EPICENTER MUST OPERATE AT RESTRICTED SPEED UNTIL TRACK, STRUCTURES AND SIGNAL SYSTEM HAVE BEEN INSPECTED. TRACK AND SIGNAL INSPECTIONS ARE REQUIRED.

MAGNITUDE 5.0 TO 5.4: ALL TRAINS WITHIN A 30 MILE RADIUS MUST OPERATE AT RESTRICTED SPEED UNTIL SIGNAL SYSTEM HAS BEEN INSPECTED. TRACK OR STRUCTURE INSPECTIONS ARE AT THE DISCRETION OF THE MGR OF MAINTENANCE OF WAY.

MAGNITUDE 4.9 TO LOWER: PROCEED AT NORMAL SPEED. NO INSPECTIONS ARE REQUIRED.

***NOTE: TRAINS MAY BE MOVED THE MINIMUM DISTANCE REQUIRED NOT EXCEEDING 5 MPH TO AVOID AN EMERGENCY SITUATION (IE: TO CLEAR A BRIDGE, GRADE CROSSING, ETC.)**

When an earthquake is reported, the Metrolink Operations Center Supervisor of Commuter Operations (SCO) shall determine the area nearest the heaviest reports of ground movement. The SCO shall take the following action:

- A. Instruct all trains within a 100-mile radius of that location to immediately reduce to restricted speed using the following instruction:

"DO NOT EXCEED RESTRICTED SPEED DUE TO EARTHQUAKE CONDITIONS."

- B. Then notify the following (Note, on night and weekends call officers at home and page if no answer):

	Phone Number	Name	
Superintendent-Dispatching		Bailey	
Dir Engineering		Maxey	
Asst. Dir. Engr.	213-219-9875	Walker	
Mgr MofW	213-305-8859	Ridens	
Dist. Signal Mgr.	213-305-9474	Cox	
Dist. Signal Mgr.	213-305-9468	Romo	
General Manager		Mcdonald	
Asst. Dir. of Operations		Lettengarver	
ALTA (if ML trains will be delayed)			
Media	213-494-8538	Oaxaca	

- C. Use the Cube System to verify the exact epicenter and magnitude of the earthquake. If Cube System is inoperative, contact Caltech 626-395-6955 or 626-795-1200 (Hot Line) or call 510-642-3977 (Berkeley) or 303-273-8500 (Colorado)
- D. With the updated information regarding the epicenter and magnitude, instruct all affected trains according to the following:
 1. **ABOVE MAGNITUDE 7.4:** All trains must **STOP*** until track, structures, and signal system have been inspected and the **COMMAND CENTER** releases trains.
 2. **MAGNITUDE 7.0 TO 7.4:** All trains within a **100 MILE RADIUS** of known epicenter must **STOP*** and not proceed until track, structures, and signal system have been inspected.
 3. **MAGNITUDE 6.5 TO 6.9:** All trains within a **70 MILE RADIUS** of known epicenter must **STOP*** and not proceed until track, structures, and signal system have been inspected.

4. **MAGNITUDE 6.0 TO 6.4:** All trains within a **50 MILE RADIUS** of known epicenter must **STOP*** and not proceed until track, structures, and signal system have been inspected.
5. **MAGNITUDE 5.5 TO 5.9:** All trains within a **30 MILE RADIUS** of known epicenter must operate at restricted speed until track, structures, and signal system have been inspected. Track and signal inspections are required.
6. **MAGNITUDE 5.0 TO 5.4:** All trains within a **30 MILE RADIUS** must operate at restricted speed until signal system has been inspected. Track or structure inspections are at the discretion of the Manger of Maintenance of Way.
7. **MAGNITUDE 4.9 TO LOWER:** Proceed at normal speed. No inspections are required.

***NOTE:** Trains may be moved the minimum distance required not exceeding 5 mph to avoid an emergency situation (i.e: to clear a bridge, grade crossing, etc.)

FURTHER NOTE: In case of a Tsunami Alert, train may be moved as described herein away from “Low Track” at risk from tsunami. See Section 17 “Tsunami Response” for definitions and additional information.

17.4 EARTHQUAKE INSPECTION

17.4.1 GENERAL

- A. Inspections following earthquakes shall be given the highest priority. Train dispatchers shall arrange for joint time, time behind, or other methods to accomplish a complete inspection and restore train operations. Except to move passenger trains to the next station or to move trains out of the way of inspectors, dispatchers shall give priority to accomplishing these inspections instead of moving trains.
- B. Inspectors shall not stop inspections and begin repairs unless required to move loaded passenger trains to a place of safety. The goal of the inspections is to determine the overall extent of damage and serviceability of the railroad.
- C. Track Inspectors shall perform a general observation of the track, structures, and signals over the territory that they inspect following an earthquake. Their observations will guide more detailed inspections by structures and signal personnel, if indicated. As they complete inspection of each track segment, they shall release it for train movement unless other

indications are presence that will require further inspections or repairs to track, signals, or structures.

- D. Structures inspections shall be performed for earthquakes exceeding magnitude 5.8, and at problem locations identified by the Track Inspector for lesser earthquakes.
- E. Signal inspections shall be performed for earthquakes exceeding magnitude 5.8, at problem locations identified by Track Inspectors for lesser earthquakes, and as directed by Contract Signal Supervisors or SCRRRA Manager of Signals and Communications. Signal inspections shall also be guided by data received from monitoring systems, defect detectors, and the CTC communications network.

17.4.2 INCIDENT COMMAND

In the event of an earthquake, the Dispatcher is the central point of contact for all information concerning the status of the railroad. Inspectors shall report their whereabouts to the Dispatcher and estimate their time of arrival to their territory. After contact is established with the Dispatcher, Inspectors shall contact the appropriate Manager of Maintenance of Way or Signal and Communication for additional instructions. Upon arrival at their territory, inspectors shall provide inspection assessments to the Dispatcher. The Managers of Maintenance of Way and Signals and Communications shall also contact the Dispatcher on a regular basis until such time as the railroad is back in order. These managers shall also keep the Director Engineering and Construction up-to-date as information is developed.

17.4.3 EARTHQUAKE TRACK INSPECTION

- A. Track Inspectors will observe the right of way as a whole for earthquake damage. The goal is to determine whether any condition affecting the safe operation of trains exists and to guide recovery efforts. Examples of general conditions include:
 - 1. Fallen overhead utility lines.
 - 2. Fallen buildings, retaining walls, or trees.
 - 3. Earth slides, rock falls, or fissures.
 - 4. Displacement (faulting) of the earth.
 - 5. Ruptured pipes.
 - 6. Congregations of displaced people.
 - 7. Fires in adjacent properties.

- B. Track Inspectors shall impose speed restrictions for these general conditions if necessary for the safety of train operations or for the public safety.
- C. Track Inspectors shall inspect track for line and surface. Particular attention shall be given to bridge abutments and high fills, which may settle. During times of high temperatures, they shall inspect for signs of thermal rail stress because earthquake shaking can disturb the ballast. They shall impose speed restrictions and arrange for repairs for any condition not meeting FRA track safety standards.
- D. Track Inspectors shall inspect each railroad bridge for track alignment and surface and for signs of ballast displacement. Bridges with spans in excess of 45 feet shall, in addition, be inspected by observation of the bridge seats to determine whether there has been any displacement between the superstructure and the abutments or piers. If any conditions are encountered that may compromise the safety of trains using the bridge, they shall immediately contact their supervisor. When completing inspection for a segment of track and releasing it for train movement, they shall confirm that all structures within that segment have been observed and no visible defects were found. For earthquakes less than magnitude 5.8, no additional bridge inspection is required unless directed by the Manager, Track and Structures Maintenance, or the Structures Manager.
- E. Track Inspectors will observe each highway and pedestrian bridge over the railroad for signs of displacement, settlement, or fallen debris. They shall observe bridge seats for signs of movement. If any conditions are encountered that may compromise the safety of trains passing under the bridge or vehicular or pedestrians using the bridge, they shall immediately contact their supervisor. When completing inspection for a segment of track and releasing it for train movement, they shall confirm that all structures within that segment have been observed and no visible defects were found.
- F. Track Inspectors shall inspect each tunnel for indications of damage to the concrete lining, fallen concrete, or misalignment of tunnel walls in addition to inspecting track alignment. If any conditions are encountered that may compromise the safety of trains using the tunnel, they shall immediately contact their supervisor. When completing inspection for a segment of track and releasing it for train movement, they shall confirm that tunnels within that segment have been observed and no visible defects were found.
- G. Track Inspectors shall report any of the following exceptions to the train dispatcher immediately upon observation. When completing track inspection for a segment of track and releasing it for train movement they

shall confirm that none of these conditions exist. Track Inspectors shall observe each signal location for the following conditions:

1. Signal masts, antennae, and houses not displaced.
2. Gate arms not fouled by utility lines; gate arms not broken.
3. Crossing warning not operating unless activated.
4. Power Off indicator status.
5. Area near signals clear of fallen wires, trees, and structures.

17.4.4 STRUCTURE INSPECTIONS

- A. The Manager, Track and Structures Maintenance, will determine whether structure inspections should be initiated for earthquakes of less than 5.8 magnitude. Track Inspectors' reports of irregularities at bridges following earthquakes of less than 5.8 magnitude will also authorize structure inspections. All railroad structures shall be inspected following earthquakes of magnitude 5.8 or greater; the Manager, Track and Structures Maintenance, will direct the distance from the epicenter for structures inspections.
- B. Structure Inspections shall initially focus on tunnels and bridges with spans of 45 feet and longer unless Track Inspector reports track irregularities on short-span bridges or culverts. Upon completion of inspection of the longer span bridges, Structures Inspectors shall check a representative sample of short span bridges.
- C. Structures Inspectors shall have access to prior bridge inspection records to determine if signs of distress are new or have been reported previously and therefore do not endanger railroad operations.
- D. The Manager, Track and Structures Maintenance, will direct structures inspections following earthquake magnitudes between 5.0 and 5.8 for temporary conditions such as:
 1. Bridges supported by scaffolding.
 2. Open excavations within load influence zone of track.
 3. Bridges under construction.

17.4.5 SIGNAL INSPECTIONS

- A. The Manager, Signals and Communications, will determine whether signal inspections should be initiated for earthquakes of less than 5.8 magnitude.

Track Inspectors' reports of irregularities at signal locations or crossings, or dispatcher reports of CTC problems following earthquakes of less than 5.8 magnitude will also authorize signal inspections.

- B. Open wire pole line track circuits shall be inspected following an earthquake of magnitude 5.4 or higher within 30 miles of the pole line.
- C. A signal system inspection shall be performed to determine that devices (relays, batteries, etc.) have not been displaced inside signal enclosures and to verify condition of open wire pole lines for earthquakes in excess of 5.8 magnitude. Remote communication sites shall be checked remotely or inspected within 24 hours. The Manager, Signals and Communications, will direct the distance from the epicenter for signal inspections.

17.5 INSPECTION REPORTS

- A. Upon the completion of each segment of track, signal, and structures inspection, inspectors shall inform the dispatcher and department manager of conditions found and whether the operation of training may resume.
- B. Upon completion of all inspections for an earthquake event, each inspector shall complete an inspection report per 49CFR213.239.

17.6 MAINTENANCE-OF-WAY COMMAND CENTERS

- A. Command centers shall be established as soon as possible after an earthquake if a magnitude of 5.0 or greater is reported. They should be established where all means of communications are available. If possible, these centers shall be established where maintenance-of-way radio base stations are located because of the congestion which will occur on the road and PBX frequencies making communications on these frequencies less reliable.
- B. A backup center should be selected in case the primary center is made inoperable by the earthquake.
- C. The primary personnel coordinator in these centers will be the Manager, Track and Structures Maintenance, with personnel and backup personnel as selected. One of the personnel for each center should be a person who normally is near the city of the command center. This person shall report to the command center and ensure that expeditious inspections are coordinated and documented. Backup personnel shall also include individuals who are normally in the city of the command center.
- D. The SCO shall be kept fully informed as the inspections progress to avoid unnecessary delay to train operations.

- E. A list of key inspection locations shall be prepared and regularly maintained by the contractor for each Division and forwarded to the SCRRRA Director of Engineering and Construction after each update. This list should include:
1. Slide areas.
 2. Tall structures, adjacent to track, such as: buildings, chimneys, overpasses, and water towers that could collapse and foul the railroad.
 3. Tunnels.
 4. Steel and concrete bridges.
 5. Other locations.

SECTION 18 *TSUNAMI RESPONSE*

18.1 GENERAL

- A. Once a warning of a tsunami is received, the train dispatcher shall immediately determine the time remaining until shore impact and the location of trains near or approaching the shore. Depending upon the time remaining, trains shall be directed away from areas at risk (Low Track of a particular height) and restricted from entering these areas. Trains located outside the areas identified as the particular height Low Track area shall be considered safe. Refer to Figure 18-1, Tsunami Zone Chart. In regard to a tsunami anticipated to be greater than 50 feet above sea level, the Low Track 100 column of Figure 18-1 shall govern. Engineering and operating field employees shall be assigned as observers to report on the effects of the tsunami and manage inspections and repair efforts.

- B. A tsunami is an ocean wave of water of extraordinary height and length. When a tsunami impacts a shore it can flow inland for a matter of several minutes. At the end of the inflow phase, that same volume of water will flow back to the ocean. The effects of a tsunami on landforms and infrastructure is a very intense flood of rapidly flowing water and water-carried debris. A tsunami can be expected to erode railroad embankments, wash away tracks and bridges, and deposit large amounts of debris. Railroad rolling stock is likely be swept off of the tracks and rolled over.

- C. Earthquakes are frequently the cause of tsunamis. An earthquake off the coast of California is one probable cause of a tsunami. The safety of train operations and the inspection of tracks and signals is governed by both Section 17, Earthquake Response, and this Section. Specifically, Section 17.3 entitled “Earthquake Instructions” requires the emergency movement of a train at restricted speed if the train is within the Low Track at risk of a tsunami. A tsunami may also be generated by an earthquake far away such as Alaska; this would mean there is no earthquake response and the tsunami response alone guides the emergency procedures.

- D. The SCRRA region has much lower risk of exposure to a tsunami than an earthquake. However some tsunamis can be predicted with hours of advance warning and managers of train and infrastructure operation have a better opportunity of mitigating a tsunami than an earthquake. Therefore tsunami preparation and planning is an important responsibility because remedial measures can be taken before the event.

18.1.1 DEFINITIONS

- A. **Earthquake:** Any shaking of the earth’s surface, whether minor or major, caused by underground tectonic forces.

- B. **Low Track 10:** Track less than 10 feet above sea level and vulnerable to a tsunami of up to 10 feet.
- C. **Low Track 20, etc:** Track less than the number of feet (20 in this example) above sea level and vulnerable to a tsunami of that height.
- D. **High Track:** The track above the predicted height of a tsunami and considered to be not at risk of damage.
- E. **SCO:** The Metrolink Operations Center Supervisor of Commuter Operations.
- F. **Tsunami:** A very large ocean wave caused by an earthquake or an undersea landslide.
- G. **Tsunami Alert:** A warning of a tsunami that may impact the ocean shore in the SCRRA service territory, usually received from government or contract weather forecasting sources.

18.2 TSUNAMI INSTRUCTIONS

- A. When a Tsunami Alert is received, the Metrolink Operations Center SCO will determine the estimated time of arrival of the wave (which may vary along the coast) and the estimated height of the tsunami. If the first report of a possible tsunami is received from the media or individual persons, the SCO must attempt to confirm the alert information from the contract weather forecasting service.
- B. Figure 18-1 is a listing of locations that are to be considered Low Track for the height of the predicted tsunami. The SCO will refer to this table in taking the following actions.

18.2.1 LESS THAN TWO HOURS TO IMPACT INSTRUCTIONS

- A. If there is less than two hours before the predicted arrival of the tsunami, the SCO will immediately halt all train approaching the Low Track and will make arrangements for trains and workers within the Low Track to move to the High Track. If there is only a short amount of time available, exceptions to normal operations are permissible as explained below.
- B. The SCO will immediately contact personnel with Track and Time or Form B in effect within the Low Track and instruct them to exit the area, restoring track if practicable. If none of these work activities are in effect, the SCO will make a general broadcast to any roadway workers within the Low Track (because workers may be using Watchman/Train Approach Warning to protect workers).

- C. Generally, trains in the Low Track shall continue in their direction of travel toward High Track, unless the High Track to the rear of the train is 10 or more miles closer to the train than High Track ahead of the train (this is because several minutes will be lost reversing direction).
- D. Exceptions to normal operation: If there is insufficient time to evacuate train to High Track, trains may be authorized to make exceptional operations, including the following:
 - 1. Trains headed for High Track shall offer to stop and transport Roadway Workers (including third party contractors working on the right of way) to High Track.
 - 2. Amtrak and Commuter trains shall make all station stops of both parties, offering transportation to any people at the station (however conductors may need to limit the duration of these station stops so as to arrive at High Track before the time of the wave impact).
 - 3. Train may be directed to enter Track and Time limits in effect and proceed toward High Track at a speed prepared to stop within the range of vision until coming upon the party having the Track and Time and aid in evacuating that party.
 - 4. Freight trains may leave their cars between switches of sidings and the crews may proceed light engine if that will make the difference between arriving at High Track before or after the arrival of the tsunami. Freight trains shall make every practicable effort to move cars containing Hazardous Material to High Track.
 - 5. Passenger trains unable to proceed to High Track within the time remaining may discharge passengers at locations where they may use streets or pedestrian pathways to gain access to high ground.

18.2.2 TWO OR MORE HOURS TO IMPACT

Trains may enter the limits of Low Track if they can exit before two hours of the predicted arrival time. The SCO will notify Roadway Workers as described above. Generally, the “exceptions” in the Section 18.2.1 entitled “Less than Two Hours to Impact Instructions” will not be permitted if there is more than two hours of warning time.

18.3 UPDATING INFORMATION

- A. Throughout the Tsunami Alert period, the SCO shall update information and revise the emergency response accordingly. The agency issuing the alert will probably revise their predicted arrival times and wave height. The media or other public agencies (fire departments, etc.) may be able to

provide reports on actual wave development or arrival, particularly for waves that are traveling south (e.g. from the Gulf of Alaska); these waves will impact Northern California an hour or more before impacting the SCRRA territory and these reports can be used to refine the response plan.

- B. A tsunami response plan should not be cancelled nor should regular train operations be resumed unless two or more credible sources indicate that there is no risk to operations.

18.4 FIELD OBSERVERS

- A. The SCO will arrange with SCRRA or service contractor (train operation or track or signal maintenance) to have observers at locations where they can observe the arrival (or non-arrival) of the tsunami. Observers shall locate themselves at an elevation above the predicted height of the wave and within sight of the ocean or the tracks.
- B. Observers shall communicate directly with the train dispatchers on the road channel and shall use the mobile PBX function of their railroad radios to communicate with the MOC. Observers shall be fully equipped and capable of using these communications without reliance on cell phones or other public commercial channels.
- C. Observers shall identify themselves to public safety officials as essential components of the tsunami public safety response and should resist efforts at forced evacuation provided that they are on sufficiently high ground.
- D. Observers shall report the extent of tsunami travel onshore and damage observed from their vantage point. Because tsunamis may arrive in groups and because their arrival time is uncertain, observers shall not leave their high ground until 30 minutes after the tsunami flows out to the ocean or 30 minutes after the predicted arrival time of the tsunami if none is observed.
- E. If no tsunami is observed for 30 minutes after the predicted arrival time, observers shall begin reconnaissance closer to the ocean to report what, if any, the extent of tsunami damage is.
- F. Observers shall coordinate with track and signal inspectors on the conditions observed, liaison with public safety officials, and report location of trains and roadway workers.

18.5 POST-TSUNAMI INSPECTIONS

18.5.1 GENERAL

SCRRA and contractor inspectors shall position themselves near the limits of the Low Track and be ready to perform inspections when possible to do so. They shall use railroad radio and PBX communication as described in Section 18.4

entitled “Field Observers”. They shall identify themselves to public safety officials as personnel essential to the public safety. They may take public safety officials on their inspections if railroad safety is not compromised.

18.5.2 NO TSUNAMI IMPACTS

If the observers report that the actual arrival of the tsunami was of a minor nature or if the Tsunami Alert is officially cancelled, regular train operations shall be resumed without prior track or signal inspections. Track inspectors shall perform an inspection of the track and shoreline adjacent to the ocean within three hours.

18.5.3 INSPECTION OF TSUNAMI DAMAGE

- A. If the tsunami is known to have impacted the shore or overtopped the tracks, inspections shall be performed before train operations are resumed. If tracks are damaged or covered with debris, a walking inspection will be necessary. Note, it is more valuable to complete a comprehensive overview/inspection than to immediately initiate repairs.
- B. Inspectors shall advise the SCO of conditions and estimated time to complete inspections or repairs as frequently as information is known. The judgment of the Inspector shall govern the manner of inspection; the following guidelines are only a checklist and a suggested priority.
- C. If the tsunami has inundated the ground at signal devices, they are to be considered inoperable. Grade crossings may have to be de-activated and gates raised and Rule 6.32.2 applied by all trains in order to restore public access to affected areas. The highest priority of signal inspection and repair will generally be to restore the track circuits and wayside signals.
- D. Inspectors shall prepare a comprehensive estimate of repairs needed and shall coordinate repair plans with operating priorities.

18.5.4 NOTIFICATIONS

Consistent with the above actions the SCO must notify the following Maintenance-of-Way (MofW) supervisors to arrange inspection of all trackage, structures, and signal systems in the affected area:

- A. SCRRRA Emergency Duty Officer, or if cannot be reached, notify the following:
 - 1. SCRRRA – Manager / Maintenance-of-Way
 - 2. Track Maintenance Contractor – Track Inspector
 - 3. Signal Maintenance Contractor – Communications and Signal Maintainers

4. SCRRRA Sheriff and Claims, if applicable
- B. SCRRRA Emergency Duty Officer, or if cannot be reached, notify the following:
 1. SCRRRA Director of Operations
 2. SCRRRA Director of Engineering and Construction

18.5.5 INSPECTION REPORTS

- A. Upon the completion of each segment of track, signal, and structures inspection, inspectors shall inform the dispatcher and department manager of conditions found and whether the operation of training may resume.
- B. Upon completion of all inspections for a tsunami event, each inspector shall complete an inspection report per 49CFR213.239.

18.6 PUBLIC AND PASSENGER INFORMATION

(This subject is not included in the Engineering and MofW instructions, but will be found in the SCO and Metrolink Commuter Operations (MCO) manuals.)

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FIGURE 18-1 - TSUNAMI ZONE CHART

Low Track 10	Low Track 20	Low Track 30	Low Track 40	Low Track 50	Low Track 100
Escondido Jct. 0.0 to MP 2.0	Escondido Jct. 0.0 to MP 2.0	Escondido Jct. 0.0 to MP 2.0	Escondido Jct. 0.0 to MP 2.0	Escondido Jct. 0.0 to MP 3.0	Escondido Jct. 0.0 to MP 4.0
CP Serra 199.9 to CP Songs 209.2	CP Capistrano 198.0 to CP Songs 209.2	CP Capistrano 198.0 to CP Songs 209.2	CP Capistrano 198.0 to CP Songs 209.2	CP Capistrano 198.0 to CP Songs 209.2	San Juan Capistrano Station 197.2 to MP 210.5
CP Cardiff 239.6 to CP Craven 241.1	CP Mesa 222.6 to Fallbrook Jct. 224.1	CP Mesa 222.6 to Fallbrook Jct. 224.1	CP Mesa 222.6 to Fallbrook Jct. 224.1	MP 217.5 to CP Oneil 220.8	MP 216.0 to MP 251.0
CP Valley 242.2 to CP Torrey 248.8	CP Escondido Jct. 227.2 to CP Farr 231.4	MP 225.0 to CP Shell 225.9	MP 225.0 to CP Shell 225.9	CP Mesa 222.6 to MP 236.0	MP 257.5 to MP 270.0
CP Tecolote 263.2 to MP 265.0	CP Ponto 234.5 to MP 236.0	CP Escondido Jct. 227.2 to Carlsbad Village 229.2	Oceanside Sta. 226.4 to Poinsettia Sta. 233.3	CP Cardiff 239.6 to CP Pines 249.8	
CP Ash 267.2 to MP 270.0	CP Cardiff 239.6 to CP Craven 241.1	MP 230.0 to MP 231.0	MP 234.3 to MP 235.5	MP 259.0 to MP 270.0	
	CP Valley 242.2 to CP Del Mar 243.9	MP 232.4 to Poinsettia Sta. 233.3	CP Cardiff 239.6 to CP Pines 249.8		
	MP 245.0 to CP Torrey 248.8	CP Ponto 234.5 to MP 236.0	CP Morena 260.5 to MP 270.0		
	CP Morena 260.5 to MP 270.0	CP Cardiff 239.6 to CP Del Mar 243.9			
		MP 245.0 to Sorrento Valley 249.0			
		CP Morena 260.5 to MP 270.0			

SOUTHERN CALIFORNIA REGIONAL RAIL AUTHORITY TRACK MAINTENANCE, RIGHT OF WAY AND STRUCTURES, ENGINEERING INSTRUCTIONS APPENDIX A – SYSTEM MAP (AS OF 2007)



**SOUTHERN CALIFORNIA REGIONAL RAIL AUTHORITY
TRACK MAINTENANCE, RIGHT OF WAY AND STRUCTURES,
ENGINEERING INSTRUCTIONS
APPENDIX B - GLOSSARY**

Adjusting/Destressing: The procedure by which a rail's temperature is re-adjusted to the desired value. It typically consists of cutting the rail and removing rail anchoring devices, which provides for the necessary expansion and contraction, and then re-assembling the track.

Alignment – General: The physical appearance of the railroad as viewed from above, which consists of a series of straight lengths of track, referred to as tangents, connected by simple, compound, or reverse curves.

Angle Bar: Short pieces of steel used to join together standard sections of rail (usually 39 feet in length). Four bolts, fastened through a pair of holes at each end of the angle bar, are used to join the rails together.

Ballast: Selected material placed on the roadbed to support and hold track in line and surface. Ballast preferably consists of sized hard particles easily handled in tamping that distribute the load, drain well, and resist plant growth.

Ballast Section: The cross section of a track around and under the crossties and between and above the toes of the ballast slopes. This section may include sub-ballast.

Branch Line: A secondary railroad line that is not a main line.

Buckling: The formation of a lateral misalignment of rail sufficient in magnitude to constitute a deviation from the Class 1 requirements. Typically caused by excessive thermal expansion of the rail, insufficient lateral strength, or both.

Cant: Tilt or inclination, as the inward inclination of a rail, accomplished by using canted tie plates. The undesirable outward tilt of tie plates on sharp curves.

Centralized Traffic Control (CTC): A signalling system used by railroads that consists of a centralized train dispatcher's office that controls railroad switches and signals in the CTC territory.

Compromise Joint: A special rail joint, sometimes also called a step joint, for uniting rails of different sections; made so it brings gage sides and joined rail heads into line so that continuous smooth surfaces are presented to treads and flanges of passing wheels. A joint for uniting the abutting ends of rails of different cross section (for example 115 RE rail to 136 RE rail).

Continuous Welded Rail (CWR): Rail that is 400 foot or greater in length. Rail laid in typical lengths of 1,500 feet or so (roughly a 1/4-mile), rather than 39-foot stick rail bolted together. CWR will not buckle if properly adjusted and anchored.

Controlled Siding: A siding where switches and signals are remotely controlled by a dispatcher.

Control Point: An interlocking or the location of a track signal which dispatchers can specify when controlling trains.

Cross Buck: Highway or roadway vehicle signage to indicate the approach of a roadway to a railroad grade crossing.

Crossover: Facilitates the movement of rail equipment onto parallel tracks via back-to-back switches.

Crossing: Commonly known as a diamond, they allow for railroad tracks to intersect each other at any type of angle that does not allow for actually switching on to the other track. It is also the term often referred to the place where highways and railroad tracks meet commonly known as grade crossings.

Cross Tie: See Tie.

Derail: Track safety device to guide rolling stock or other equipment off the rails at a selected spot as means of protection against equipment out of its secured limits. A track designed to derail rolling stock in case of an emergency.

Destress: See Adjusting/Destressing.

Diamond: Similar to a crossing, a situation when two railroad lines cross one another without the means of switching onto the other track. See Crossing.

Double Track: Parallel sets of main line tracks, typically found in areas with high densities of traffic.

Dynamic Track Stabilizer: On-track equipment used to mechanically compact the track structure and increase the track's lateral load capacity.

Fill: A railroad right-of-way formed by leveling a low area to keep the ruling grade manageable.

Fit Rail: Used rail that has been visually inspected and ultrasonically tested within the last 6 months and found fit for use.

Fouling the Track: Fouling the track means being within the designated safe clearance envelope of the railroad track. Refer to SCRRRA's RWP (Roadway Worker Protection) rules

Flangeway: Space between running rail, guard rail, frog casting, frog wing rail or timber in road crossing to provide clearance for passage of wheel flanges.

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. Switches are numbered according to the angle of their frogs (so the sharper the curve the less speed it can be taken at). For instance, a Number 20 switch separates the rails one foot for every twenty feet traveled.

Frog – Spring: An appliance that contains, among other things, a fixed frog point, a moveable spring wing rail, a rigid wing rail, frog hold-down assemblies, and spring box.

Gage: The measurement between the inside of the two rails 5/8" below the running surface of a rail. Standard Gage is 4 feet 8 1/2 inches.

Grade: The slope or angle of the railroad right-of-way. It is based on percentages so if the ruling grade for a rail line or section of railroad track is 2 percent that means that the right-of-way rises roughly two feet per every one-hundred feet traveled.

Grade Crossing: A highway or road crossing that is at the same level (grade) as the railroad

Guard Rail: Usually placed on bridges one or two rails are placed inside the running rails to prevent derailed railroad equipment from contacting other structures.

Head Block: Ties used to support the switch-point operating mechanism and the switch stand.

Highway-Crossing Warning Devices (Active): An arrangement of one or more highway-crossing signals, with or without gates, to protect highway traffic.

Hi-Rail Vehicle: A vehicle that can be used on or off the rail.

Interlockings: An arrangement of signals, switch locks, and signal appliances so interconnected that their movements succeed each other in a predetermined order. It may be operated manually or automatically.

Jointed Rail: Rail in standard sections (usually 39 feet) that was bolted together, as opposed to continuously welded rail (CWR).

Joint – Insulated: A rail joint designed to arrest the flow of electric current from rail to rail by means of insulation so placed as to separate the rail ends and other metal parts connecting them.

Junction: The area where two or more rail lines meet or intersect.

Light Engine: Train consisting of only a locomotive.

L/V Ratio: The relationship of lateral force on the rail to the vertical force on the rail, which is produced by the wheel of railroad rolling stock, work equipment, and other equipment moving along the track.

Main Line: The principal railroad track that connects two points. It usually also includes sidings, spurs, and yards at a number of different locations to serve train meets, customers, and hold freight cars.

Maintenance of Way: The repair and maintenance of a railroad right-of-way and track structure.

Maximum Authorized Speed (Authorized Speed): That speed for a portion of track as specified in the current Employee's Timetable.

MofW OPR Rules: SCRRRA General Code of Operating Rules for Maintenance of Way Employees.

OTM: Other Track Material which includes tie plates, rail joints, fasteners, bolts and other miscellaneous track material

Neutral Temperature: The temperature at which rail is secured in a stress-free condition having neither compressive nor tensile stress.

Pound (Rail): The unit of measure of rail size is weight per yard. For instance, 120-lb rail gets its weight designation because every three feet of rail weighs roughly 120 lbs.

Premium Rail: Premium rail is high strength rail (alloy or head hardened).

Prestressed Concrete: Type of reinforced concrete in which cables or wires are stretched placing them in tension before loading, thereby placing what would normally be the tension areas of the concrete in compression. It allows for economical use of both concrete and steel.

Pull-Aparts: A track defect caused by excessive contraction of the rail when cold, it may be the rupture of all bolts in a joint or a rail fracture that pulls apart the rail.

Rail: Hot rolled steel in the profile (cross-section) of an asymmetrical I-beam is usually used as the surface on which railway equipment wheels run on.

Rail Anchor: A device attached to the base of a rail bearing against a crosstie to prevent the rail from moving longitudinally under traffic.

Rail Bond: A device used to transfer an electric circuit across rail ends at a rail joint.

Rail Fastening System: The hold-down appliances that provide the required combination of horizontal, lateral, and vertical restraint to permit the safe operation of rail vehicles. Examples of systems found on SCRRRA include the cut spike, Pandrol “e” clip, fast clip, and coach screw.

Rail Joint: A fastening designed to unite the abutting ends of contiguous rails.

Rail Lubricator: A device designed to apply grease to gage side of the railhead at the beginning of a curve. In order to minimize wear of the rail and wheel flange or to eliminate noise.

Right of Way: Land or water rights used for the railroad for its roadbed and its structures.

Roadbed: The foundation on which the rails and ties of a railroad are placed. Contains Sub-grade, Sub-Ballast and Ballast.

Scrap: Rail, ties, or other track materials (OTM) that are not suitable for reuse.

Shoulder (Track): That portion of the ballast between the end of the tie and the toe of the ballast slope. Used to support the track structure laterally

Shunting: A “short circuiting” or false signal caused by completing an electrical circuit between one rail and another. This is because the track signaling system uses the rail car wheels and axle to complete an electrical circuit between one rail and the other. The completion of this circuit is used as a signal that the train is present. The signal may be used to activate crossing arms or other train signals.

Siding: An additional track found to the right or left of the main line that allows for trains to operate more efficiently over a line whereby they can "pull over" to allow another train to pass.

Single Track: One main track, on which trains operate in either direction, distinguished from double or multiple tracks.

Span: Length between supports.

Spike: A long steel square nail with a cutting edge used to secure rail in place.

Spur: A short stretch of track splitting from the main line which is normally used to serve either customers or to store equipment. Also, spur track.

Standard Gage: See Gage 4'-8 1/2".

Stock Rail: The rail against which the point of a switch rests.

Surface (Track): The condition of the track as to vertical and horizontal evenness or smoothness.

Surfacing: Raising ballast and making it smooth: Surfacing falls into three categories of raising ballast:

Out-of-face surfacing: 2 inches and over

Skin lift or smoothing: under 2 inches

Spotting: raising various low spots

Superelevation: The height difference between the outer (higher) rail above the inner rail which results in banking of tracks on curves.

Switch: Track equipment (component) that allows for cars to move, or crossover, from one track to another. The verb meaning of this term refers to shuffling or moving rail cars, usually within a yard (also called marshaling).

Switch Machine: The Communications and Signals (C&S) appliance that powers and provides for the positive movement and locking of the switch rails and/or moveable point frog to permit the safe, uninterrupted movement of rail vehicles through a turnout.

Switch Point: Can be moved laterally into one of two positions so as to determine whether a train coming from the narrow end will be led towards the straight path or towards the diverging path

Switch Tie: The transverse member of the track structure that is longer than, but functions, as a cross tie, and in addition supports a crossover or turnout. See Tie.

Tamper: A power-driven machine for compacting ballast under ties.

Tangent: The term for straight track.

Tie: The component of railroad infrastructure that holds the rails in place and supported by the surrounding ballast. Ties are usually made of wood, concrete, or newer composite materials. The transverse member of the track, 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. Also, Cross Tie.

Tie Crib: The ballast or the open space between two adjacent crossties.

Tie Plate: A steel plate interposed between a rail or other track structure and a tie.

Tolerance: An allowance made for a small variation from dimensions specified.

Track: The rail, ties, rail fastenings, hardware, and roadbed between points not less than 4 feet outside of each rail.

Track Buckling: The sudden formation of large lateral misalignments caused by high compressive forces, in the presence of some other influencing factors.

Track Chart: A map-like representation of the grade and alignment of a section of a railroad (Includes additional information – rail size, rail year, type of tie, structures and of fitted points along the rail right of way)

Track Gage: See Gage.

Track Signal: A signaling system that uses the rail for transmitting signals. These signals may be used to warn of an approaching train and lower crossing arms.

Transpose Rail: Changing rail from one side to the other on curves because of headwear.

Trestle: A structure that spans a short distance (usually a stream or overpass that uses timbers or steel for supports).

Truck: The complete assembly of parts including wheels, axles, bearings, side frames, bolster, brake rigging, springs and all associated connecting components, the function of which is to provide support, mobility and guidance to a railroad car. Turnout: An arrangement of a switch and a frog with closure rails by means of which rolling stock may be diverted from one track to another. Another name for “track switch.”

Turnout: Another term for a railroad track switch.

Washout: An erosion of the permanent roadbed by storm or flood to such an extent as would cause delay of trains or endanger traffic.

Weld – Butt: A weld joining two abutting surfaces. This weld serves to unite the rail ends. Electric butt rail welding is accomplished with a stationary in-plant or electrical in-plant.

Weld – Thermite: A weld joining two abutting surfaces with an intervening space. The weld serves to unite the abutting surfaces with the introduction of metal weldment. This process is accomplished by using easily handled weld kits.

Welded Rail: See Continuous Welded Rail (CWR). A piece of rail that is 400 foot in length or greater.

Yard: A system of tracks within defined limits provided for the making up of trains, storing of cars and other purposes. A system of tracks branching from a common track.

END OF APPENDIX B - GLOSSARY

**SOUTHERN CALIFORNIA REGIONAL RAIL AUTHORITY
TRACK MAINTENANCE, RIGHT OF WAY AND STRUCTURES,
ENGINEERING INSTRUCTIONS**

APPENDIX C - SUMMARY OF SPEED RESTRICTIONS FOR TRACKWORK

	Type of work performed	First train	Up to 24 Hours	After 24 hours
	Maximum speed	Pass/Frt ¹⁰	Pass/Frt	Pass/Frt
SPECIAL TRACKWORK	Newly installed switches or turnouts - not surfaced	10/10 mph	10/10 mph	Not Applicable
	Newly installed switches or turnouts - surfaced, not stabilized	10/10 mph	30/20 mph	Timetable
	Newly installed switches or turnouts - surfaced and stabilized	30/20 mph	Timetable	Timetable
TIE INSTALLATION	Tie Installation - spot, less than 200' - surfaced	15/10 mph	30/20 mph	Timetable
	Tie Installation - spot, less than 200' - surfaced and stabilized	30/20 mph	Timetable	Timetable
	Tie Installation - production, greater than 200TF - surfaced, not destressed and not stabilized below 80 degree F or below ARLT	15/10 mph	30/20 mph	Timetable
	Tie Installation - production, greater than 200TF - surfaced, not destressed and not stabilized above 80 degrees F or above the ARLT	15/10 mph	15/10 mph	15/10 mph
	Tie Installation - production, greater than 200TF - surfaced, stabilized not destressed below 80 degree F or below ARLT	30/20 mph	Timetable	Timetable
	Tie Installation - production, greater than 200TF - surfaced, stabilized not destressed above 80 degrees F or above the ARLT	15/10 mph	15/10 mph	15/10 mph
	Tie Installation - production, greater than 200TF - surfaced and destressed, not stabilized	15/10 mph	30/20 mph	Timetable
	Tie Installation - production, greater than 200TF - surfaced, destressed and stabilized	30/20 mph	Timetable	Timetable

¹⁰ Pass/Frt. means Passenger/Freight. When train speed is written as two numbers separated by a “/”, it shall be understood that the first number applies to passenger trains and the second number applies to freight trains.

	Type of work preformed	First train	Up to 24 Hours	After 24 hours
	Maximum speed	Pass/Frt ¹⁰	Pass/Frt	Pass/Frt
CWR INSTALLATION	CWR Installation, surfaced, distressed, not stabilized, with welds	10/10 mph	30/20 mph	Timetable
	CWR Installation, surfaced, distressed, not stabilized, without welds	15/10 mph	40/30 mph	Timetable
	CWR Installation, surfaced, distressed, and stabilized, with welds	10/10 mph	40/30 mph	Timetable
	CWR Installation, surfaced, distressed, and stabilized, without welds	15/10 mph	40/30 mph	Timetable
	CWR Installation, distressed with welds and no surfacing required	10/10 mph	40/30 mph	Timetable
	CWR Installation, distressed without welds and no surfacing required	30/20 mph	40/30 mph	Timetable
	CWR Installation, not distressed with welds and no surfacing required below 80 degree F or below ARLT	10/10 mph	30/20 mph	40/30 mph
	CWR Installation, not distressed with welds and no surfacing required above 80 degree F or above ARLT	10/10 mph	30/20 mph	Not Applicable
	CWR Installation, not distressed without welds and no surfacing required below 80 degree F or below ARLT	10/10 mph	30/20 mph	40/30 mph
	CWR Installation, not distressed without welds and no surfacing required above 80 degree F or above ARLT	10/10 mph	30/20 mph	Not Applicable
SURFACING	Track Surfacing without stabilizing	15/10 mph	30/20 mph	Timetable
	Track Surfacing with dynamic stabilizing	50/40 mph	Time table	Timetable
	Newly Constructed Track without stabilizing	10/10 mph	30/20 mph	Timetable
	Newly Constructed Track with dynamic stabilizing	30/20 mph	50/40 mph	Timetable
RAIL DEFECTS/ JOINTS	Engine Burn 1/8 inch deep or greater	30/20 mph	30/20 mph	30/20 mph
	CWR Insulated Joint – signs of stress	30/25 mph	30/25 mph	30/25 mph

END OF APPENDIX C –
SUMMARY OF SPEED RESTRICTIONS FOR TRACKWORK

METROLINK INSPECTION FORM

STRUCTURES DEPARTMENT

NEW BRIDGE	<input type="checkbox"/>	BRIDGE TYPE	<input type="text"/>	<input type="checkbox"/>
BETWEEN CONTROL POINTS	<input type="text"/>	SEQUENCE NO.	<input type="text"/>	
SCRRRA SUBDIVISION	<input type="text"/>	DATE INSPECTED	<input type="text"/>	INSPECTED BY
PANEL LENGTH	<input type="text"/>	NO. PANELS	<input type="text"/>	SIZE
				NO. OPENINGS
				LENGTH
TOTAL SPANS	<input type="text"/>	SPAN LENGTH	<input type="text"/>	SECTION 1 OF
				SECTION LENGTH
TRACK	<input type="text"/>	TRACK ALIGNMEN	<input type="text"/>	NO. TRACKS
				TOTAL LENGTH
ERECTION DAT	<input type="text"/>	RATING	<input type="text"/>	OBSERVED UNDER TRAFFIC
				CLASS
PRIORITY	<input type="text"/>	DESIGN	<input type="text"/>	FAB. DATE
				CT/HT/BOB
				CT/HT/BR
CROSSING	<input type="text"/>	ORIG. OWNER	<input type="text"/>	CURRENT OWNER
MAINT. RESP.	<input type="text"/>	RENEW DATE	<input type="text"/>	BRIDGE STANDARDS
				OLD M.P

BRIDGES

<input type="checkbox"/> LINE AND SURFACE <input type="checkbox"/> ANCHORAGE <input type="checkbox"/> TIES <input type="text"/> <input type="checkbox"/> HEAD OF BANKS <input type="text"/> RAIL YEAR <input type="checkbox"/> RUNNING RAIL <input type="text"/> <input type="checkbox"/> GUARD RAIL <input type="text"/> <input type="checkbox"/> WALK / HANDRAIL <input type="checkbox"/> WATERPROOFING <input type="checkbox"/> APRON PLATE <input type="checkbox"/> PIERS, BENTS, TOWERS <input type="checkbox"/> PEDISTALS <input type="checkbox"/> ABUTMENT, WINGWALL <input type="checkbox"/> CLEARANCES MEASURED <input type="text"/> POSTED <input type="text"/> <input type="checkbox"/> EPOXY <input type="checkbox"/> PAINT YEAR PAINTED <input type="text"/> <input type="checkbox"/> VEGETATION	<input type="checkbox"/> CAPS/ SIZE <input type="text"/> <input type="checkbox"/> DUMP PLANK <input type="checkbox"/> SHIMS <input type="checkbox"/> PILES # PILE/BENT <input type="text"/> <input type="checkbox"/> FRAMED BENTS <input type="checkbox"/> POSTED PILE/NO. <input type="text"/> <input type="checkbox"/> NO. HELPER PILE <input type="text"/> <input type="checkbox"/> SASH / SWAY BRACES <input type="checkbox"/> LONG. BRACE <input type="checkbox"/> BENT HARDWARE <input type="checkbox"/> CHORD TIN <input type="checkbox"/> STRINGERS <input type="checkbox"/> TREATED <input type="checkbox"/> ROLLING <input type="checkbox"/> HELPERS STRINGER DATE <input type="text"/> STRINGER NO. <input type="text"/> STRINGER SIZE <input type="text"/>	<input type="checkbox"/> LATERAL BRACING <input type="checkbox"/> MAIN BEAMS <input type="checkbox"/> TRUSS MEMBERS <input type="checkbox"/> MAIN XFRAME <input type="checkbox"/> BEARINGS <input type="checkbox"/> GUARD TIMBER <input type="text"/> BALLAST CURB SIZE <input type="text"/> <input type="checkbox"/> CURB HT. <input type="text"/> <input type="checkbox"/> BALLAST DEPTH <input type="text"/> <input type="checkbox"/> DECK/ TYPE <input type="text"/> TH <input type="text"/> DECK YEAR <input type="text"/> <input type="checkbox"/> DECK HARDWARE <input type="checkbox"/> HARDWARE <input type="checkbox"/> CHANNEL, WATERWAY, DRIFT <input type="checkbox"/> UTILITIES, ATTACHMENTS <input type="checkbox"/> DAMAGE-BY RR, HW <input type="checkbox"/> SCOUR, RIP RAP <input type="checkbox"/> INSPECTION FACILITIES
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CULVERTS

<input type="checkbox"/>	ASPHALT COATING
<input type="checkbox"/>	MASONRY
<input type="checkbox"/>	FLOOR_SIDE_ROT
<input type="checkbox"/>	CENTER ROT
<input type="checkbox"/>	CLEAR
<input type="checkbox"/>	DEBRIS
<input type="checkbox"/>	PLUGGED

<input type="checkbox"/>	WALKWAY-TYPE	<input type="text"/>
<input type="checkbox"/>	HANDRAIL-TYPE	<input type="text"/>
<input type="checkbox"/>	HEADWALL-TYPE	<input type="text"/>
<input type="checkbox"/>	WINGWALL-TYPE	<input type="text"/>
	CL_TO_FACE	<input type="text"/>
	TOP/CULVERT/BR	<input type="text"/>
	HEADWALL_TO_BR	<input type="text"/>

<input type="checkbox"/>	OBSTRUCTION
<input type="checkbox"/>	CLEAN UPSTREAM
<input type="checkbox"/>	CLEAN DOWNSTREAM
<input type="checkbox"/>	SCOUR UPSTREAM
<input type="checkbox"/>	SCOUR DOWNSTREAM
<input type="checkbox"/>	SCOUR HEADWALL
<input type="checkbox"/>	DAMAGE FROM BLOWS

TUNNELS

<input type="checkbox"/>	VEG. WEST PORTAL
<input type="checkbox"/>	VEG. EAST PORTAL
<input type="checkbox"/>	PORTAL WEST
<input type="checkbox"/>	PORTAL EAST
	WST_POR_TYPE <input type="text"/>
	EST_POR_TYPE <input type="text"/>
	LINNING <input type="text"/>

<input type="checkbox"/>	CROWN
<input type="checkbox"/>	LT_SIDE
<input type="checkbox"/>	RT_SIDE
<input type="checkbox"/>	LT_SPRINGLINE
<input type="checkbox"/>	RT_SPRINGLINE
<input type="checkbox"/>	LT_FOOTING
<input type="checkbox"/>	RT_FOOTING

<input type="checkbox"/>	FIRE RETARDENT
<input type="checkbox"/>	PUMPS
<input type="checkbox"/>	WEEP HOLES
<input type="checkbox"/>	DRAINAGE
<input type="checkbox"/>	INVERT
	CLEARANCE_HT <input type="text"/>
	CLEARANCE_WD <input type="text"/>

NOTES

WORK ORDER

NEW BRIDGE

**SOUTHERN CALIFORNIA REGIONAL RAIL AUTHORITY
TRACK MAINTENANCE, RIGHT OF WAY AND STRUCTURES,
ENGINEERING INSTRUCTIONS**

APPENDIX E – UNBALANCE (E.S. 2302 – 2 THROUGH 7)

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APPENDIX E – E.S. 2302 – 02 - TABLE 4 – 4-INCH SUPERELEVATION UNBALANCE
PASSENGER LIMITING SPEEDS, STANDARD SPIRAL LENGTHS, MAXIMUM TRAIN SPEED: 110 MPH

Degree of Curve	E ₀ =0"		E ₀ =1/2"		E ₀ =1"		E ₀ =1 1/2"		E ₀ =2"		E ₀ =2 1/2"		E ₀ =3"		E ₀ =3 1/2"		E ₀ =4"		E ₀ =4 1/2"		E ₀ =5"		E ₀ =5 1/2"		E ₀ =6"			
	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s		
>0°30'	10	264																										
0°30'	10	257																										
0°45'	8	209	93	222	98	234	102	246	107	257																		
1°00'	76	181	80	182	85	203	89	213	93	222	96	235	100	360	104	435	107	513										
1°15'	68	162	72	172	76	181	79	190	83	199	86	209	89	322	93	389	96	459	99	532	101	609	104	688	107	770		
1°30'	62	148	65	157	69	166	72	174	75	181	79	206	82	234	85	355	87	419	90	486	93	555	95	628	98	703		
1°45'	57	137	61	145	64	153	67	161	70	168	73	219	76	272	78	329	81	388	83	450	86	514	88	581	90	651		
2°00'	53	128	57	136	60	143	63	150	65	157	68	204	71	255	73	307	76	363	78	421	80	481	82	544	85	609		
2°15'	50	121	53	128	56	135	59	142	62	148	64	193	67	240	69	290	71	342	73	397	76	454	78	513	80	574		
2°30'	48	115	51	122	53	128	56	135	59	141	61	183	63	228	65	275	68	325	70	376	72	430	74	486	76	544		
2°45'	46	109	48	116	51	122	53	128	56	134	58	174	60	217	62	262	64	309	66	359	68	410	70	464	72	519		
3°00'	44	105	46	111	49	117	51	123	53	128	56	167	58	208	60	251	62	296	64	344	66	393	67	444	69	497		
3°15'	42	101	44	107	47	113	49	118	51	124	53	160	55	200	57	241	59	285	61	330	63	377	65	426	66	477		
3°30'	40	97	43	103	45	108	47	114	49	124	52	155	53	192	55	232	57	274	59	318	61	364	62	411	64	460		
3°45'	39	94	41	99	44	105	46	110	48	124	50	150	52	186	53	224	55	265	57	307	59	351	60	397	62	444		
4°00'	38	91	40	96	42	101	44	106	46	124	48	148	50	186	52	217	53	257	55	298	57	340	58	384	60	430		
4°30'	36	86	38	91	40	96	42	100	44	124	46	145	47	186	49	217	50	248	52	281	53	321	55	362	56	406		
5°00'	34	81	36	86	38	91	40	95	41	124	43	145	45	186	46	217	48	248	49	279	51	310	52	344	53	385		
5°30'	32	77	34	82	36	86	38	93	39	124	41	145	43	186	44	217	46	248	47	279	48	310	50	341	51	372		
6°00'	31	74	33	79	35	83	36	93	38	124	39	145	41	186	42	217	44	248	45	279	46	310	48	341	49	372		
6°30'	30	71	31	75	33	80	35	93	36	124	38	145	39	186	41	217	42	248	43	279	44	310	46	341	47	372		
7°00'	29	69	30	73	32	77	34	93	35	124	36	145	38	186	39	217	40	248	42	279	43	310	44	341	45	372		
8°00'	27	64	28	68	30	72	31	93	33	124	34	145	35	186	37	217	38	248	39	279	40	310	41	341	42	372		
9°00'	25	60	27	64	28	68	30	93	31	124	32	145	33	186	35	217	36	248	37	279	38	310	39	341	40	372		
10°00'	24	57	25	61	27	64	28	93	29	124	30	145	32	186	33	217	34	248	35	279	36	310	37	341	38	372		
11°00'	23	55	24	58	25	62	27	93	28	124	29	145	30	186	31	217	32	248	33	279	34	310	35	341	36	372		
12°00'	22	52	23	55	24	58	26	93	27	124	28	145	29	186	30	217	31	248	32	279	33	310	34	341	35	372		

- Maximum allowable operating speed (mph) for the Superelevation, E₀, shown in the column heading
- Spiral Length, L_s: the longest of: L_s = 1.20 • MPH • E₀
L_s = 0.6 • MPH • E_U
L_s = 62 • E₀
L_s = 30 (Exception: Curves less than 0° 30')

- Round Theoretical Elevations to the next highest 1/4"; Round Theoretical Spiral Length to next longer 10 ft. increment
- No Elevation/Curvature Permitted to Right of Heavy Line

APPENDIX E – E.S. 2302 – 03 - TABLE 4M – 4-INCH SUPERELEVATION UNBALANCE
PASSENGER LIMITING SPEEDS, MINIMUM SPIRAL LENGTHS, MAXIMUM TRAIN SPEED: 110 MPH

Degree of Curve	E ₀ =0"		E ₀ =1/2"		E ₀ =1"		E ₀ =2"		E ₀ =3"		E ₀ =4"		E ₀ =5"		E ₀ =6"	
	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s
30° 30'	110	254														
0° 30'	107	257														
0° 45'	87	208	93	222	98	234	102	245	107	257						
1° 00'	76	181	80	192	85	203	89	213	93	222	96	289	100	380	104	435
1° 15'	68	162	72	172	76	181	79	190	83	199	86	268	89	322	93	389
1° 30'	62	148	65	157	69	166	72	174	76	181	79	238	82	294	85	355
1° 45'	57	137	61	145	64	153	67	161	70	168	73	219	76	272	78	329
2° 00'	53	128	57	136	60	143	63	150	65	157	68	204	71	255	73	307
2° 15'	50	121	53	128	56	135	59	142	62	148	64	183	67	240	69	290
2° 30'	48	115	51	122	53	128	56	135	59	141	61	183	63	228	65	275
2° 45'	46	109	48	116	51	122	53	128	56	134	58	174	60	217	62	262
3° 00'	44	105	46	111	49	117	51	123	53	128	56	167	58	208	60	251
3° 15'	42	101	44	107	47	113	49	118	51	124	53	160	55	200	57	241
3° 30'	40	97	43	103	45	108	47	114	49	124	52	155	53	192	55	232
3° 45'	39	94	41	99	44	105	46	110	48	124	50	155	52	186	53	224
4° 00'	38	91	40	96	42	101	44	106	46	124	48	155	50	186	52	217
4° 30'	36	86	38	91	40	96	42	100	44	124	45	155	47	186	49	217
5° 00'	34	81	36	86	38	91	40	95	41	124	43	155	45	186	46	217
5° 30'	32	77	34	82	36	86	38	93	39	124	41	155	43	186	44	217
6° 00'	31	74	33	79	35	83	36	86	38	124	39	155	41	186	42	217
6° 30'	30	71	31	75	33	80	35	83	36	124	38	155	39	186	41	217
7° 00'	29	69	30	73	32	77	34	83	35	124	36	155	38	186	39	217
8° 00'	27	64	28	68	30	72	31	83	33	124	34	155	35	186	37	217
9° 00'	25	60	27	64	28	68	30	83	31	124	32	155	33	186	35	217
10° 00'	24	57	25	61	27	64	28	83	29	124	30	155	32	186	33	217
1° 00'	23	55	24	58	25	62	27	83	28	124	29	155	30	186	31	217
12° 00'	22	52	23	56	24	62	26	83	27	124	28	155	29	186	30	217

- Maximum allowable operating speed (mph) for the Superelevation, E₀, shown in the column heading
- Spiral Length, L_s: the longest of: L_s = 1.00 × MPH × E₀
L_s = 50 × E₀
L_s = 30 (Exception: Curves less than 0° 30')
- Round Theoretical Elevations to the next highest 1/4"; Round Theoretical Spiral Length to next longer 10 ft. increment
- No Elevation/Curvature Permitted to Right of Heavy Line

APPENDIX E – E.S. 2302 – 04 - TABLE D – DESIGN (3.6 – INCH) SUPERELEVATION AND PASSENGER SPEEDS, STANDARD SPIRAL LENGTHS, MAXIMUM TRAIN SPEED: 110 MPH

Degree of Curve	E ₀ =0"		E ₀ =1/2"		E ₀ =1"		E ₀ =1 1/2"		E ₀ =2"		E ₀ =2 1/2"		E ₀ =3"		E ₀ =3 1/2"		E ₀ =4"		E ₀ =4 1/2"		E ₀ =5"		E ₀ =5 1/2"		E ₀ =6"			
	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s
30° 30'	110	238																										
0° 30'	81	219																										
0° 45'	83	179	88	191	94	202	99	213	103	248																		
1° 00'	72	155	77	165	81	175	85	184	89	215	93	260	97	350	101	423	104	500										
1° 15'	64	139	68	148	73	157	76	165	80	192	83	250	87	313	90	378	93	447	96	520	99	595	102	673	105	754		
1° 30'	59	126	62	135	66	143	70	151	73	175	76	229	79	285	82	345	85	408	88	474	91	543	93	614	96	688		
1° 45'	54	117	58	125	61	132	65	139	68	162	71	212	73	264	76	320	79	378	81	439	84	503	86	569	89	637		
2° 00'	51	110	54	117	57	124	60	130	63	152	66	208	69	247	71	299	74	354	76	411	78	470	81	532	83	598		
2° 15'	48	103	51	110	54	117	57	123	60	143	62	187	65	233	67	282	69	333	72	387	74	443	76	502	78	562		
2° 30'	45	98	48	105	51	111	54	117	57	136	59	177	61	221	64	268	66	316	68	367	70	421	72	476	74	533		
2° 45'	43	93	46	100	49	106	51	111	54	129	56	169	59	211	61	255	63	302	65	350	67	401	69	454	71	508		
3° 00'	41	89	44	95	47	101	49	106	52	124	54	162	56	202	58	244	60	289	62	335	64	384	66	434	68	487		
3° 15'	40	86	42	92	45	97	47	102	50	124	52	155	54	194	56	235	58	277	60	322	61	369	63	417	65	468		
3° 30'	38	83	41	88	43	94	46	99	48	124	50	155	52	187	54	226	56	267	57	310	59	355	61	402	63	451		
3° 45'	37	80	40	85	42	90	44	95	46	124	48	155	50	186	52	218	54	258	56	300	57	343	59	389	60	435		
4° 00'	36	77	38	83	41	88	43	93	45	124	47	155	49	186	50	217	52	250	54	290	55	333	57	376	59	422		
4° 30'	34	73	36	78	38	83	40	93	42	124	44	155	46	186	47	217	49	248	51	279	52	314	54	355	55	397		
5° 00'	32	69	34	74	36	78	38	93	40	124	42	155	43	186	45	217	47	248	48	279	50	300	51	341	52	377		
5° 30'	31	66	33	70	35	75	36	93	38	124	40	155	41	186	43	217	44	248	46	279	47	300	49	341	50	372		
6° 00'	29	63	31	67	33	71	35	93	37	124	38	155	40	186	41	217	43	248	44	279	45	300	47	341	48	372		
6° 30'	28	61	30	65	32	69	33	93	35	124	37	155	38	186	40	217	41	248	42	279	43	300	45	341	46	372		
7° 00'	27	59	29	62	31	66	32	93	34	124	35	155	37	186	38	217	39	248	41	279	42	300	43	341	44	372		
8° 00'	25	55	27	58	29	62	30	93	32	124	33	155	34	186	36	217	37	248	38	279	39	300	40	341	41	372		
9° 00'	24	52	26	55	27	61	28	93	30	124	31	155	32	186	34	217	35	240	36	279	37	310	38	341	39	372		
10° 00'	23	49	24	52	26	62	27	93	28	124	30	155	31	186	32	217	33	248	34	279	35	310	36	341	37	372		
11° 00'	22	47	23	50	24	62	26	93	27	124	28	155	29	186	30	217	31	248	32	279	33	310	34	341	35	372		
12° 00'	21	45	22	48	23	62	25	93	26	124	27	155	28	186	29	217	30	248	31	279	32	310	33	341	34	372		

- Maximum allowable operating speed (mph) for the Superelevation, E₀, shown in the column heading
- Spiral Length, L_s; the longest of:
 - $L_s = 1.20 \cdot \text{MPH} \cdot E_0$
 - $L_s = 0.6 \cdot \text{MPH} \cdot E_u$
 - $L_s = 62 \cdot E_0$
 - $L_s = 30$ (Exception: Curves less than 0° 30')
- Round Theoretical Elevations to the next highest 1/4"; Round Theoretical Spiral Length to next longer 10 ft. increment
- No Elevation/Curvature Permitted to Right of Heavy Line

APPENDIX E – E.S. 2302 – 05 - TABLE DM – DESIGN (3.6 – INCH) SUPERELEVATION AND PASSENGER SPEEDS,
MINIMUM SPIRAL LENGTHS, MAXIMUM TRAIN SPEED: 110 MPH

- Maximum allowable operating speed (mph) for the Superelevation, E_0 , shown in the column heading
- Spiral Length, L_s ; the longest of: $L_s = 1.00 \cdot MPH \cdot E_0$
 $L_s = 50 \cdot E_0$
 $L_s = 30$ (Exception: Curves less than $0^\circ 30'$)
- Round Theoretical Elevations to the next highest $\frac{1}{4}$ "; Round Theoretical Spiral Length to next longer 10 ft. increment
- No Elevation/Curvature Permitted to Right of Heavy Line

Degree of Curve	$E_0 = 0''$		$E_0 = 1/2''$		$E_0 = 1''$		$E_0 = 1 1/2''$		$E_0 = 2''$		$E_0 = 2 1/2''$		$E_0 = 3''$		$E_0 = 3 1/2''$		$E_0 = 4''$		$E_0 = 4 1/2''$		$E_0 = 5''$		$E_0 = 5 1/2''$		$E_0 = 6''$				
	Max. Spd.	L_s	Max. Spd.	L_s	Max. Spd.	L_s	Max. Spd.	L_s	Max. Spd.	L_s	Max. Spd.	L_s	Max. Spd.	L_s	Max. Spd.	L_s	Max. Spd.	L_s	Max. Spd.	L_s	Max. Spd.	L_s	Max. Spd.	L_s	Max. Spd.	L_s	Max. Spd.	L_s	
$0^\circ 30'$	110	0																											
$0^\circ 30'$	101	30																											
$0^\circ 45'$	83	30	88	44	94	94																							
$1^\circ 00'$	72	30	77	38	81	81	85	128	89	179																			
$1^\circ 15'$	64	30	68	34	75	75	76	115	80	160	85	209	87	261															
$1^\circ 30'$	59	30	62	31	66	66	70	105	73	146	76	191	79	238	82	288	85	340	88	395									
$1^\circ 45'$	54	30	58	30	61	61	65	97	68	135	71	176	73	220	76	266	79	315	81	366	84	419	86	474					
$2^\circ 00'$	51	30	54	30	57	57	60	91	63	126	66	165	68	206	71	249	74	295	76	342	78	392	81	443	85	497			
$2^\circ 15'$	48	30	51	30	54	54	57	85	60	119	62	156	65	194	67	235	69	278	72	323	74	361	76	418	78	468			
$2^\circ 30'$	45	30	48	30	51	51	54	81	57	113	59	148	61	184	64	223	66	264	68	306	70	351	72	397	74	444			
$2^\circ 45'$	43	30	46	30	49	49	51	77	54	108	56	141	59	176	61	213	63	251	65	292	67	334	69	378	71	424			
$3^\circ 00'$	41	30	44	30	47	47	50	75	52	103	54	135	56	168	58	204	60	241	62	279	64	320	66	362	68	406			
$3^\circ 15'$	40	30	42	30	45	45	50	75	50	100	52	129	54	162	56	196	58	231	60	269	61	307	63	348	65	390			
$3^\circ 30'$	38	30	41	30	43	43	50	75	48	100	50	125	52	156	54	188	56	225	57	259	59	296	61	335	63	376			
$3^\circ 45'$	37	30	40	30	42	42	50	75	48	100	48	125	50	150	52	182	54	215	56	250	57	286	59	324	60	363			
$4^\circ 00'$	36	30	38	30	41	41	50	75	45	100	47	125	49	150	50	176	52	208	54	242	55	277	57	314	59	351			
$4^\circ 30'$	34	30	36	30	38	38	50	75	42	100	44	125	46	150	47	175	49	200	51	228	52	261	54	296	55	331			
$5^\circ 00'$	32	30	34	30	36	36	50	75	40	100	42	125	43	150	45	175	47	200	48	225	50	250	51	280	52	314			
$5^\circ 30'$	31	30	33	30	35	35	50	75	38	100	40	125	41	150	43	175	44	200	46	225	47	250	49	275	50	300			
$6^\circ 00'$	29	30	31	30	33	33	50	75	37	100	38	125	40	150	41	175	43	200	44	225	45	250	47	275	48	300			
$6^\circ 30'$	28	30	30	30	32	32	50	75	35	100	37	125	38	150	40	175	41	200	42	225	43	250	45	275	46	300			
$7^\circ 00'$	27	30	29	30	31	31	50	75	34	100	35	125	37	150	38	175	39	200	41	225	42	250	43	275	44	300			
$8^\circ 00'$	25	30	27	30	29	29	50	75	32	100	33	125	34	150	36	175	37	200	38	225	39	250	40	275	41	300			
$9^\circ 00'$	24	30	26	30	28	28	50	75	30	100	31	125	32	150	34	175	35	200	36	225	37	250	38	275	39	300			
$10^\circ 00'$	23	30	24	30	26	26	50	75	28	100	30	125	31	150	32	175	33	200	34	225	35	250	36	275	37	300			
$11^\circ 00'$	22	30	23	30	24	24	50	75	27	100	28	125	29	150	30	175	31	200	32	225	33	250	34	275	35	300			
$12^\circ 00'$	21	30	22	30	23	23	50	75	26	100	27	125	28	150	29	175	30	200	31	225	32	250	33	275	34	300			

APPENDIX E – E.S. 2302 – 06 - TABLE 3 – 3-INCH SUPERELEVATION UNBALANCE
 FREIGHT LIMITING SPEEDS, STANDARD SPIRAL LENGTHS, MAXIMUM TRAIN SPEED: 110 MPH

Degree of Curve	E ₀ -0"		E ₀ -1/2"		E ₀ -1"		E ₀ -1 1/2"		E ₀ -2"		E ₀ -2 1/2"		E ₀ -3"		E ₀ -3 1/2"		E ₀ -4"		E ₀ -4 1/2"		E ₀ -5"		E ₀ -5 1/2"		E ₀ -6"		
	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	
>0°-30'	110	98																									
0°-30'	93	67																									
0°-45'	76	53	82	147	87	157	93	167	88	234																	
1°-00'	65	118	71	127	76	136	80	144	85	203	89	266	93	333	96	405	100	480									
1°-15'	59	105	63	114	68	122	72	129	78	181	79	238	83	298	86	362	89	429	93	500	96	574	99	651	101	730	
1°-30'	53	96	58	104	62	111	65	118	69	166	72	217	76	272	79	330	82	392	85	456	87	524	90	594	93	667	
1°-45'	49	89	53	96	57	103	61	109	64	153	67	201	70	252	73	306	76	363	78	423	81	485	83	550	86	617	
2°-00'	46	83	50	90	53	96	57	102	60	143	63	188	65	236	68	286	71	339	73	395	76	454	78	514	80	577	
2°-15'	44	79	47	85	50	91	53	96	56	135	59	177	62	222	64	270	67	320	69	373	71	428	73	485	76	544	
2°-30'	41	75	45	80	48	86	51	93	53	128	56	168	59	211	61	256	63	304	65	354	68	406	70	460	72	516	
2°-45'	39	71	43	77	46	82	48	93	51	124	53	160	56	201	58	244	60	289	62	337	64	387	66	439	68	492	
3°-00'	38	68	41	73	44	79	46	93	49	124	51	155	53	192	56	234	58	277	60	323	62	370	64	420	65	471	
3°-15'	36	65	39	71	42	75	44	93	47	124	49	155	51	186	53	224	55	266	57	300	59	356	61	403	63	453	
3°-30'	35	63	38	68	40	73	43	93	45	124	47	155	49	186	52	217	53	257	55	296	57	343	59	389	61	436	
3°-45'	34	61	37	66	39	70	41	93	44	124	46	155	48	186	50	217	52	248	53	289	55	331	57	376	59	422	
4°-00'	33	59	35	64	38	68	40	93	42	124	44	155	46	186	48	217	50	248	52	279	53	321	55	364	57	408	
4°-30'	31	56	33	60	36	64	38	93	40	124	42	155	44	186	45	217	47	248	49	279	50	310	52	343	53	385	
5°-00'	29	53	32	57	34	62	36	93	38	124	40	155	41	186	43	217	45	248	46	279	48	310	49	341	51	372	
5°-30'	28	50	30	54	32	62	34	93	36	124	38	155	39	186	41	217	43	248	44	279	46	310	47	341	48	372	
6°-00'	27	48	29	52	31	62	33	93	35	124	36	155	38	186	39	217	41	248	42	279	44	310	45	341	46	372	
6°-30'	26	46	28	50	30	62	31	93	33	124	35	155	36	186	38	217	39	248	41	279	42	310	43	341	44	372	
7°-00'	25	45	27	48	29	62	30	93	32	124	34	155	35	186	36	217	38	248	39	279	40	310	42	341	43	372	
8°-00'	23	42	25	45	27	62	28	93	30	124	31	155	33	186	34	217	35	248	37	279	38	310	39	341	40	372	
9°-00'	22	39	24	42	25	62	27	93	28	124	29	155	31	186	32	217	33	248	35	279	36	310	37	341	38	372	
10°-00'	21	37	22	40	24	62	25	93	27	124	28	155	29	186	30	217	32	248	33	279	34	310	35	341	36	372	
11°-00'	20	36	21	38	23	62	24	93	25	124	27	155	28	186	29	217	30	248	31	279	32	310	33	341	34	372	
12°-00'	19	34	20	37	22	62	23	93	24	124	26	155	27	186	28	217	29	248	30	279	31	310	32	341	33	372	

- Maximum allowable operating speed (mph) for the Superelevation, E₀, shown in the column heading
- Spiral Length, L_s; the longest of:
 - $L_s = 1.20 \cdot \text{MPH} \cdot E_0$
 - $L_s = 0.6 \cdot \text{MPH} \cdot E_C$
 - $L_s = 62 \cdot E_0$
 - $L_s = 30$ (Exception: Curves less than 0° 30')
- Round Theoretical Elevations to the next highest 1/4"; Round Theoretical Spiral Length to next longer 10 ft. increment
- No Elevation/Curvature Permitted to Right of Heavy Line

APPENDIX E – E.S. 2302 – 07 - TABLE 3M – 3-INCH SUPERELEVATION UNBALANCE
 FREIGHT LIMITING SPEEDS, MINIMUM SPIRAL LENGTHS, MAXIMUM TRAIN SPEED: 110 MPH

Degree of Curve	E ₀ =0"		E ₀ =1/2"		E ₀ =1"		E ₀ =1 1/2"		E ₀ =2"		E ₀ =2 1/2"		E ₀ =3"		E ₀ =3 1/2"		E ₀ =4"		E ₀ =4 1/2"		E ₀ =5"		E ₀ =5 1/2"		E ₀ =6"			
	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s	Max. Spd.	L _s		
20°30'	110	0																										
0°30'	95	30																										
0°45'	76	30	82	41	87	87	93	109	98	85																		
1°00'	65	30	71	35	76	76	80	100	85	89	222	93	278	96	337	100	400											
1°15'	59	30	63	32	68	68	72	106	76	79	98	83	248	86	302	89	358	93	417	96	478	96	542	101	609			
1°30'	53	30	58	30	62	62	65	98	69	72	181	76	227	79	275	82	327	85	380	87	436	90	495	93	555			
1°45'	49	30	53	30	57	57	61	91	64	67	168	70	210	73	255	76	302	78	352	81	404	83	458	86	514			
2°00'	46	30	50	30	53	53	57	85	60	63	157	65	196	68	238	71	283	73	309	76	378	78	429	80	481			
2°15'	44	30	47	30	50	50	53	80	56	59	148	62	185	64	225	67	267	69	311	71	356	73	404	76	454			
2°30'	41	30	45	30	48	48	51	76	53	56	140	59	176	61	213	63	253	65	295	68	338	70	383	72	430			
2°45'	39	30	43	30	46	46	50	75	51	54	134	56	167	58	203	60	241	62	281	64	322	66	365	68	410			
3°00'	38	30	41	30	44	44	48	73	49	51	128	53	160	56	195	58	231	60	269	62	309	64	350	65	393			
3°15'	36	30	39	30	42	42	46	71	47	49	125	51	154	53	187	55	222	57	258	59	296	61	336	63	377			
3°30'	35	30	38	30	40	40	43	75	45	48	125	49	150	52	180	53	214	55	249	57	286	59	324	61	364			
3°45'	34	30	37	30	39	39	41	79	44	46	125	48	150	50	175	52	207	53	241	55	276	57	303	59	351			
4°00'	33	30	35	30	38	38	40	75	42	44	125	46	150	48	175	50	200	52	233	53	267	55	303	57	340			
4°30'	31	30	33	30	36	36	38	75	40	42	125	44	150	45	175	47	200	49	225	50	252	52	286	53	321			
5°00'	29	30	32	30	34	34	36	75	38	40	125	41	150	43	175	45	200	46	225	48	250	49	275	51	304			
5°30'	28	30	30	30	32	32	34	75	36	38	125	39	150	41	175	43	200	44	225	46	250	47	275	48	300			
6°00'	27	30	29	30	31	31	33	75	35	36	125	38	150	39	175	41	200	42	225	44	250	45	275	46	300			
6°30'	26	30	28	30	30	30	31	75	33	35	125	36	150	38	175	39	200	41	225	42	250	43	275	44	300			
7°00'	25	30	27	30	29	29	30	75	32	34	125	35	150	36	175	38	200	39	225	40	250	42	275	43	300			
8°00'	23	30	25	30	27	27	28	75	30	32	125	33	150	34	175	35	200	37	225	38	250	39	275	40	300			
9°00'	22	30	24	30	25	25	26	75	28	30	125	31	150	32	175	33	200	35	225	36	250	37	275	38	300			
10°00'	21	30	22	30	24	24	25	75	27	28	125	29	150	30	175	32	200	33	225	34	250	35	275	36	300			
11°00'	20	30	21	30	23	23	24	75	26	27	125	28	150	29	175	30	200	31	225	32	250	33	275	34	300			
12°00'	19	30	20	30	22	22	23	75	24	26	125	27	150	28	175	29	200	30	225	31	250	32	275	33	300			

- Maximum allowable operating speed (mph) for the Superelevation, E₀, shown in the column heading
- Spiral Length, L_s; the longest of: L_s = 1.00 * MPH * E₀

$$L_s = 50 * E_0$$

$$L_s = 30 \text{ (Exception: Curves less than } 0^\circ 30')$$
- Round Theoretical Elevations to the next highest 1/4"; Round Theoretical Spiral Length to next longer 10 ft. increment
- No Elevation/Curvature Permitted to Right of Heavy Line

APPENDIX F – UNUSUAL OCCURRENCE REPORT

Forward reports to the Manager, Track and Structures Maintenance

Line/Subdivision _____ M.P. _____ To M.P. _____ Date: _____

Inspection Type (Mark all that apply) _____

Bridge _____ Culvert _____ Structure _____

Accident _____ Hot _____ Rail _____
 _____ Weather _____ Storm _____ Defect _____

Earthquake _____ Tsunami _____ Other _____
 _____ (Explain) _____

Location _____ Time _____ Rail Temp. _____ Rail Sec. _____ Other _____
 M.P. _____

Description: _____

Location _____ Time _____ Rail Temp. _____ Rail Sec. _____ Other _____
 M.P. _____

Description: _____

Location _____ Time _____ Rail Temp. _____ Rail Sec. _____ Other _____
 M.P. _____

Description: _____

Inspector's Signature _____ Supervisor Sign-Off _____ Date and Time Inspection Completed _____

Page ____ of ____

1 of 1