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USACE / NAVFAC / AFCESA / NASA **UFGS-34 11 00 (January 2007)**

Preparing Activity: USACE **Superseding UFGS-34 11 00 (April 2006)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2007

Latest change indicated by CHG tags
****

SECTION TABLE OF CONTENTS

DIVISION 34 - TRANSPORTATION

SECTION 34 11 00

RAILROAD TRACK AND ACCESSORIES

01/07

3.3.3 Unloading the Materials
3.3.4 Ties
3.3.5 Tie Plates
3.3.6 Rail
3.3.6.1 Laying Rail
3.3.6.2 Joints
3.3.6.3 Expansion Allowance
3.3.6.4 Cutting Rail
3.3.6.5 Matching Rails
3.3.6.6 Rail Replacement
3.3.6.7 Out-of-Face Rail Relay
3.3.6.8 Spot Rail Replacement
3.3.7 Joint Bars
3.3.8 Spiking
3.3.8.1 Spiking Procedures
3.3.8.2 Number of Spikes
3.3.9 Tie Plugs
3.3.10 Rail Anchor Placement
3.3.11 Inner Guard Rails
3.3.12 Derails
3.3.13 Superelevation
3.3.14 Preliminary Surfacing
3.3.14.1 Lifts
3.3.14.2 Tamping
3.3.14.3 Replacement of Ties
3.3.14.4 Track Off The Ends of Open Deck Bridges
3.3.14.5 Runoff of Track Raises
3.3.14.6 Horizontal Realignment
3.3.15 Final Surfacing
3.3.15.1 Final Tamping
3.3.15.2 Final Alignment
3.3.15.3 Final Dressing
3.3.15.4 Surplus Ballast
3.3.16 Cleanup
3.3.16.1 Shoulder Removal and Reconstruction
3.3.16.2 Spoil Materials
3.3.17 Final Adjustments
3.3.18 Tolerances for Finished Track
3.3.18.1 Gage
3.3.18.2 Alignment
3.3.18.3 Track Surface
3.3.18.4 Guard Face Gage
3.3.18.5 Guard Check Gage
3.4 TURNOUTS AND TRACK CROSSINGS
3.4.1 Turnout Reconstruction
3.4.1.1 Install Salvaged Turnouts
3.4.1.2 Salvage and Install Turnouts
3.4.1.3 Turnout Removal and Salvaged or Scrapped
3.4.1.4 Trackbed
3.4.1.5 Replacement Turnout
3.4.1.6 Matching
3.4.1.7 Placing of Ballast
3.4.1.8 Existing Switch Stand
3.4.1.9 Rail Anchors
3.4.2 Turnout Repair
3.4.2.1 Switch Ties
3.4.2.2 Bolt Tightening
3.4.2.3 Rebuild Switch Points and Protectors, Frogs, and Guard Rails
3.4.2.4 Regage Closure Rails

3.5 HIGHWAY CROSSINGS
3.5.1 Subgrade
3.5.2 Geotextile Installation
3.5.2.1 Preparation
3.5.2.2 Placement
3.5.2.3 Placement of Cover Material
3.5.2.4 Equipment Operations on the Cover Material
3.5.2.5 Minimum Ballast Depth
3.5.2.6 Tamping Operations
3.5.2.7 Double Layers
3.5.3 Ballast Placement and Surfacing
3.5.4 Ties
3.5.5 Tie Plates, Spikes, and Anchors
3.5.6 Rail
3.5.7 Lining and Surfacing
3.5.8 Crossing Surface
3.5.8.1 Type 1 Aggregate Crossings
3.5.8.2 Type 1A Aggregate with Timber Flangeway Guards Crossings
3.5.8.3 Type 2 Timber Plank Crossings
3.5.8.4 Type 3a Asphalt Crossings
3.5.8.5 Type 3b Asphalt With Timber Flangeway Header Crossings
3.5.8.6 Type 4a Cast-in-place Concrete Crossings
3.5.8.7 Type 4b Prefabricated Concrete Panel Crossings
3.5.8.8 Type 5 Full Depth Rubber Crossings
3.5.9 Signs and Signals
3.5.9.1 Location and Positioning of Signs
3.5.9.2 Traffic Control
3.5.10 Crossing Flangeways
3.5.10.1 Flangeway Filler
3.5.10.2 Clean Grade Crossing Flangeways
3.5.11 As-Built Drawings
3.6 BONDING AND GROUNDING TRACK
3.6.1 Rail Joint Bond
3.6.2 Rail Cross-Bond and Ground
3.6.3 Inspection of Rail Bond and Ground
3.6.4 Rail Bonds At Signalized Grade Crossings
3.6.5 Existing Bonds
3.6.6 Removal of Defective Bonds
3.7 INSTALLATION OF MISCELLANEOUS TRACK MATERIALS
3.7.1 Tie Plates
3.7.2 Insulated Joints
3.7.3 Bumping Posts, Cushion Head, and Wheelstops
3.7.4 Inner Guard Rails
3.7.5 Gage Rods
3.7.6 Installation of Joint Bars
3.8 BRIDGE REPAIR
3.8.1 State and Local Government Permits
3.8.2 Work Hours
3.8.3 Schedule of Bridge Repair Work
3.8.4 Timber Pile Repair
3.8.5 Timber Pile Replacement
3.8.6 Bridge Tie Replacement Open-Deck Bridges
3.8.7 Rivet Replacement
3.9 ELECTRIC ARC WELDING
3.9.1 Welding Supervision
3.9.2 Weather Conditions
3.9.3 Welding Manganese Frogs and Crossings
3.9.3.1 Manganese Overheating
3.9.3.2 Slotting

-- End of Section Table of Contents --

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USACE / NAVFAC / AFCESA / NASA | UFGS-34 11 00 (January 2007)

Preparing Activity: USACE | Superseding
UFGS-34 11 00 (April 2006)

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****

SECTION 34 11 00

RAILROAD TRACK AND ACCESSORIES
01/07

****
NOTE: This guide specification covers the requirements for new railroads after the roadbed has been prepared, and railroad rehabilitation.

Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).
****

PART 1 GENERAL

****
NOTE: This section will be used only for railroad construction after the roadbed has been prepared. Sections 31 11 00 CLEARING AND GRUBBING and 31 00 00 EARTHWORK will be used for specifying roadbed preparation. CAUTION: Coordination of this section with other sections of the specifications and with the project drawings is required. For Civil Works projects edit this section to reference the appropriate UFGS identified in the header as "Preparing Activity: USACE -CW" (ex: UFGS-03 30 04 CONCRETE FOR MINOR STRUCTURES).

The following information should be shown on the drawings:

a. Location of various sizes of rail if required.

b. Approximate location of compromise joints.

c. Locations of accessories such as welded joints, rail anchors, guard rails, gage rods, bonded and grounded track, etc.

d. Locations of items of equipment such as derails and car bumpers.

e. Location of turnouts, including dimensions from point of switch and center of last switch tie. Also type of switch stand and quantity and location of switch ties.

f. Track section with all needed dimensions.

g. Superelevation locations and amounts.

h. Highway grade crossing location, type, and details (cross-sections) as required. Standard details for each type of crossing are available on CADD through the PCASE program.

****

1.1 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

****

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO HB-17	(2002; Errata 2003; Errata 2005) Standard Specifications for Highway Bridges
AASHTO M 288	(2006) Standard Specification for Geotextile Specification for Highway Applications

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION (AREMA)

AREMA Manual	(2006) Manual for Railway Engineering
AREMA Track Plans	(2004) Portfolio of Track Work Plans

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT CP-189	(2001) ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2006; Errata 2006) Structural Welding Code - Steel

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C2	(2003) Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes
AWPA C3	(2003) Piles - Preservative Treatment by Pressure Processes
AWPA C6	(1999) Crossties and Switch Ties - Preservative Treatment by Pressure Processes
AWPA M2	(2001) Standard for Inspection of Treated Wood Products
AWPA M6	(1996) Brands Used on Forest Products
AWPA P2	(2001) Standard for Creosote Solutions

ASTM INTERNATIONAL (ASTM)

ASTM A 242/A 242M	(2004e1) Standard Specification for High-Strength Low-Alloy Structural Steel
ASTM A 325	(2006) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 325M	(2005) Standard Specification for Structural Bolts, Steel, Heat Treated, 830

	Mpa Minimum Tensile Strength (Metric)
ASTM A 490	(2006) Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
ASTM A 490M	(2004a; R 2006) Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)
ASTM A 992/A 992M	(2006a) Standard Specification for Structural Steel Shapes
ASTM C 117	(2004) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 127	(2004) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C 131	(2006) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 142	(1997; R 2004) Standard Test Method for Clay Lumps and Friable Particles in Aggregates
ASTM C 535	(2003e1) Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 702	(1998; R 2003) Reducing Samples of Aggregate to Testing Size
ASTM C 88	(2005) Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM D 1241	(2000) Materials for Soil-Aggregate Subbase, Base, and Surface Courses
ASTM D 1310	(2001) Flash Point and Fire Point of Liquids by Tag Open-Cup Apparatus
ASTM D 1556	(2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(2002e1) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)

ASTM D 217	(2002) Cone Penetration of Lubricating Grease
ASTM D 2171	(2001) Viscosity of Asphalts by Vacuum Capillary Viscometer
ASTM D 2922	(2005) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(2005) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 3740	(2004a) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM D 3776	(1996; R 2002) Mass Per Unit Area (Weight) of Fabric
ASTM D 402	(2002) Distillation of Cut-Back Asphaltic (Bituminous) Products
ASTM D 4354	(1999; R 2004) Sampling of Geosynthetics for Testing
ASTM D 4355	(2005) Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus
ASTM D 445	(2006) Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)
ASTM D 4491	(1999; R 2004e1) Water Permeability of Geotextiles by Permittivity
ASTM D 4595	(2005) Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method
ASTM D 4751	(2004) Determining Apparent Opening Size of a Geotextile
ASTM D 4759	(2002) Determining the Specification Conformance of Geosynthetics
ASTM D 4791	(1999) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D 566	(2002) Dropping Point of Lubricating Grease
ASTM D 75	(2003) Standard Practice for Sampling Aggregates
ASTM E 11	(2004) Wire Cloth and Sieves for Testing

Purposes

ASTM F 405 (1997) Corrugated Polyethylene (PE) Tubing and Fittings

U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)

MUTCD (2003) Manual of Uniform Traffic Control Devices for Streets and Highways

UNDERWRITERS LABORATORIES (UL)

UL 651 (2005e7) Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings

1.2 UNIT PRICES

****
NOTE: When lump-sum payment is desired in the Invitation for Bids for work covered under this section the UNIT PRICES paragraphs will be deleted and subsequent paragraphs renumbered.
****

Each bid item will be measured by the unit listed in the Bid Schedule. Materials must be actually used or installed in the completed work. No measurement will be made for wasted materials or materials used for the convenience of the Contractor. The quantities thus determined will be paid for at their respective unit prices as shown in the Unit Price Schedule. This payment will constitute full compensation for furnishing materials, equipment, and labor and incidentals necessary to complete the work required, and for removing and properly disposing of replaced materials. Any required work or materials, such as lubricants and creosote, which are not listed on the Unit Price Schedule, shall be considered subsidiary to the items listed, and their cost shall be included in the costs for the listed items. Bid items are self-explanatory except as described below.

1.2.1 Rail

****
NOTE: Use the following paragraph for new track construction. Use paragraphs Out-of-Face Rail Replacement and Spot Rail Replacement below forilitation work.
****

Rail will be paid for on a unit price per linear meter ft of rail weight shown in the Unit Price Schedule. Stock rails and closure rails will be included for payment in the turnout unit price. The rails in road crossings will be included for payment for rail. Payment [will] [will not] include such items as [furnishing the rail,] [cutting and drilling the rail,] [installing the rail,] [and] [delivering the old rail removed from track to the designated storage area].

1.2.1.1 Out-of-Face Rail Replacement

Measurement will be by the linear meter of 30.5 m ft of 100 ft or more of contiguous replacement rail acceptably installed. Payment will be at the contract unit price per linear meter ft for "Out-of-Face Rail Replacement".

1.2.1.2 Spot Rail Replacement

Measurement will be by the linear meter of less than 30.5 m ft of less than 100 ft of contiguous replacement rail acceptably installed. Existing rails which are adjusted in the track during spot rail replacement will not be measured for payment. Existing rails which must be transposed or exchanged during spot rail replacement, as determined by the Contracting Officer, [will] [will not] be measured for payment. Payment will be at the contract unit price per linear meter ft for "Spot Rail Replacement".

1.2.2 Joint Bars

****
NOTE: List joint bars required.
****

Joint bars will be paid for at the unit price per pair under "Furnish Joint Bars" for the following items: [_____].

1.2.3 Compromise Joints

Compromise joints will be paid for at the contract unit price per joint for "Furnish Compromise Joint".

1.2.4 Turnouts

1.2.4.1 New Turnouts

Turnout construction will be measured and paid for at the contract unit price for "Furnish and Install New Turnouts". Each turnout shall include the complete switch, switch stand, connecting rod, switch rods, attachments, switch points, slide plates, rail braces, frog, fillers, joint bars and track bolts for the switch and frog, switch ties, and all other required items, including rail, rail anchors, standard tie plates, and spikes. Ballast will be paid for at the unit price for ballast. The pay limit for turnout construction begins at the center of the No. "0" tie at the front of the turnout to the last long switch tie of the rear of the turnout.

1.2.4.2 Turnout Repair

The following are turnout and track crossing unit price pay items:

a. "Switch Repair"

(1) "Replace Switch Stand" - Each
(2) "Replace Switch Points" - Each
(3) "Install or Replace Heel Fillers" - Each
(4) "Install or Replace Heel Filler Bolt Assembly" - Each
(5) "Install or Replace Switch Plates" - Each
(6) "Install or Replace Switch Braces" - Each
(7) "Remove and Respike Braces and Plates" - Each
(8) "Adjust Adjustable Braces" - Each
(9) "Install or Replace Switch Rods and Clips" - Each
(10) "Replace Connecting Rod" - Each
(11) "Grind and Dress Switch Point and Adjacent Stockrail" - Each
(12) "Clean, Adjust, and Lubricate Switch" - Each
(13) "Rebuild Switch Point Protector" - Each

(14) "Rebuild Switch Point" - Each
(15) "Paint Switch Stand

b. "Frog Repair"

(1) "Replace Frog" - Each
(2) "Install or Replace Frog Plates or Hook Plates" - Each
(3) "Rebuild Frog" - Each
(4) "Grind and Dress Frog, Install or Replace Frog Bolt Assembly" - Each

c. "Guard Rail Repair"

(1) "Replace Guard Rail" - Each
(2) "Install or Replace Guard Rail Plates" - Each
(3) "Install or Replace Guard Rail Bolt Assembly" - Each
(4) "Install or Replace Guard Rail Fillers" - Each
(5) "Install or Replace Clamp Assembly including Fillers and Wedges" - Each
(6) "Tighten all Bolts in Turnouts" - Each

1.2.5 Track Crossing

Track crossings will be paid for at the contract unit price for "Furnish and Install Track Crossing".

1.2.6 Crossties and Switch Ties

****
NOTE: If only one of the AREMA Manual standard crosstie grades listed below is to be used, list only the specified grade and delete the other grade.
****

Crossties will be measured for each defective crosstie removed and for each new crosstie acceptably furnished and installed as indicated. Switch ties will be measured for each length of defective switch tie removed and for each length of new switch tie acceptably furnished and installed as indicated. Defective crossties and switch ties removed become the property of the Contractor. Crossties will be paid for at the contract unit price for each type listed below:

"152 by 203 mm 6 by 8 in Grade Crosstie"
"178 by 229 mm 7 by 9 in Grade Crosstie"

Switch ties will be paid for at the contract unit price each for the length of switch tie listed below:

"2.74 m 9 ft 0 in Switch Tie"
"3.05 m 10 ft 0 in Switch Tie"
"3.35 m 11 ft 0 in Switch Tie"
"3.66 m 12 ft 0 in Switch Tie"
"3.96 m 13 ft 0 in Switch Tie"
"4.27 m 14 ft 0 in Switch Tie"
"4.57 m 15 ft 0 in Switch Tie"
"4.88 m 16 ft 0 in Switch Tie"
"5.18 m 17 ft 0 in Switch Tie"

1.2.7 Geotextiles

****
NOTE: Remove this paragraph when Geotextiles are not required.
****

Geotextile quantities will be paid for at the unit price as shown on the Unit Price Schedule. Payment for material used in laps, seams, or extra lengths such as anchorage and for associated equipment such as securing pins along with the associated materials, equipment, labor, and operations is included in the contract unit price for "geotextile" and shall not be paid for separately. For payment purposes, installed geotextile will be measured in place to the nearest square meter square yard of placement area. Only material must be actually used or installed in the completed work will be paid for.

1.2.8 Ballast, Out-of-Face Surface and Aligning

Ballast shall be measured based upon certified scale tickets for railcars or other delivery vehicles. Payment for ballast material will be made at the contract unit price per net metric ton ton of each gradation acceptably furnished and placed in track for "Furnish and Place Ballast". Copies of waybills and delivery tickets shall be submitted during the progress of work. Before the final statement is allowed, the Contractor shall file certified waybills and delivery tickets for ballast actually used. Out-of-Face Surface and Aligning will be measured by the unit track-meter track-ft for each track-meter track-ft of raise of each type or fraction thereof, acceptably performed. Payment will be at the contract unit price per track meter ft for each item given below:

"Out-of-Face Surface and Aligning - skin Lift"
"Out-of-Face Surface and Aligning - 51 mm 2 in Raise"
"Out-of-Face Surface and Aligning - 102 mm 4 in Raise"
"Out-of-Face Surface and Aligning - 152 mm 6 in Raise"
"Out-of-Face Surface and Aligning - [_____] mm [_____] in Raise"

1.2.9 Subballast

****
NOTE: Remove this paragraph when Subballast is not required.
****

Subballast shall be measured based upon certified scale tickets. Payment for subballast material will be made at the contract unit price per net metric ton ton of each gradation acceptably furnished and placed and compacted on the track bed for "Furnish, Place, and Compact Subballast." Copies of waybills and delivery tickets shall be submitted during the progress of work. Before the final statement is allowed, the Contractor shall file certified waybills and delivery tickets for subballast actually used.

1.2.10 Bridge Work

****
NOTES: Remove this paragraph when Bridge Work is not required in the contract. This paragraph should be edited to include payment for the items shown if

they are not paid for separately under the Bidding Schedule.

Open deck bridge repair would not be track construction. Repair would require bridge tie renewals and wood guard rail renewals as separate items.

****

The following items relating to bridge repair will be measured separately for payment and are described under other sections of these specifications.

ITEM DESCRIPTION	UNIT
Timber Pile Repair	Lin m
Timber Pile Replacement	Lin m
Shotcrete Repair	Square m
Bridge Tie Replacement (Open-deck)	Each
Rivet Replacement	Each
Gabion and Gabion Mattress	Cubic m

ITEM DESCRIPTION	UNIT
Timber Pile Repair	Lin ft
Timber Pile Replacement	Lin ft
Shotcrete Repair	Square ft
Bridge Tie Replacement (Open-deck)	Each
Rivet Replacement	Each
Gabion and Gabion Mattress	Cubic yd

All other work relating to bridge repairs will not be measured but will be paid for under the contract lump sum prices listed below for work at the following locations: [_____].

1.2.10.1 Lump Sum Payment

Payment for each lump sum shall be full compensation for all material, labor, equipment, and incidentals necessary to complete the work as shown on the drawings and as specified herein. Lump sum payment will be exclusive of those items specifically covered by the unit prices referenced above. The lump sum payment items include, but are not limited to, permitting, traffic maintenance, demolition, excavation, excavation supports, backfill, clearing, grubbing, protection of utilities and signals, timber repairs, temporary supports, jacking bridges, concrete construction, ballast retaining walls, pipe, end walls, removal and reinstallation of existing track, surface preparation, and painting.

1.2.10.2 Track over Ballasted-deck Bridges

Repair of track over ballasted-deck bridges will be measured and paid for at the contract unit price for the applicable repair item. Removal of track over ballasted-deck bridges which are to be repaired is considered incidental to the bridge repair. Reconstruction of track over open deck bridges will be measured per track m ft and paid for at the contract unit price for TRACK CONSTRUCTION AND OUT-OF-FACE RELAY.

1.2.11 Track Spikes

Measurement will be by the unit keg for each keg of spikes acceptably

furnished. Payment will be at the contract unit price per keg under "Furnished Track Spikes". Payment [will] [will not] be made for installation incidental to tie replacement or rail relay.

1.2.12 Track Bolt Assemblies

****
NOTE: List required bolt sizes.
****

Track bolt assemblies shall include bolt, spring washer (nutlock and nut). Measurement will be for each bolt furnished of the following sizes: [_____]. Payment will be at the contract unit price per each "Furnished Track Bolt Assembly". Payment [will] [will not] be made for installation incidental to rail joint repair or rail relay.

1.2.13 Tie Plates

****
NOTE: List tie plate sizes required.
****

Measurement will be for each tie plate acceptably furnished of the following size: [_____]. Payment will be at the contract unit price per each under "Furnish Tie Plates". Payment [will] [will not] be made for installation incidental to tie replacement or rail relay.

1.2.14 Rail Anchors

****
NOTE: List rail weight and section for which anchors are required.
****

Measurement will be for each anchor of the following weight [_____] and section [_____] acceptably furnished and installed. Payment will be at the contract unit price for "Furnish and Install Rail Anchors".

1.2.15 Insulated Joints

****
NOTE: List rail weight and section for which insulated joints are required.
****

Insulated joints will be measured for each insulated joint acceptably furnished and installed and will be paid for at the contract unit price for "Furnished and Installed Insulated Joints". Insulated joints will be required for the following rail weight [_____] and section [_____].

1.2.16 New Bumpers

****
NOTE: List type of bumpers required.
****

New bumpers of [_____] type will be measured for each bumper acceptably furnished and installed. Payment for furnishing and installing new bumpers will be at the contract unit price per each under "Furnish and Install New

Bumpers".

1.2.17 New Wheelstops

****
NOTE: List type of wheelstops required.
****

New wheelstops of [_____] type will be measured by the unit pair for each pair of wheelstops acceptably furnished and installed. Payment for furnishing and installing new wheelstops will be at the contract unit price for each pair for "Furnish and Install New Wheelstops".

1.2.18 Salvaged Bumpers and Wheelstops

Salvage of existing track bumpers and wheelstops will be measured and paid for each bumper or pair of wheel stops salvaged.

1.2.19 Install Bumpers

Installation of salvaged bumpers will be measured for each bumper under "Install Track Bumper".

1.2.20 Install Wheelstops

Installation of salvaged wheelstops will be measured for each pair of wheelstops acceptably installed and will be paid for at the contract unit price for "Install Wheelstops".

1.2.21 Cushion Head for Bumper

Payment for furnishing and installing cushion head will be at the contract unit price per each new cushion bumper head.

1.2.22 Fastenings

Payment for fastenings used in the installation or reinstallation of bumping post, wheelstops, or cushion head for bumpers are considered incidental and included in the installation pay item for each.

1.2.23 Inner Guard Rail

Inner guard rail will be measured by the linear m ft of rail acceptably furnished and installed and will be paid for at the contract unit price for furnished and installed "Inner Guard Rail". Each rail of dual guard rail installations will be measured separately. The other track materials (OTM, i.e., joint bars, bolt assemblies, tie plates and spikes) will be included with the guard rail.

1.2.24 Adjusted gage Rods

Readjusting existing gage rods, as designated by the Contracting Officer, will be measured for each and be paid for at the contract unit price per each under "Adjust gage Rods".

1.2.25 New gage Rods

New gage rods will be measured for each gage rod acceptably furnished and installed and will be paid for at the contract unit price for "Furnish and

Install gage Rods".

1.2.26 Salvaged gage Rods

Removal and salvage of existing gage rods will be measured and paid for at the contract unit price for each under "Salvage gage Rod".

1.2.27 Installed Salvaged gage Rods

Installation of salvaged gage rods will be measured for each gauge rod acceptably installed and will be paid for at the contract unit price for each under "Install Salvaged gage Rods".

1.2.28 New Derails

New derails will be measured and paid for at the contract unit price per each new derail acceptably furnished and installed under the bid item "Furnish and Install New Derail".

1.2.29 Installed Derails

Installation of salvaged derails will be measured for each derail acceptably installed and will be paid for at the contract unit price for each under "Install Derail".

1.2.30 Rail Welding

1.2.30.1 Rail Welding Thermite

Thermite rail welding to eliminate joints will be measured for payment based upon the number of rails welded and accepted by the Contracting Officer. Payment will be made for costs associated with rail welding of Government furnished and Contractor furnished rails. No payment will be made for replacement welds found unacceptable by ultrasonic testing.

1.2.30.2 Rail Welding Electric Arc

Electric Arc rail welding of [rebuilt rail ends] [engine burns] [_____] will be measured for payment based upon the number of rails welded and accepted by the Contracting Officer. Payment will be made for costs associated with rail welding of Government furnished and Contractor furnished rails. No payment will be made for replacement rails or replacement welds found unacceptable by ultrasonic testing.

1.2.31 Rail Joint Gap Adjustment

Measurement will be by the unit for each rail gap acceptably adjusted by replacing rail. Rail gaps which are created by rail adjusting (pulling or bumping) operations will not be measured for payment. Payment will be at the contract unit price per each under "Spot Rail Replacement".

1.2.32 Rail Joint Repair

Measurement will be by the unit for each joint acceptably repaired (disassembly, cleaning, inspection, repairing any rail end mismatch, and reassembly with new bolt assemblies). Joints which are repaired coincident with adjacent other repair work, such as spot rail replacement, will not be measured for payment. Payment will be at the contract unit price per each under "Rail Joint Repair".

1.2.33 Respiking

Measurement will be by the unit for each 90.7 kg 200 pound keg utilized in track respiking. Respiking of joints located in a rail which is being shifted as part of a regaging operation will not be measured for payment. Spiking of ties installed under this contract will not be measured for payment. Respiking of ties in areas of "Rail Joint Repair" will not be measured for payment. Payment will be made at the contract unit price per tie under "Respiking".

1.2.34 Rail Cropping

Measurement will be by the unit for each rail end acceptably cropped and redrilled. Payment will be at the contract unit price for "Rail Cropping".

1.2.35 Tighten Bolts

Measurement will be made by the track km mile of bolts tightened, or removing and installing bolts that cannot be tightened, or replacing bolts that are missing. Payment will be made at the contract unit price for km mile or portion thereof under "Tighten Bolts".

1.2.36 Bolt Assembly Replacement

Measurement will be by the unit for each bolt assembly acceptably replaced. Payment will be at the contract unit price for "Bolt Assembly Replacement".

1.2.37 Track Construction

Track construction is defined as the initial construction of track or total reconstruction of track from the subgrade up. The pay item "Track Construction" includes all plant, equipment, and labor necessary to install rail, ties, and track materials and construct the track in accordance with this specification. Track materials shall be furnished under their respective pay items in the contract Unit Price Schedule. Track construction will be measured and paid for by the track m ft for construction acceptably performed at the contract unit price for "Track Construction".

a. Reconstruction of track through grade crossings and between points 6 meters 20 ft beyond the outside limits of the crossing surface as shown will be considered to be track construction.

b. Track relocation or realignment of existing track by more than 1 meter 3 ft when associated with the relocation of turnouts or other work will be measured and paid for as "Track Construction".

c. Minor shifting of existing track associated with the replacement of turnouts, or any shifting less than 1 meter 3 ft is considered to be minor work incidental to related lining and surfacing work.

d. Where track construction abuts a turnout, the pay limit for construction of various items will be the center of the No. "0" tie in front of the turnout and the last long switch tie at the rear of the turnout and shall not include turnout.

e. Rail, ties, and other track materials for use in track construction will be included for measurement and payment under

the respective contract unit prices for furnishing that material. Ballast and subballast will be measured and paid for at the contract unit prices for "Furnish and Install Ballast" and "Furnish, Place, and Compact Subballast". Costs for surfacing and alignment will be included in the contract unit price for "Track Construction".

1.2.38 Track Removal and Salvage

Removal of track will be measured by the track-meter track-ft, acceptably removed, and materials salvaged, inspected, inventoried, marked, stacked, and transported to designated storage sites. Track removal and salvage will be paid at the contract unit price per track meter ft under "Track Removal and Salvage".

1.2.39 Track Removal and Scrap

Track removal and scrap will be measured by the track meter ft of track acceptably removed and all of the scrap materials removed from the installation. Track removal and scrap will be paid for at the contract unit price per track meter ft of "Track Removed and Scraped".

1.2.40 Turnout Removal and Salvage

Turnout removal and salvage consist of removing all turnout materials, including switch ties. Limits of the turnout removal and salvage will be from the switch point to the last long switch tie. Also, included is the transportation of the materials to the designated storage site. The removal and salvage will be measured for each turnout removed and turnout material salvaged.

1.2.41 Straight Rail Turnout

****
NOTE: Straight rail turnout is performed when a turnout is removed, but one track is to remain in service.
****

Straight rail turnout consists of installing crossties in place of switch ties and replacing the previously removed switch and frog with rail and other track materials. The straight rail turnout will be measured for each turnout removed.

1.2.42 Rail Bonds

Rail bonds will be measured for each bond acceptably furnished and installed and will be paid for at the contract unit price for each of the following:

a. "Furnish and Install Railhead Bonds"
b. "Furnish and Install Duplex Web Bonds"

1.2.43 Rail Grounds

Rail grounds, including grounding rods, connecting cables, and hardware will be measured by the unit for each rail ground assembly acceptably furnished and installed and will be paid for at the contract unit price for each "Ground Assembly" furnished and installed.

1.2.44 Removal of Existing Crossing Surfaces

Removal and disposal of existing crossing surfaces and adjacent pavements will be measured by the square meter yard of surface or pavement acceptably removed and will be paid for at the contract unit price for "Pavement Removal". Removal of aggregate crossings will not be measured for payment as this work is considered incidental to "Track Construction".

1.2.45 Salvage of Grade Crossing Panel

Salvage of existing grade crossing panels and other materials will be measured by the track meter ft of crossing surface acceptably salvaged and will be paid for at the contract unit price per track m ft under "Grade Crossing Panel Salvage".

1.2.46 Track Removal and Track Construction Through Crossings

Track removal through crossings will be measured by the track meter ft and paid for as "Track Removal". Track construction using existing rail through crossings will be measured and paid for at the contract unit prices as specified in the appropriate sections of this specification. Track construction furnishing rail and other track material will be measured and paid for at the unit prices as specified in the appropriate sections of this specification.

1.2.47 Grade Crossing Surface Installation

****

NOTE: Throughout this section, delete crossing types not applicable to the work by coordinating with the project standard drawings and cross sections. Designer should add a separate bid item for signs if required.

****

Grade crossing surface installation will be measured by the track meter ft of crossing surface acceptably installed and paid for at the contract unit prices for the items listed below:

TYPE	DESCRIPTION
1	GRAVEL: (SEMI-PERMANENT)
1A	GRAVEL: WITH TIMBER HEADERS
2	TIMBER: FULL DEPTH
2A	TIMBER: FULL DEPTH, PREFABRICATED TIMBER SECTIONAL
3	ASPHALT: FULL-DEPTH WITH TIMBER HEADERS
4	CONCRETE: CAST-IN-PLACE
4A	CONCRETE: PRECAST CROSSING PANELS/SYSTEMS
5	RUBBER (ELASTOMERIC)

1.2.48 Subdrains

Subdrains acceptably installed will be measured and paid for by the linear meter ft at the contract unit price for "Grade Crossing Subdrains".

1.2.49 Conduit

****

NOTE: Delete this paragraph if grade crossing conduit is not required for automatic crossing protection warning devices. Installation should be considered if future crossing signal installation is anticipated.

****

PVC cable conduit of 100 mm 4 in diameter acceptably installed will be measured and paid for by the linear m ft at the contract unit price for "Grade Crossing Conduit".

1.2.50 Cleaning Flangeways

Cleaning the gage side flangeways in grade crossings shall be considered incidental work.

1.2.51 Ultrasonic Testing of Rail

Ultrasonic testing will be measured by the track meter ft and will be paid for as "Ultrasonic Testing".

1.2.52 Electric Arc Welding

Electric arc welding will be measured and paid for by the item, rebuilt in the track or in the shop and installed in the track. Items to be included are as follows:

a. "Switch point", each.
b. "Frog", each.
c. "Batter rail end", each.
d. "Guard rail", each.
e. "Engine burn", each.
f. "Railroad crossing", each.

1.3 SUBMITTALS

****

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office

(Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

****

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Bridge Repair; G, [_____]

Shop drawings necessary for the construction and erection of the railroad bridge work. Shop drawings shall be made from measurements taken at the site wherever possible or from established measurements, when actual measurements are not available. The Contractor shall be responsible for the accuracy of the established measurements, the information furnished to the subContractors for the preparation of their Shop Drawings, and the checking of all Shop Drawings. Drawings shall bear the stamp of a Professional Engineer.

As-Built Drawings; G, [_____]

One set of reproducible originals of the final as-built drawings for each automatic crossing protection installation prior to final acceptance by the Contracting Officer.

SD-03 Product Data

Wood Ties

Name of the tie manufacturer, Rail Tie Association membership, the wood species proposed, the quantities of ties for each specie proposed, and product data for the ties to be furnished, including the type of seasoning to be utilized, prior to ordering the ties.

Engineered Polymer Composite Ties

Name of the tie manufacturer, dimensions, and the pre-drill size as recommended by the tie manufacturer for the type and size fastening system being used.

Steel Ties

Name of the tie manufacturer, dimensions, type of fixation and the chemical analysis of the steel.

Concrete Ties

Name of the tie manufacturer, dimensions, type of fixation and the chemical analysis of the concrete mix.

New Jointed Rail; G, [_____]
Relay Rail; G, [_____]
Joint Bars
Compromise Joint Bars.

Manufacturer's data on new rail including: rail weight, rail section, drilling, rail length, date rolled, and the name of the mill where the rail was rolled. Include chemical analysis for Industrial Grade Rail. For relay rail the required information shall include weight, section, lengths, and the name of the supplier. The maximum allowable vertical wear on the rail head and the maximum allowable horizontal wear on the side of the rail shall be provided. The design of the joint bars and compromise joint bars proposed to be furnished with each rail section shall also be provided.

Miscellaneous Track Materials

Manufacturer's data for all track materials to be furnished.

Crossing Material or Surface

Within 30 days of the Notice to Proceed, the brand name of the premanufactured crossing material or crossing surface material proposed for use along with manufacturer's literature concerning the product; and for built-in-place crossings, the type of materials to be used along with manufacturer's literature.

Detailed installation procedure for the premanufactured crossing material or crossing surface material proposed for use within 30 days of the notice to proceed.

Acceptable Replacement Materials; G, [_____]

Performance data for components or products proposed as an equivalent to those specified. The Contracting Officer's written approval is required for any such equivalent type component or product proposed to be used.

Traffic Maintenance and Detour Plans; G, [_____]

Traffic maintenance and detour plans for approval.

Thermite Welding Procedures; G, [_____]

A detailed statement covering the step-by-step procedures to be employed in making the welds, including a complete description of each of the following items, as applicable, and any other essential characteristics included in the welding procedures:

a. The manufacturer's trade name for the welding process.

b. The method used for cutting and cleaning the rail ends. Flame cutting of rail ends will not be allowed.

c. The minimum and maximum spacing between rail ends.

d. The method used for maintaining the rails in alignment during welding.

e. The method used for preheating, including time and temperature.

f. The tapping procedure, including the minimum time required to cool the weld under the mold insulation.

g. The method used, including a description of special tools and equipment, for removing the upset metal and finishing the weld to the final contour.

h. Quality control procedures to be followed.

i. The contractual agreements with any subcontractor employed by the Contractor in doing the work.

Electric Arc Welding

A detailed specification covering the step-by-step procedures to be employed in making the electric arc welds. A complete description of each of the following items as applicable and any other essential characteristics shall be included in the procedure specifications.

a. Type, size, and capacity of electric welding machine (250 amp minimum), grinder and other equipment. Also, type and size of material (welding rod or wire).

b. The method to be used to remove defective and excess metal prior to welding (arcair or grinding).

c. The method to be used to prevent warping.

d. The method used for preheating, including time and temperature.

e. The method of applying metal buildup and slag removal.

f. The method of securing original contour of items welded.

g. Quality control procedures to be followed.

h. Welding materials (rod or wire), name and manufacturer of materials (low carbon steel) for welding rail, rail frogs, guard rails, switch point protectors, and switch points without manganese inserts and materials (manganese alloy) for welding manganese frogs, RBM frogs, manganese switch point inserts and manganese railroad crossing inserts or castings.

Materials and Samples

A complete schedule of the materials proposed for installation within 60 days of receipt of notice to proceed, and before installation of the materials; the schedule shall include a list of equipment proposed for the work.

SD-04 Samples

Geotextile

Geotextile samples for testing. Samples shall be submitted a minimum of [30] [60] [90] [_____] days prior to the beginning of installation of the geotextiles. One sample shall be provided for each 20 units (rolls, panels, etc.) of geotextile to be used in the contract. All samples shall be from the same production lot as will be supplied for the contract. Samples shall be identified by the manufacturer's name, brand name, lot designation, and project name. The minimum size of sample submitted for testing shall be the full width of the geotextile by [1.7] [9] [_____] m [5] [30] [_____] ft.

Ballast
Subballast

Samples of the ballast [and subballast] material for testing. Samples shall be submitted a minimum of [30] [60] [90] [_____] days prior to the installation of the material. Samples shall be obtained from the quarry, supplier, or other source that will be used to provide the ballast [and subballast] materials for this project using the methods described in ASTM D 75. [One representative sample of not less than 90.6 kg 200 lbs of ballast material shall be submitted for each 9070 MT 10,000 ton of ballast to be installed.] [One representative sample of not less than 90.6 kg 200 lbs of subballast material shall be submitted for each 9070 MT 10,000 ton of subballast to be installed.]

SD-06 Test Reports

Sampling and Testing

One certified copy of Test Reports for each test performed on the ballast [and subballast] within 2 working days of the test completion.

Wood Ties

Certified [test] [and] [inspection] reports for crossties and switch ties subsequent to treatment, a minimum of seven calendar days prior to any ties being installed in track. [Test] [and] [inspection] reports shall contain the information required by Part 7 of AWPA M2.

Engineered Polymer Composite Ties

Certified test reports for crossties and switch ties, a minimum of seven calendar days prior to any ties being installed in track. Test reports shall document compliance of the ties to the performance criteria in Chapter 30, Part 5 of AREMA Manual.

Concrete Ties

Certified test reports for ties and fastening system, a minimum of seven calendar days prior to any ties being installed in track. Test reports shall document the testing required by Chapter 30 of

AREMA Manual.

Geotextiles

Independent testing laboratory's certified test reports for geotextiles, including necessary analysis and interpretation. These reports shall provide results of the laboratory testing performed on samples of the geotextile material delivered to the jobsite. Test reports shall be submitted at least [5] [_____] working days prior to the installation of the geotextile.

Ultrasonic Test

Results of the ultrasonic rail testing. Results shall list defects and rail stationing.

SD-07 Certificates

Wood Ties

Certificates of compliance prior to any ties being installed in track.

Engineered Polymer Composite Ties

Certificates of compliance prior to any ties being installed in track.

Ballast
Subballast

Certificates of Compliance for the ballast [and] [subballast] materials to be installed in this project.

Materials and Samples

Manufacturer's certificates of conformance for the following materials:

a. Rail.
b. Tie plates.
c. Track bolts, nuts, and spring washers.
d. Joint bars.
e. Rail anchors.
f. Track spikes.
g. Turnouts.
h. Rail welding process.
i. Premanufactured car bumpers.
j. Premanufactured road crossings and/or crossing surfaces.

SD-10 Operation and Maintenance Data

Rail
Turnouts and Track Crossings
Switches
Grade Crossings

Submit Data package 1 in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Materials and Samples

The Contracting Officer will notify the Contractor of the materials approved or disapproved. Disapproved materials that have already been delivered to the project site, shall be promptly segregated from the approved materials and removed from the premises. If materials are disapproved, acceptable replacement materials shall be provided at no additional cost to the Government. Initial approval by the Contracting Officer will not prevent the removal and replacement of materials that are materially defective or materials not meeting this specification that are discovered during construction and/or routine quality control/quality assurance operations.

1.4.2 Geotextiles

Geotextiles shall be shipped and stored in their original ultraviolet resistant cover until the day of installation. Geotextiles shall be protected from vandalism, temperatures greater than 60 degrees C 140 degrees F, dirt, dust, mud, debris, moisture, sunlight, and ultraviolet rays. Geotextiles delivered to the project site shall be clearly labeled on the material cover to show the manufacturer's name, brand name, fabric type, location and date manufactured, lot identification, width, and length.

1.5 QUALIFICATIONS

1.5.1 Track Construction

Track construction shall be performed under the direction of qualified and competent supervisory personnel experienced in railroad construction.

1.5.2 Welding

Welding shall be performed under the direct supervision of an experienced welding supervisor or foreman.

1.6 PROJECT/SITE CONDITIONS

1.6.1 Temporary Work

During construction, suitable roads and crossings with all necessary lights, signs, drainage, and other appurtenances required for safe public and local travel shall be provided. Suitable temporary fences shall be erected and maintained where required to prevent trespass upon work or damage to adjoining property. Drainage shall be maintained, and the accumulation of water that might affect the stability of the roadbed will not be permitted.

1.6.2 Traffic Control

Traffic control devices shall comply with MUTCD. Suitable warning signs shall be placed near the beginning of the work site and well ahead of the work site for alerting approaching traffic from both directions. Small markers shall be placed along newly painted lines or freshly placed raised markers to control traffic and prevent damage to newly painted surfaces or displacement of raised pavement markers. Painting equipment shall be marked with large warning signs indicating slow-moving painting equipment

in operation.

1.6.3 Welding

Welding shall not be performed in rain, snow, or other inclement weather without adequately protecting the weld from the elements.

1.6.4 License Agreement

****
NOTE: The Designer should assess the need to include this paragraph and its subparagraphs in the project specifications. Delete if not applicable.
****

The work under this contract is being accomplished under a license agreement between the [_____] RAIL CORPORATION (hereinafter referred to as the Railroad Company) and the UNITED STATES OF AMERICA executed on [_____].

1.6.4.1 Provisions and Requirements

The following provisions and requirements are made a part of this contract in order for the UNITED STATES OF AMERICA to perform its obligations under the License agreement:

a. The Contractor shall perform the work in conformance with the standards of care and practice appropriate to the nature of the work.

b. The Contractor shall allow the Railroad Company to view and inspect the work at any time.

c. The Contractor shall not enter the Railroad Company's premises until specifically authorized by the Contracting Officer. The Contractor shall notify the Contracting Officer at least 7 days prior to the planned date for entering the premises of the Railroad Company.

d. The Contractor shall take any safety precautions that the Railroad Company deems necessary. No equipment, unless being utilized to perform work on the railroad track, shall be located within 3.5 m 12 ft of the centerline of the nearest railroad track. Such equipment allowed within 3.5 m 12 ft of the centerline of the nearest railroad track shall be attended at all times.

e. The Contractor shall furnish evidence of Workmen's Compensation coverage for both itself and for all subContractors.

f. The Contractor shall maintain at all times during any construction, maintenance, or removal work, the following insurance coverages:

(1) Contractor's Public Liability and Property Damage Liability Insurance, including automobile coverage, with a combined single limit of $2,000,000 per occurrence;

(2) For each subcontractor, Contractor's Protective Public Liability and Property Damage Liability Insurance, including automobile coverage, with a combined single limit of $2,000,000

per occurrence;

(3) Railroad Protective Public Liability and Property Damage Liability Insurance with a combined single limit of $2,000,000 per occurrence.

1.6.4.2 Insurance Policy Requirements

The Railroad Protective Liability policy shall name the [_____] Rail Corporation, [_____] Corporation, and [_____] as the named insureds and shall include an endorsement in the form appearing in the Standard Provisions of the contract documents. The Contractor shall furnish to the Railroad Company, the Railroad Protective Liability policy and the certificates evidencing the other insurance coverage required in this section. Each policy and/or certificate shall provide that cancellation of the insurance cannot be accomplished unless at least ten (10) days notice is given to the Railroad Company.

PART 2 PRODUCTS

2.1 BALLAST

****

NOTE: No. 5 ballast should only be used around turnouts and other areas requiring a smooth walking surface. Depth of ballast will be indicated on the drawings.

A wide choice of materials may be used for ballast, depending on economics and availability. Prepared ballast is preferred since production can be controlled. The use of unprepared ballast for heavy-duty track will increase maintenance requirements. The inapplicable types of ballast will be deleted, and brackets will be removed. The size number will be indicated in this paragraph. Normally, prepared ballast will be used conforming to sizes of gradations established by AREMA Manual. Ballast, crushed stone and slag numbers 4, 4A, or 5 are acceptable. Size numbers 4 and 4A are typically mainline ballast materials. Size number 5 is typically used on yard and house tracks. Any or all of these sizes can be specified, with a Contractor's option. The depth and other details of the ballast section will be shown on the contract drawings.

Blast furnace slag should be considered a last choice or limited to areas with low rainfall and moisture and obtained from a source that is known to have provided good performing ballast in recent years. Most slag ballast tend to cement together over time or otherwise disintegrate more rapidly than better quality crushed rock. Water seems to accelerate this process. (This behavior is much like some poorer quality limestones.) Thus, unless its performance is already well known, using slag for ballast is much riskier than using crushed rock.

****

Prepared ballast shall be crushed stone, [crushed air-cooled blast-furnace slag,] [or] [crushed steel furnace slag] Size No. [4,] [4A,] [or] [5] conforming to Chapter 1, Part 2, of AREMA Manual for quality, soundness and gradation. In the portion retained on each sieve specified, the crushed gravel shall contain at least 90 percent by weight of crushed pieces having two or more freshly fractured faces with the area of each face being at least equal to 75 percent of the smallest midsectional area of the plane. When two fractures are contiguous, the angle between planes of the fractures shall be at least 30 degrees in order to count as two fractured faces. Flat and elongated particle dimension ratio used in ASTM D 4791 shall be 1:3. Ballast materials shall meet the property requirements shown in TABLE I.

TABLE I. MINIMUM PROPERTY REQUIREMENTS - BALLAST

Property	Maximum Value	Minimum Value	Test Method
Percent passing 0.075 sieve (No. 200 Sieve)	1.0 percent	--	ASTM C 136 ASTM C 117
Bulk specific gravity			
Rock	--	2.60	ASTM C 127
Blast furnace slag	--	2.30	
Absorption			
Rock	2.0 percent	--	ASTM C 127
Blast furnace slag	5.0 percent	--	
Clay lumps and friable particles	0.5 percent	--	ASTM C 142
Degradation Soundness	35 percent	--	ASTM C 535
Sodium sulfate - 5 cycles	10 percent	--	ASTM C 88
Flat or elongated particles	5 percent	--	ASTM D 4791

TABLE I. MINIMUM PROPERTY REQUIREMENTS - BALLAST

Property	Maximum Value	Minimum Value	Test Method
Percent passing No. 200 Sieve	1.0 percent	--	ASTM C 136 ASTM C 117
Bulk specific gravity			
Rock	--	2.60	ASTM C 127
Blast furnace slag	--	2.30	
Absorption			
Rock	2.0 percent	--	ASTM C 127
Blast furnace slag	5.0 percent	--	
Clay lumps and	0.5 percent	--	ASTM C 142

TABLE I. MINIMUM PROPERTY REQUIREMENTS - BALLAST

Property	Maximum Value	Minimum Value	Test Method
friable particles			
Degradation Soundness	35 percent	--	ASTM C 535
Sodium sulfate - 5 cycles	10 percent	--	ASTM C 88
Flat or elongated particles	5 percent	--	ASTM D 4791

2.2 SUBBALLAST

****

NOTE: Subballast should be used in frost areas where the ballast thickness requirement exceeds 254 mm (10 inches). Where subballast in necessary, indicate the kind of subballast to be used; the depth and other details of subballast section will be shown on the contract drawings. In some cases, the subballast material may be substituted for the lower portion of the ballast layer. The subballast is often constructed as a filter layer between the ballast and subgrade. Gradation of subballast generally ranges from the largest subgrade particles to the smaller or middle ballast particle sizes. Where practical, subballast should be placed in layers and thoroughly compacted to form a stable foundation for the ballast. AREMA Manual has a procedure for selecting gradation based on gradation of ballast and subgrade.

****

Subballast shall consist of aggregate-soil materials conforming to an ASTM D 1241 Type I, Gradation [A] [B] [C] [D] mixture.

2.3 GEOTEXTILE

****

NOTE: Requirements for geotextile will be deleted unless a thorough investigation indicates that geotextile is necessary. Where geotextile is necessary, subballast is recommended and the following information should be shown on the drawings:

a. Locations for geotextile installation.

b. Locations for drainage work, including subdrains to provide drainage for the geotextile.

c. Typical cross-section through track showing rail, tie, ballast, subballast, geotextile, and subgrade with dimensions.

d. Locations for disposal of spoil materials.

Numerical values listed in TABLE II, except AOS, represent Minimum Average Roll Values (MARV) and are the value in the weaker principal direction as defined in AASHTO M 288.

Color should be grey or tinted to prevent "snow blindness" of personnel during installation.

The permeability of the geotextile should be at least five times greater than the permeability of the subgrade soil, but not less than the specified value. The pressure used to measure the nominal thickness (necessary to calculate the permeability) in ASTM D 1777 should be based on the pressure expected to be placed on the geotextile in the installation.

Most railroad applications use overlap as a method of joining separate pieces of geotextile.

See UFC 3-230-01 for additional information on subsurface drainage and filtration criteria.

The minimum depth of ballast for the track section being constructed/reconstructed is to be specified. However, where geotextiles are used in the track structure, the minimum depth of ballast/subballast between the tie and the geotextile of 300 mm (12 in.) should be enforced to avoid severe damage to the geotextile.

****

2.3.1 Physical Property Requirements

The geotextile shall be a nonwoven, pervious sheet of polymeric material and shall consist of long-chain synthetic polymers composed of at least 95 percent by weight polyolefins, polyesters, or polyamides. The use of woven slit film geotextiles (i.e. geotextiles made from yarns of a flat, tape-like character) will not be allowed. The geotextile shall contain stabilizers and/or inhibitors as necessary to make the filaments resistant to deterioration from ultraviolet light and heat exposure, particularly prior to placement and coverage. The fibers shall be formed into a network which will be dimensionally stable. The edges of the geotextile shall be finished in a way to prevent the outer fibers from being pulled away from the geotextile. The geotextile shall exceed the applicability property requirements stated in TABLE II.

TABLE II - PROPERTY REQUIREMENTS-GEOTEXTILE

PROPERTY	MINIMUM REQUIREMENTS*	TEST METHOD
Weight**	0.57 kg/0.836 sq m (15 oz/sq yd)	ASTM D 3776 Option B
Color	Grey or tinted	--

TABLE II - PROPERTY REQUIREMENTS-GEOTEXTILE

PROPERTY	MINIMUM REQUIREMENTS*	TEST METHOD
Strength	Class 1	AASHTO M 288
Apparent opening size (AOS) (maximum required valve)	Less than 0.22 mm (No. 70 sieve)	ASTM D 4751
Permittivity	0.1 per sec	ASTM D 4491
Ultraviolet degradation at 500 hours	50 percent strength retained	ASTM D 4355

TABLE II - PROPERTY REQUIREMENTS-GEOTEXTILE

PROPERTY	MINIMUM REQUIREMENTS*	TEST METHOD
Weight**	15 oz/sq yd	ASTM D 3776 Option B
Color	Grey or tinted	--
Strength	Class 1	AASHTO M 288
Apparent opening size (AOS) (maximum required valve)	Less than 0.22 mm (No. 70 sieve)	ASTM D 4751
Permittivity	0.1 per sec	ASTM D 4491
Ultraviolet degradation at 500 hours	50 percent strength retained	ASTM D 4355

*These property requirements are Minimum Average Roll Values in the weaker principal direction.

**Geotextile selection shall not be limited by the minimum weight shown. Selection shall be based on the other property requirements listed. Heavier geotextiles have shown greater resistance to abrasion.

2.3.2 Dimensional Requirements

Each roll of geotextile shall match the roadbed width and be at least 3.6 m 12 ft.

2.4 JOINT BARS

****
NOTE: Lone toe joint bars are not recommended for high used tracks.
****

Joint bars shall be of the size, shape, and punching pattern to fit the rail being joined.

2.4.1 New Joint Bars

New joint bars shall be used with new rail, and shall be of the "toeless" and "head free design" to match rail section. New joint bars shall conform to the requirements of "Specifications For High-Carbon Steel Joint Bars" or "Specifications For Quenched Carbon-Steel Joint Bars and Forged Compromise Joint Bars" found in Chapter 4, Part 2 of AREMA Manual for the joint bar and assemblies recommended in Chapter 4, Part 1 of AREMA Manual.

2.4.2 Used Joint Bars

Used joint bars in good condition shall be used with relay rail only. The type of joint bar shall be "toeless" type. The used "long toe" type of joint bar shall not be employed where, because of the tie plate punching pattern, the spike slots are used to spike the rail to alignment at the joints. Used joint bars shall be straight, free from cracks, breaks, and other visual defects. Excessive rust, dirt, and other foreign materials on the joint bars are not permitted. Used joint bars shall be of the proper size to make good contact with the underside of the rail head and the top of the rail base on the rails being joined. Joint bars shall have alternating round and oval bolt holes. Bolt holes shall not show excessive wear that would prevent use of the oval neck track bolt normally used with that joint bar. Joint bars that have been flame-gouged, flame cut, or otherwise altered shall be considered scrap and shall not be used.

2.4.3 Compromise Joint Bars

Compromise joint bars shall be of the size, shape, and punching pattern to fit the rail sizes and sections being joined. Only factory designed and constructed (forged or cast) compromise joint bars shall be used to join rails of different sizes.

2.4.3.1 New Compromise Joint Bars

Compromise joint bars shall conform to the requirements of "Specifications For Quenched Carbon-Steel Joint Bars and Forged Compromise Joint Bars" found in Chapter 4, Part 2 of AREMA Manual.

2.4.3.2 Used Compromise Joint Bars

Requirements for joint bars in paragraph Used Joint Bars shall also apply to used compromise joint bars.

2.5 GREASE

Grease for lubricating moving parts in turnouts and other trackwork shall have the following typical characteristics:

Calcium Soap, percent	9.0
Solid Additive (Graphite),percent	11.5
Penetration, ASTM D 217 at 25 degrees C worked	340
Dropping Point ASTM D 566 at 25 degrees C	101/214
Oil Viscosity, square mm/record at 40 degrees C	81.8
ASTM D 445 SUS at 38 degrees C	379
Penetration, ASTM D 217 at 77 degrees F worked	340

Dropping Point ASTM D 566 at 77 degrees F	101/214
Oil Viscosity, cSt at 104 degrees F	81.8
ASTM D 445 SUS at 100 degrees F	379

Other types of grease or lubricating oil (like SoyTrak) may be used provided that the grease or oil has been used successfully by local commercial railroads and has the approval of the Contracting Officer.

2.6 OIL FOR CORROSION PROTECTION

Oil for protecting rail and other track materials from corrosion, except joints, shall conform to the following general specification:

Asphalt, 100 penetration minimum 45 percent	ASTM D 402
Flash point, minimum 55 degrees C	ASTM D 1310
Viscosity, kinematic, 60 degrees C 480 to 700 sq mm/s	ASTM D 2171
Flash point, minimum 130 degrees F	ASTM D 1310
Viscosity, kinematic, 140 degrees F 480 to 700 centistokes	ASTM D 2171

2.7 RAIL

2.7.1 New Jointed Rail

****

NOTES: Designer will indicate the desired rail weight and section. Rail weights/sections recommended for new rail purchases include: 115 RE, 132 RE, 133 RE, and 136 RE.

The designer will insert the rail section and the drilling pattern for each rail section required. Recommended rail drillings and joint bar punchings are found in Chapter 4, Part 1 of AREMA Manual. An example specification for 57 kg (115 lbs) rail and a 6-hole joint bar would be:

RAIL	**DRILLING**
115RE	**89-152-152 mm (3-1/2, 6, 6 inch)**

****

2.7.1.1 General Requirements

New jointed rail shall comply with the following:

a. Rail Lengths: New rail shall be a [_____] kg/m lbs/yd section or heavier and shall conform to the specifications in Chapter 4, Parts 1 and 2 of AREMA Manual that were in effect at the time of its manufacture. New rail shall be provided in [11.9] [24.4] m [39] [80] ft lengths.

b. Rail Drilling: New rail shall be provided with the rail ends drilled. Drilling shall be uniform and to the patterns specified.

RAIL	DRILLING
[_____]	[_____]

2.7.1.2 New Industrial Grade Rail

All steel shall be produced in an electric furnace and be continuous cast, free of hydrogen. All injurious hot marks, or surface imperfections shall be culled out and eliminated. Rail shall control cooled to AREMA specifications. Rail shall be rolled in accordance with the general physical dimensional requirements of AREMA design but shall meet the Section tolerances and Chemical Composition listed below.

SECTION TOLERANCES

Height	+1.5 to -0.7 mm+0.060 to -0.025 inch
Head Width	+1.2 to -1.1 mm+0.045 to -0.045 inch
Base Width	+1.5 to -1.5 mm+0.060 to -0.060 inch
Web Width	+1.5 to -0.7 mm+0.060 to -0.025 inch

GENERAL COMPOSITION

		PRODUCT ANALYSIS %	
ELEMENT	CHEMICAL ANALYSIS %	UNDER MINIMUM	OVER MAXIMUM
Carbon	0.65 to 0.85	0.04	0.04
Manganese	0.70 to 1.30	0.06	0.06
Phosphorus Max.	0.040		0.008
Sulfur Maximum	0.050		0.008
Silicon	0.10 to 0.50		0.50

Rail shall be ultrasonically tested to the following calibration guidelines:

CALIBRATION GUIDLINES

Head	2.4 mm0.10 inch Flat bottom Hole
Web	3.2 mm0.13 inch Flat Bottom Hole
Base	3.2 mm X 12.7 mm.013 x 0.50 inch Slot

Rail shall be straightened for line in a press or roller straightener. End straightness shall meet the following guidelines:

Droop	1.0 mm0.040 inch Maximum
Dip	1.0 mm0.040 inch Maximum
Hook	1.0 mm0.040 inch Maximum

2.7.2 Used Jointed Rail

****

NOTES: Due to the ever-changing markets for used rail, it may be beneficial to allow the Contractor the option to provide an acceptable rail section for relay. Hence, the list of acceptable rail sections, acceptable rail weights, and sections should be chosen for compatibility with the existing rail and

to minimize the number of different rail weights and sections on the installation. Delete unacceptable weights/sections from the list. Normally, rail less than 115 lbs should not be purchased for DOD track.

The designer will insert the rail section and the drilling pattern for each rail section required. To the greatest extent practical, the specified drillings should match the drilling pattern in the existing rail that is to remain in track. Recommended rail drillings and joint bar punchings are found in Chapter 4, Part 1 of AREMA Manual. An example specification for 57 kg (115 lbs) rail and a 6-hole joint bar would be:

RAIL	**DRILLING**
115RE	**89-152-152 mm (3-1/2, 6, 6 inch)**

****

2.7.2.1 Relief Rail

Used rail for spot rail replacement of defective rails (relief rail) shall be the same weight, section, drilling, and length as the rail being replaced. Relief rail shall meet the requirements specified for relay rail.

2.7.2.2 Relay Rail

****

NOTE: Relay rail is typically available in nominal lengths of 10.1 and 11.9 meters (33 and 39 ft). Relay rail can be justified if the construction cost is substantially below that of new rail.

A comparison of the usable metal in the heads of a new 57 kg/m (115-lbs) RE rail and a 57 kg/m (115-lbs) relay rail shows that the relay rail has about 32 percent less usable metal. Based on construction cost, the rail constitutes about 47 percent of the total track above roadbed; therefore, for economy, track constructed with 57 kg/m (115-lbs) relay rail should cost at least 15 percent (33 percent times 0.47 equals about 15 percent) less than track constructed with new 57 kg/m (115-lbs) rail. Other conditions can be evaluated in a similar manner.

Specifying relay rail that meets AREMA is not adequate for military track. AREMA permits excessive end batter because rail ends are intended to be cropped off before welding. All relay rail should have ultrasonic inspection after it is installed. For Army projects the default values in Table IV are the maximum values. For Navy projects, the maximum wear shall be 5 mm (3/16 inch) for the top and 3 mm (1/8 inch) for the side.

FORSCOM projects require the used of 115RE, 132RE, 133RE or 136RE rail sections.

****

Relay rail shall be control cooled. [Used rail for out of face replacement and new construction shall be 45 kg/m 90 lb/yd or heavier and shall have the same section and drilling pattern for each rail weight. Acceptable rail weights and sections are: [90 ARA-A,] [100 ARA-B,] [112 AREA,] [115 AREA,] [130 AREA,] [132 AREA,] [133 AREA,] [136 AREA,] [_____]] [All relay rail provided shall be the same section.]Relay rail shall not be cut into jointed rail from continuous welded rail.

a. Rail Drilling: Relay rail shall be provided with the rail ends drilled. Drilling shall be uniform and to the patterns specified.

RAIL	DRILLING
[_____]	[_____]

b. Length: Relay rail shall be standard [10.1] [11.9] m [33] [39] ft lengths. Not more than 10 percent of the lot may be shorts. No rail shorter than 8.2 m 27 ft will be accepted.

c. Maximum Allowable Wear: For each rail, the average top wear shall meet the requirements on Table IV, except rail in turnouts which shall conform to paragraph Maximum Wear Used Rails Installed in Turnouts. Side wear shall be measured 16 mm 5/8 in below the original top of rail.

d. Condition and Appearance: Relay rail shall be free from obvious defects and clean in appearance. Rail that has severe pitting and corrosion or has been flame-gouged, or spike nipped will not be accepted. Rail shall be straight from line and surface and free from any kinks or bends. Rail bases shall be solid and free from visual defects such as plate wear, spike notching, pitting, and flame-gouging. All existing bond wires shall be removed from relay rail by shear cutting old cables immediately adjacent to the weld or pin. Bond wire heads shall be completely removed from the gage side.

(1) Maximum Allowable Lip: Lip or overflow shall not exceed 3 mm 1/8 inch on either side of the rail head.

(2) Engine Burns: Engine burns shall not be greater than 13 mm 1/2 inch diameter and 0.8 mm 1/32 inch deep. A maximum of 6 engine burns is allowed per rail and engine burns shall not affect more than 25 percent of the total order.

(3) End Batter and Chipping: Rail end batter shall not exceed a maximum of 3 mm 1/8 inch when measured 13 mm 1/2 inch from the rail end with a 460 mm 18 inch straightedge laid only on the rail being measured. Chipped or broken rail ends will not be accepted.

(4) Running Surface Damage: Running surface damage shall not exceed 6 mm 1/4 inch long by 13 mm 1/2 inch wide, and shall be not greater than 1.5 mm 1/32 inch deep. Flat spots are not permitted on the rail head.

(5) Defects Not Permitted: Relay rail having any of the following defects shall not be accepted: bolt hole cracks or breaks, broken base, breaks, crushed head, detail fracture, engine burn fracture, head-web separation, piped rail, horizontal split head, vertical split head, torch cut rail ends, torch cut bolt holes, and

compound or transverse fissures. The presence of any of these defects in the rail render that rail as scrap.

TABLE IV. ALLOWABLE WEAR LIMITS FOR RELAY RAIL

Nominal Rail Weight, kg/m	Maximum Allowable Wear, mm Top	Side
57.0 or less	3.2	6.4
Greater than 57.0	6.4	9.5

TABLE IV. ALLOWABLE WEAR LIMITS FOR RELAY RAIL

Nominal Rail Weight, lbs/yds	Maximum Allowable Wear, in. Top	Side
Less than 115	1/8	1/4
115 or Greater	1/4	3/8

2.7.3 Welded Rail

****

NOTE: While the use of continuously welded rail and concrete ties may be beneficial in some situations, the cost effectiveness for general use for DOD track has not been proven at this time. A thorough life-cycle cost analysis should be performed prior to specifying these materials.

****

New rail shall be, [_____] kg/m lbs, [_____] section and shall conform to Chapter 4, Part 2 of AREMA Manual. Relay rail shall conform to TABLE IV, [_____] kg/m lbs. Relay rail that is to be welded shall meet the criteria specified in Chapter 4, Part 2 of AREMA Manual for welded rail. Mingling of new and relay rail will not be permitted.

2.8 TIE PLATES

2.8.1 General

Tie plates shall be of the dimensions and punching pattern (A or B) to fit the rail. New tie plates conforming to Chapter 5, Part 1 of AREMA Manual shall be used with new rail. Used tie plates in good condition may be used with relay rail and shall be the dimensions as originally specified by AREMA Manual. The used tie plates shall not be smaller than 190.5 by 254 mm 7-1/2 by 10 inch for use with relay rail having nominal weights less than 49.6 kg/m 100 lbs/yd, or not smaller than 190.5 by 279 mm 7-1/2 by 11 inch double-shoulder for use with relay rail having nominal weights of 49.6 kg/m 100 lbs/yd and greater. Both flat and canted plates will be required to match the existing tie plates that are in track. Canted tie plates shall be used in all new rail and relay out-of-face rail replacements.

2.8.2 Used Tie Plates

Used tie plates shall be free from excessive rust, pitting, mechanical damage, and dirt and other foreign materials. Cracked or broken plates

shall be considered as scrap and shall not be used. Shoulders on the tie plates shall project a minimum of 6 mm 1/4 inch above the plane of the rail seat. The thickness of the tie plate shall be at least 13 mm 1/2 inch when measured anywhere in the rail seat area. Spike holes shall be square and not corroded, worn, or mechanically enlarged.

2.9 WOOD TIES

****

NOTE: Because of differences in treatability of the many species of wood used to manufacture railroad ties, installations should limit the number of acceptable species to those most commonly used in their geographic area. Red Oak, White Oak, and Southern Pine will provide good service in the eastern states while Douglas Fir will generally be more available in the western states. Southern Pine should not be used as mainline ties or as switch ties. Gum and pine ties are not recommended for use in areas having high humidity, such as the southeastern states. If unsure about the most appropriate species of wood for timber ties in the job geographic area, the engineering department of the local commercial railroad should be consulted.

The size and form of the crossties will be inserted in this paragraph using the following guidance.

a. For main lines, access tracks, or other tracks where the movement may be classified as heavy or the desired speed is in excess of 64.4 km/hr (40 miles per hour), crossties will be not less than 178 mm (7 in.) thick by 229 mm (9 in.) wide. The length of crossties will be 2.591 m (8 ft 6 in.) or 2.743 m (9 ft).

b. For yard or body, industrial, storage, siding, and running tracks, and for access tracks where the movement is not classified as heavy, crossties not less than 152 mm (6 in.) thick by 203 mm (8 in.) wide can be used. The length of crossties will either be 2.438 m (8 ft) or 2.591 m (8 ft 6 in.).

c. For road crossings, ties 178 mm (7 in.) thick by 229 mm (9 in.) wide and 2.743 m (9 ft) long will be required, unless the manufacturer recommends a different length.

d. If locally available, oak is preferred for switch ties. A bill of material for switch ties should be provided on the drawings for each proposed type of turnout. AREMA Track Plans, Plan 912 contains bills of switch ties for various size turnouts and crossovers.

Other local species may be listed if used by railroads in the area.

****

All ties shall be new. Species shall be Ash, Beech, Red and White Oak, [Gum,] [Spruces] [_____] [Pine,] [Douglas Fir,] [and] [other Fir]. Switch ties shall be Ash or Oak. Conditioning and seasoning shall conform to the requirements of AWPA C6 for the individual wood species. Ties shall be well seasoned. Prior to preservative treatment, wood ties shall be dried to the oven dry moisture content, or less, as specified in paragraph 3.14 of AWPA C6. The wood may be air dried, vapor dried, or boultonized. Ties which are to be dried by artificial means shall be conditioned and treated as soon as possible after sawing, but no more than 30 days later. The temperature used for boultonizing shall be as high as possible but in no case less than 94 degrees C 200 degrees F. Vapor dried ties shall be transferred from drying cylinders to treatment cylinders as quickly as possible to avoid loss of heat from the seasoned ties. Ties shall be pressure treated in accordance with Chapter 30, Part 3 of AREMA Manual by the empty cell process with a 60/40 creosote/coal tar solution (Grade C) in accordance with AWPA P2 to a minimum retention of 128 kg/cu m 8 lbs/cu ft of wood. Bridge ties shall be treated in accordance with paragraph Bridge Ties. The Contractor shall record treatment as specified in AWPA M2. Treated ties shall be permanently marked or branded by the producer in accordance with AWPA M6. Ties shall be produced by a member of the Railway Tie Association. All ties, except Southern, Red, and Ponderosa Pine, shall be incised on all four sides in the pattern specified in AREMA Manual, Chapter 30, Part 3, prior to treatment. Splits shall not be longer than 100 mm 4 inch and not wider than 5 mm 1/4 in at either end. Splits longer than 100 mm 4 inch but not longer than the width of the face in which the split appears, will be acceptable if specified anti-splitting devices are installed with the splits compressed. Any required adzing and drilling for spikes shall be performed prior to treatment. The Contractor shall notify the Contracting Officer at least 15 days prior to the shipment of any treated ties or timbers from the manufacturer's plant, to provide the Government the opportunity to inspect the materials before shipment. When inspections of onsite materials result in product rejection, the Contractor shall promptly segregate and remove rejected material from the premises. The Government may also charge the Contractor any additional cost of inspection or test when prior rejection makes reinspection or retesting necessary.

2.9.1 Crossties

Wood crossties shall conform to Chapter 30, Part 3 of AREMA Manual.

a. Wood crossties except at road crossings: Wood ties shall be sawed and shall be not less than [_____] mm inch thick and [_____] mm inch wide. The length shall be [2.44] [2.6] [2.75] m [8.0] [8.5] [9.0] ft.

b. Wood crossties at road crossings: Wood ties shall be sawed and shall not be less than 178 mm thick and 229 mm wide 7 inch thick and 9 inch wide. The length shall be 2.75 m 9 ft, unless recommended otherwise by the manufacturer of crossing surface materials.

2.9.2 Switch Ties

Switch ties shall conform to Chapter 30, Part 3 of AREMA Manual and shall be sawed 178 mm 7 inch thick and 229 mm 9 inch wide. The length and quantities shall be as shown.

2.9.3 Bridge Ties

****
NOTE: Delete this paragraph and paragraphs Ballasted-Deck Bridge Ties and Open-Deck Bridge Ties if bridge work is not included in the contract.
****

The method for treatment of bridge ties shall be in accordance with AWPA C2. The treatment standards shall be based on the type of deck on the bridge. Any drilling of bolt holes shall be performed prior to treatment. The ties shall be sawed to dimensions and furnished in the quantities indicated on the contract drawings. The Contractor shall field verify all dimensions and quantities prior to furnishing timber bridge ties.

2.9.3.1 Ballasted-Deck Bridge Ties

Ties for use in track over ballasted deck bridges shall be standard crossties.

2.9.3.2 Open-Deck Bridge Ties

Bridge ties for open-deck bridges shall be sized on two sides and of adequate size to distribute the track load to all stress-carrying stringers. Preservative treatment shall be in accordance with AWPA C2 for above-ground exposure.

2.9.4 Tie Plugs

Tie plugs shall fit holes from which spikes are drawn. The plugs shall comply and be treated in accordance with Chapter 30, Part 3 Section 3.1.5 of AREMA Manual.

2.9.5 Anti-splitting Devices

Crossties and switch ties shall be equipped on each end with gang nail end plates anti-splitting devices of the type specified, regardless of whether or not the wood has shown any tendency to split. Products used shall conform to Chapter 30, Part 3 Sections 3.1.6 and 3.1.7 of AREMA Manual.

2.10 BRIDGE TIMBERS

****
NOTE: Delete this paragraph if bridge work is not included in the contract.
****

Bridge timbers include all structural members such as stringers, caps, and posts. Timbers shall be incised on two sides. Creosote preservative treatment shall be in accordance with AWPA C2for above ground exposure and shall have fire-retardant coating for creosoted wood in accordance with AREMA Manual, Chapter 7 Section 1.11.

2.11 BRIDGE LUMBER

****
NOTE: Delete this paragraph if bridge work is not included in the contract.
****

Lumber used in decks and bracing above the waterline shall be treated for above ground exposure. Lumber used in retaining walls, fender systems, and bracing below the high waterline shall be treated for soil contact exposure. Preservative treatment shall be in accordance with AWPA C2 and AREMA Manual, Chapter 73.

2.12 BRIDGE PILES

****
NOTE: Delete this paragraph if bridge work is not included in the contract.
****

Preservative treatment of piles shall conform to AWPA C3 and AREMA Manual, Chapter 7, Part 1, Section 1.9 for piles. Piles used as friction or end-bearing piles shall be a First-Class pile in accordance with AREMA Manual, Chapter 7, Part 1, Section 1.9.4. Second-class piles can be used in retaining walls, dolphins, and fender systems supports.

2.13 ENGINEERED POLYMER COMPOSITE TIES

****
NOTE: Engineered polymer composite ties, also commonly known as plastic ties, are a relatively new technology compared to the more conventional sawn wood and concrete ties. Engineered polymer composite ties are inherently resistant to moisture, rot, and insects and may be preferred for certain locations. Besides out-of-face applications, engineered polymer composite ties can be used for maintenance (intermingled) replacement of deteriorated wood crossties.

Recommended size requirements for engineered polymer composite ties follow the same basic guidance as in the NOTE for paragraph WOOD TIES above pertaining to wood tie sizes.

Engineered composite ties are designed to use the same tie spacing and ballast structure as wood ties. The ties can be installed using conventional hardware and installation equipment. Specific installation detials, such as which fasteners work best, size of pre-drill holes, etc., should be based on the manufacturer's recommendations.

For increased lateral and longitudinal track stability, engineered polymer composite ties can be manufactured with specially designed surface patterns to create a mechanical interlock between the tie and the ballast. Individual manufacturers have different proprietary designs to provide a range of lateral track stability. Experinece has shown that this interlock (track stability) can be achieved with little or no train traffic commonly needed upon replacement of wood ties.
****

Engineered polymer composite ties shall conform to Chapter 30, Part 5 of AREMA Manual. The ties shall incorporate a surface pattern to provide a minimum single tie lateral push result of 11.1 kN 2,500 lbf after no more than 100,000 gross tons of accumulated traffic.

2.13.1 Crossties

a. Engineered polymer composite crossties, except at road crossings, shall be not less than [_____] mm inch thick and [_____] mm inch wide. The length shall be [2.44] [2.6] [2.75] m [8.0] [8.5] [9.0] ft.

b. Engineered polymer composite crossties at road crossings shall not be less than 178 mm thick and 229 mm wide 7 inch thick and 9 inch wide. The length shall be 2.75 m 9 ft, unless recommended otherwise by the manufacturer of the crossing surface materials.

2.13.2 Switch Ties

Switch ties shall conform to Chapter 30, Part 5 of AREMA Manual and shall be 178 mm 7 inch thick and 229 mm 9 inch wide. The length and quantities shall be as shown.

2.13.3 Ballasted-Deck Bridge Ties

Engineered composite ties for use in track over ballasted deck bridges shall be standard crossties.

2.13.4 Tie Plugs

Tie plugging may be utilized in engineered polymer composite ties in similar fashion as they are used in sawn wood ties. Polymer-based plugging compounds (e.g., polyurethane) are recommended.

2.14 STEEL TIES

****

NOTE: AREMA has a lighter weight steel tie section than specified below that can be used for yard tracks subject to light loads. Section minimum properties shall be changed to:

Length	**2540 mm 100 inch**
Width	**260 mm 10.2 inch**
Thickness	**10 mm 0.4 inch**
Section Depth	**97 mm 3.8 inch**
Moment of inertia	**316 cm^4 7.6 in^4**

****

Steel ties shall conform to Chapter 30 of AREMA Manual. Steel ties shall be constructed with hook-in shoulders of a 178 mm 7 inch minimum spade. Ties shall be design and furnished with elastic type rail fixation system for Pandrol E clips or safelock, or an approved equal. Ties shall have a brand rolled into the material indicating the section and manufacturer. Steel ties shall have the following minimum section:

Steel Ties

Length	2590 mm 102 inch
Width	300 mm 11.8 inch
Thickness	10 mm 0.4 inch
Section Depth	118 mm 4.6 inch

Steel Ties

Moment of inertia 610 cm^4 14.6 in^4

Ties shall be manufactured from steel free of injurious segregation with a minimum tensile strength of 312 MPa 45,000 psi. Steel shall have the chemical composition conforming to ASTM A 242/A 242M or ASTM A 992/A 992M

2.15 CONCRETE TIES

****

NOTE: Delete if concrete ties are not required. Concrete ties may be preferred for certain locations.

****

Concrete ties and fastening system shall comply with the material and strength requirements specified in Chapter 30 of AREMA Manual for [monoblock] [reinforced two-block] [prestressed two-block] ties. Concrete ties shall be a minimum of [2.44 m 8 ft] [_____] in length, width of [_____], and height of [_____]. Concrete ties shall have a factored design positive bending moment of [_____] kN-m Inch-kips at center of seat. Concrete shall be furnished with dual durometer rubber pads, which have 50 to 60 shore A durometer on the bottom surface and 75 to 85 Shore A durometer reinforced rubber on the top surface.

2.16 TURNOUTS AND TRACK CROSSINGS

****

NOTE: Detailed information on frogs may be found in AREMA Track Plans. Self-guarded frogs, in accordance with AREMA Track Work Plan No. 641 and Notes, may be specified in place of rigid-bolted frogs except: (1) for tracks where the design speed exceeds 48.3 km/hr (30 miles per hour), or (2) for track installations outside the United States. Spring rail frogs shall not be used on military track. The type of switch lamp required will be indicated on the drawings. The type or types required will be retained in the contract specification and those not required will be deleted. Those lamps with reflector units only are preferred and will be specified where possible. Those lamps with reflectors and daylight disks will be used only at important crossovers or turnouts from main running tracks. Illuminated switch lamps will not be specified except for special main track movements, or as required by the serving railroad or by special regulations.

****

The component parts of the turnouts to be furnished shall be the products of manufacturers regularly engaged in the manufacture of such products, and shall essentially duplicate items that have been in satisfactory use at least 2 years prior to bid opening. The parts need not all be made by the same manufacturer, but each turnout shall be the product of a single firm. Switch assemblies, stands, frogs, and guardrails assemblies shall conform to the requirements of AREMA Track Plans.

2.16.1 Rail and Joint Bars

****

NOTE: The rail weight and section to be used in each turnout and track crossing constructed, reconstructed, or having steel replaced will be shown on the Contract Drawings and/or listed in this paragraph along with the turnout or crossing identification number and turnout size number. Example:

TURNOUT TRACK OR CROSSING ID	SIZE OR CROSSING ANGLE	RAIL	DRILLING
T51	No. 8	90RA	72-138 mm (2-11/16-5-1/2 inch)

Designer may want new rail in turnouts to match new switch points.

****

Rail, joint bars, and miscellaneous track materials used in turnout and track crossing construction shall be furnished and installed as part of the complete turnout or crossing. Rail and miscellaneous track materials used in turnout and track crossing construction shall be the weight and section [shown on the contract drawings] [as listed:

TURNOUT TRACK OR CROSSING ID	SIZE OR CROSSING ANGLE	RAIL	DRILLING
[_____]	[_____]	[_____]	[_____]]

2.16.2 Maximum Wear Used Rails Installed in Turnouts

[The average top (vertical) wear shall be 3 mm 1/8 in or less. Gage side head wear shall not exceed 3 mm 1/8 inch] [All rail installed in turnouts shall be new].

2.16.3 Frogs, Switches, Guardrails and Appurtenances

Frogs, switches, guardrails and appurtenances shall be materials suitable for use in heavy tonnage main track. Used turnout materials shall have been fully reconditioned and shall be within plus or minus 3 mm 1/8 inch of the original specification for that turnout design. Materials used in the turnout shall be of the same weight and section. Materials shall be in good condition and free from excessive rust, dirt, and other foreign materials. The rail weight and section shall be as specified.

2.16.3.1 Switches

****

NOTE: List length, type, and quantity of switchpoints and size, type, and quantity of other turnout materials required for turnout repairs in the drawings schedule. If new switch points are required, edit the following paragraphs accordingly. Switch point Detail 5000 can also be used. Designer may want new rail in turnouts to match new

switch points. The Navy recommends the use of maganese tipped switch points on the side opposite the turnout side of the switch.

****

Switches for new turnout construction or complete turnout replacement shall be 5029 mm 16 feet and 6 inches reinforced straight split switches with graduated risers generally conforming to AREMA Track Plans, Plan Number 112. Switch materials used to replace defective materials shall be as indicated.

a. Switch points shall be new. Switch point detail shall be AREMA Track Plans, Plan No. 221, Detail 4000 or 6100. [One switch point in each turnout shall be maganese tipped in accordance with AREMA Track Plans, Plan No. 220-52-E-82, installed on the side opposite the turnout side of the switch (example the right switch point shall be maganese tipped on a left hand turnout).]

b. Switch rods and connecting rods shall be new.

c. Gage plates, switch plates, slide plates, and heel plates shall either be new or used and in good condition and not worn or corroded. Rail braces shall be either rigid or adjustable. For a given turnout all rail braces shall be of the same design.

d. Heel blocks shall be either cast or forged steel and be either new or used and in good condition. New heel block bolt assemblies shall be provided and shall be heat treated. The heel joint bars shall be either new or used in good condition and manufactured for the purpose. If floating heel blocks are used, special no. 5 double shoulder plates shall be used to maintain 160 mm6.25 inch heel spread.

2.16.3.2 Frogs

Frogs shall be [bolted rail] [railbound manganese] [solid manganese self-guarded] in the sizes indicated.

a. Frogs shall be [new] [remanufactured]. Cracked or broken used frog castings shall not be used. Cracked or broken frog castings that have been repaired by welding are not acceptable and shall not be used. Remanufactured frogs shall meet the following wear requirements:

(1) Frog points shall be in good condition and not be worn, chipped, or broken.

(2) Maximum allowable wear on used or reconditioned frogs shall be:

Frog Point:	3 mm 1/8 in
Top Surface:	3 mm 1/8 in
Raised Guarding Face (Self-Guarded)	3 mm 1/8 in
All Wear Surfaces	3 mm 1/8 in

(3) Minimum flangeway depth for used frogs shall be 45 mm 1-3/4 inch. Minimum flangeway width shall be 48 mm 1-7/8 inch.

b. Frog bolts, nuts, lock washers, and headlocks shall all be new.

2.16.3.3 New or Replacement Guard Rails

New or replacement guard rails shall be a minimum of 4.6 m 15 ft in length and shall be new or used in good condition. Guard rails shall be of any of the following designs: Tee rail per AREMA Track Plans, Plan No. 504, solid manganese steel per AREMA Track Plans, Plan No. 510, or an acceptable hook flange design. For used guard rails the guard face shall be smooth and not worn more than 3 mm 1/8 inch from its new condition. Guard rails bolted to the running rails shall be equipped with fillers. When fillers are installed or repaired new bolt assemblies shall be used. All bolts, nuts, and associated hardware shall be new. Clamped guard rails shall be equipped with block wedges, filler wedges, and cotter keys. Guard rail plates shall be new or acceptable replacements. Single-shoulder tie plates used with guard rails shall be installed with the shoulder on the inside flush against the base of the guard rail.

2.16.3.4 Hook Plates

Hook plates shall be new or acceptable used material and shall be of the designs and lengths indicated on AREMA Track Plans, Plan Nos. 112 and 241.

2.16.3.5 Switch Stands

****

NOTE: The type and manufacturer of switch stand should be the same as presently used at the jobsite or serving railroad. Mixing positive-action and automatic-action switch stands on the same military base is not recommended. Examples of acceptable types of stands are Racor models 22 and 36D, or Bethlehem Steel models 51A and 53. Other specialty designs, like a rotary wheel switch stand, may be also required.

****

a. New or replacement switch stands shall conform to AREMA Track Plans, Plan 251-64 and shall be new or fully reconditioned, low-stand type with model number [Bethlehem Steel model 51A] [_____]. Switch stand shall be [automatic-action] [semi-automatic action (spring)] [positive-action (rigid)] with [adjustment from the top with shims through a moveable cover] [spring connecting rods] [adjustable connecting rods] [_____].

b. Existing switch stands, staffs and targets, where not designated for replacement, shall be reconditioned by cleaning to bare metal and then painted with one coat of metal primer. [The interior portion of the stands, including mechanisms, shall be cleaned and re-lubricated.] The switch stand staff shall be painted with two coats of black enamel paint. Switch targets shall be similarly prepared and painted with two coats of red or white enamel paint to indicate switch position in accordance with normal railroad practice.

c. Each stand shall be equipped with one of the following switch lamps as indicated on the project plans:

(1) Reflecting Type: Approved reflecting switch lamps fitted with standard commercial-type double red and white reflecting lenses but without day signal targets.

(2) Reflecting Type with Daylight Disk: Approved reflecting switch lamps fitted with standard commercial-type double red and white reflecting lenses, and with day signal targets.

(3) Illuminated Type: Approved illuminated lamps with primary battery, battery housing, and cable.

2.16.4 Track Crossings

Track crossings shall be new and shall be fabricated in accordance with AREMA Track Plans, Plan No. [_____] and in accordance with AREMA Manual. Rail weight and section shall be [_____]. Tie layout shall be in accordance with AREMA Track Plans, Plan No. [_____].

2.16.5 Rail Braces

Rail braces shall be either the fixed or adjustable type and shall be of standard manufacture.

2.17 GRADE CROSSINGS

Recyclable materials used in Grade Crossings shall conform to EPA requirements in accordance with Section 01 62 35 RECYCLED / RECOVERED MATERIALS.

2.17.1 Crossing Material or Surface

****

NOTES: Coordinate this paragraph with the drawings showing the typical railroad crossing cross-section and details.

Where suitable local materials meeting state specifications for a granular highway base course material are available, those materials may be substituted for the ASTM D 1241 material specified below. Ballast or subballast materials may also be used for semi-permanent aggregate crossings.

****

Roadway width shall be as indicated in the contract drawings. Crossing material or surface shall comply with the following:

a. A semi-permanent aggregate crossing shall be constructed of compacted crushed aggregate placed between the rails and as short approaches to the track. The aggregate shall be a crushed gravel or crushed stone material conforming to the requirements of [ballast] [subballast] [ASTM D 1241, Type I, Gradations A or B].

b. A permanent aggregate crossing shall be constructed of compacted crushed aggregate placed in the track between bond timbers header as indicated. The crushed aggregate shall be [ballast] [subballast] [a crushed aggregate material conforming to the requirements of ASTM D 1241, Type I, Gradations A or B].

c. Full-depth timber crossings shall be [constructed-in-place] [prefabricated]. Timber road crossing materials shall be [oak] [acceptable hardwood]. Seasoning and treatment shall conform to

the requirements of AWPA C6 and paragraph WOOD TIES.

d. Bituminous paving materials for full-depth asphaltic cement concrete (bituminous) crossing with bond timbers flangeway headers shall conform to the applicable State of [_____] Highway Specification for a [_____] type mix design. Bond timbers shall be [oak] [acceptable hardwood]. Seasoning and treatment shall conform to AWPA C6 and paragraph WOOD TIES.

e. Concrete pavement materials for full-depth, cast-in-place concrete crossings shall conform to the requirements of Section [03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE] [03 30 00.00 20 CAST-IN-PLACE CONCRETE].

f. Premanufactured, precast concrete panels for grade crossings shall be constructed of reinforced concrete having a minimum 28-day compressive strength of 34.5 MPa 5,000 psi. Each panel shall be manufactured to meet HS20-44 loading in accordance with AASHTO HB-17, with 30% impact increment. Loading shall be based on single axle loads of 14,500 kg 32,000 lbs. Precast crossing panels shall be the product of a company regularly engaged in the manufacture of such panels, and whose products have been successfully used in the commercial railroad industry for at least 2 years.

g. Panels for premanufactured elastomeric crossing systems shall be full depth. Elastomeric systems with or without steel composition grade crossing panels shall be the product of a company regularly engaged in the manufacture of such products, and whose products have been successfully used in the commercial railroad industry for at least 2 years.

2.17.2 Rail

****
NOTE: The use of 57 kg (115 lbs) rail as the minimum through crossings and for 6 m (20 ft) on either side of the crossing is recommended. The use of welded joints or long (24.4 m (78 feet)) rail for the crossing area is also recommended to eliminate any joints in the crossing area. The use of 178 mm by 229 mm by 2.74 m (7 inches by 9 inches. by 9 feet) long ties is recommended throughout the crossing area. Although 2.59 m (8-1/2 feet) ties are acceptable, they are the minimum length that should be used in the crossing.
****

Rail within the road crossing and for at least 6 m 20 ft on either side of the crossing shall be [_____] [115RE] as specified in paragraph Rail and Joint Bars.

2.17.3 Ties

Ties within the road crossing and for at least 6 m 20 ft on either side of the crossing shall be hardwood or polymer composite and shall be as specified in paragraphs Crossties and Switch Ties.

2.17.4 Track Materials

For premanufactured crossing surfaces or systems, tie plates, spikes or other rail fasteners, rail anchors, and other track materials shall conform to the manufacturer's recommendations. Unless specified by the crossing manufacturer, track materials shall be as specified in paragraph MISCELLANEOUS TRACK MATERIALS.

2.17.5 Threaded Fasteners and Screw Spikes

****
NOTE: Screw spikes having an ultimate tensile strength of 483 MPa (70,000 psi) are commercially available.
****

Threaded fasteners for use in grade crossings shall be of the sizes and lengths specified by the grade crossing manufacturer or as indicated for built-in-place crossings. Screw spikes shall have a minimum ultimate tensile strength of 414 MPa 60,000 psi and shall be galvanized for corrosion protection.

2.17.6 Pipe for Subdrains

Pipe for subdrains shall be [152] [203] [_____] mm [6] [8] [_____] inch diameter corrugated, perforated [polyethylene complying with ASTM F 405] [bituminous coated galvanized corrugated steel].

2.17.7 Cable Conduit

Cable conduit under grade crossings shall be 102 mm 4 inch diameter PVC pipe conforming to UL 651, and shall be a minimum of Schedule 80.

2.18 MISCELLANEOUS TRACK MATERIALS

Miscellaneous track materials shall be as follows:

2.18.1 Spikes

2.18.1.1 Track Spikes

Track spikes shall be new and shall conform to Chapter 5, Part 2 of AREMA Manual. Track spikes size 152 by 16 mm 6 by 5/8 inch shall be used with 49.6 kg/m 100 lbs or heavier rail. Track spikes 140 by 14 mm 5-1/2 by 9/16 inch shall be used with 44.6 kg/m 90 lb and under rail.

2.18.1.2 Bridge Spikes

[Minimum 19 mm 3/4 in diameter washer head screw spikes that allow a minimum of 127 mm 5 inch penetration into the stringers shall be used to connect the bridge ties to the stringers on an open-deck bridge, in accordance with AREMA Manual, Chapter 7, Part 7.]

2.18.2 Bolts, Nuts, and Spring Washers

New track bolts, nuts, and spring washers shall be used throughout the project for both new and relay rail.[Bolts shall be used in both steel and timber bridge connections.]

2.18.2.1 Bolts and Nuts

The various rail, joint bars, and rail drillings require various lengths and diameters of bolt assemblies. The Contractor shall determine the number of bolt assemblies of each size required. All bolt diameters shall be the largest possible for a given rail drilling and joint bar punching. Track bolts and nuts shall conform to Chapter 4, Part 2 of AREMA Manual. Track bolts shall be long enough to leave at least two threads exposed after the nut is tightened.[Steel bridge connections shall use ASTM A 325M ASTM A 325 or ASTM A 490M ASTM A 490 bolts. Timber bridge connections shall use hot dip galvanized steel bolts, minimum 19 mm 3/4 in diameter with lengths as required.]

2.18.2.2 Spring Washers

Spring washers and nuts shall be sized to ensure that the spring washer develops its full reactive force and does not jam into the joint bar hole. Spring washers shall be of the size to fit the bolt and nut used and shall conform to Chapter 4, Part 2 of AREMA Manual, and Section M12 of AREMA Track Plans.

2.18.3 Rail Anchors

****

NOTE: The number and position of rail anchors will be shown on the drawings and will be based on amount of traffic, character of traffic, and local conditions. When required, anchors will be placed in accordance with AREMA recommendations for "Light Density Lines" in Chapter 5 of AREMA Manual. This recommendation calls for 16 anchors per 11.9 meters (39-ft) length of track, that is 8 anchors to resist movement in each direction. Where heavy traffic, steep grades or other factors result in rail creeping additional anchors may be specified.

****

Where special tools are required to install or remove anchors, the Contractor shall furnish a minimum of one tool for each 5,000 anchors, or fraction thereof, not to exceed 5 tools per job.

2.18.3.1 New Installation

Rail anchors for new installations shall be [new] [repinched]. Sizes shall conform to the various sizes of rail on the project and conform to "Specifications for Rail Anchors" in Chapter 5, Part 7 of AREMA Manual. Anchors may be either drive-on or spring type.

2.18.3.2 Salvaged Rail Anchors

Rail anchors salvaged from the track being removed shall become the property of the Contractor and shall be removed from the site. No used anchors shall be reinstalled unless they have been repinched.

2.18.3.3 Rail Clips and Fasteners

Provide single tight fit clips with fillers as necessary to fit rail section furnished. Clip or fastener design shall anchor rail against longitudinal movement.

2.18.4 Insulated Joints

Insulated joints shall conform to applicable portions of Chapter 4, Part 2 of AREMA Manual. Conventional continuous insulated joints with fibre insulation shall not be used. Unless otherwise directed by the Contracting Officer, insulated joints shall be for the following rail sections, rail drilling, and number of joints:

RAIL SECTION	DRILLING	NO. JOINTS
[_____]	[_____] - [_____]	[_____]

2.18.5 Bumping Posts, Cushion Heads and Wheelstops

Bumping posts, cushion heads, and wheelstops shall be new and shall be of a standard design that has been in use by commercial railroad industry for at least 5 years. Bumping posts, cushion heads, and wheelstops shall be manufactured by a company regularly engaged in the manufacture of these products.

2.18.5.1 Bumping Posts

Bumping posts shall be of all-steel construction, shall bolt firmly onto the rail, and shall be of a type designed for general service. Bumping posts shall have tension with 3800 mm^2 6 sq inch cross-sectional area and compression members with a moment of inertia not less than 15 X 10^6 mm^4 37 $inch^4$ of A36 steel. Bumping post shall be capable of withstanding a yield load of 2450 kN 550,000 pounds.

2.18.5.2 Cushion Heads

Cushion heads shall be of all steel construction, shall firmly bolt, attach, or clamp onto the bumper or end dock (platform or ramp). Cushion heads shall resist 356 kN 80,000 lbs of compression.

2.18.5.3 Wheelstops

Wheelstops shall be of all-steel construction, shall firmly bolt or clamp onto the rail, and shall be of a type designed for general service.

2.18.6 Used Bumping Posts and Wheelstops

Used bumping posts and wheelstops shall not be furnished by the Contractor. Used bumping posts and wheelstops [shall be salvaged from existing tracks which are removed or rebuilt under this Contract] [will be provided by the Government]. New fastening materials shall be used to install or reinstall used bumping posts or wheelstops. The Contractor shall furnish new fastening materials conforming to the applicable sections of this specification.

2.18.7 Inner Guard Rail

Inner guard rail shall be Class IV or better used rails as indicated in Part 2, Chapter 4, "Inspection Classification of Second Hand Rail for Welding", of AREMA Manual. Rail shall be 36 kg/m 80 lbs/yd or greater. All rails used at any one inner guard rail location shall be the same weight and section. Joint bars shall match the rail provided and shall be in good condition.

2.18.8 Gage Rods

2.18.8.1 New Gage Rods

New gage rods shall be the double-clamp style manufactured in conformance with "Specifications for Special Trackwork" of AREMA Track Plans. The double clamp style gage rods shall be threaded on both ends and shall be equipped with four malleable steel casting clamps to rigidly hold both sides of the base of both rails.

2.18.8.2 Used Gage Rods

Used gage rods shall not be furnished by the Contractor. Used gage rods [will be provided by the Government] [shall be salvaged from existing track]. Salvaged gage rods shall be cleaned and inspected prior to reinstallation. Bent or broken gage rods shall be scrapped.

2.18.9 Derails

****

NOTE: Derails may be either a hinged type, a sliding type, or a switch point derail. The contract drawings should indicate the required location, type, size, and direction. Sliding type derails are typically installed with a derail stand and operating mechanism for throwing the derail. A split switch derail is to be installed where absolute protection is required. If a switch point derail is to be installed, the project plans will show the layout of the switch point derail and this paragraph will be modified accordingly.

****

2.18.9.1 New Derails

New derails shall be of a standard design that has been in use by the commercial railroad industry for at least 5 years. Derails shall be of all-steel construction and shall be designed to be permanently spiked to a crosstie. Derails shall be either one-way or two-way as indicated. Derails shall be either sliding type or hinged type as indicated. When the type of derail indicated requires a derail stand, connecting rod, and operating mechanism for proper operation, the derail and all necessary components shall be provided as a unit. The locations, sizes, and directions of the derails shall be as indicated on the contract drawings.

2.18.9.2 Used Derails

Used derails shall not be furnished by the Contractor. Used derails [will be provided by the Government] [shall be salvaged from existing tracks that are removed or rebuilt under this Contract]. New track spikes and other fastening materials shall be used to install or reinstall the used derails. The Contractor shall furnish new fastening materials conforming to the applicable sections of this specification and AREMA Track Plans.

2.19 SALVAGED MATERIALS

2.19.1 Dunnage

Pallets, sills, and other material used for packaging and stacking salvaged track items shall be clean, free of decay or other defect, and sufficiently sturdy for the service intended.

2.19.2 Marking Paint

Marking paint shall be a good quality oil-based spray marking paint or a good quality oil-based paint marker.

2.19.3 Salvaging Rail

The Contractor shall salvage rail as directed; the Government will make available salvaged rail to the Contractor subject to the following:

a. Nondefective and reclaimable rails salvaged from existing tracks may be used to execute spot rail replacement work at other locations of the project, subject to review and approval of the materials by the Contracting Officer.

b. Reclaimable defective rails may be used to construct inner guard rails provided all defects can be cropped off. Detailed inspection shall be made of such rails to ensure that rails which contain critical defects such as transverse defects, head-web separations, vertical split heads, pipe, split webs, etc., are not incorporated in the work. Loose rails located along the right-of-way shall be inspected and used as directed.

2.19.4 Joint Bars

Nondefective joint bars salvaged from existing tracks may be used to execute spot replacement work at other locations of the project, subject to review and approval of the material by the Contracting Officer.

2.19.5 Tie Plates

Tie plates salvaged from existing tracks, which are not either broken, cracked, or severely corroded or worn, may be used to execute the work subject to review and approval of the material by the Contracting Officer.

2.20 RAIL BONDING AND GROUNDING

2.20.1 Rail Bonds

****

NOTES: Designer will select the length of web bonds based on the joint bar size; 600 mm (24 in.) joint bars require 854 mm (34 in.) bond wires, and 900 mm (36 in.) joint bars require 1154 mm (46 in.) bond wires.

Double bonding is required for crossing signals only (installation of both rail head and web bonds).

If only static electricity bonding/grounding (without signals or lightning protection) is

required, the size of cables may be reduced. If local experience indicates drive in tight connections performs satisfactorily, 12 mm drive in tight from American Steel drive socket terminal # 34100 type CPN or approved equal can be used.

****

Rail bonds shall be exothermic type ("Cadweld") bonds applied to the field side of the rail head[, or [1154] mm [46] inch bonds welded to the rail web]. The bond cables shall be flexible bare copper stranded 1/0 AWG cables with preformed ends. Bond cables shall be flexible bare copper stranded cables with preformed ends and shall conform to applicable requirements of AREMA Manual Vol. 3.

2.20.2 Grounding Rods

Grounding rods shall be [19 mm 3/4 in diameter copper clad steel rods] [25 mm 1 inch diameter zinc-coated steel rods]. The minimum length of ground rods shall be 2.5 m 8 ft.

2.20.3 Ground Connection Cables

Connections between the grounding system or ground rods and rails shall be made with a bare flexible copper stranded 2/0 AWG cable.

2.20.4 Electrical Connecting Hardware

Electrical connecting hardware shall be bronze pressure bar type materials having no rotating parts coming in direct contact with conductors.

2.21 WELDING

2.21.1 Rail Welding Kits

Kits for thermite type rail welds shall be approved by the Contracting Officer before use. Contractor shall provide welding kits for all rail sections used and no differentiation will be made between Contractor-furnished and Government-furnished rail sections for measurement and payment purposes.

2.21.2 Electrodes

Provide AWS low-hydrogen, high tensile 140-16 (extrapolation) or 25-20 electrode, Grade 310-16 and 310-15 stainless steel rod welding electrodes. Provide electrodes of the smallest practical diameter worked at the lowest compatible current. Coating on low-hydrogen type electrodes shall be thoroughly dry when the electrode is provided. Use electrodes taken from hermetically sealed packages within one hour of the time the package is opened. Electrodes not used within this one-hour period and electrodes taken from non-hermetically sealed packages shall be dried for at least one hour between 371 and 427 degrees C 700 and 800 degrees F. Electrodes so dried may be stored at temperatures between 107 and 205 degrees C 225 and 400 degrees F until used, or, if not stored and not used within one hour sfter this drying is completed, shall be re-dried before use. Do not use electrodes which have been wet.

PART 3 EXECUTION

3.1 REMOVAL, SALVAGE, AND DISPOSITION OF MATERIALS

****
NOTE: Delete paragraphs which are not applicable to the salvaged materials.
****

Tracks and segments of track shall not be dismantled until approved to do by the Contracting Officer. The following materials shall be salvaged by the Contractor for later use by the Government. Some of these items will be used in the repair of tracks as indicated.

3.1.1 Materials To Be Salvaged

****
NOTE: Provide list of materials to be salvaged. For example: "All 90RA Rail, All 90RA Joint Bars".
****

Materials to be salvaged for later use by the Government are:

a. [_____].

b. [_____].

Other materials shall become the property of the Contractor and shall be removed from the project.

3.1.2 Methods and Procedures

The Contractor may use any methods to dismantle the track, provided proper measures are taken to ensure the safety of the laborers and the general public, and no damage is caused to track components to be salvaged or other tracks and structures which are indicated to remain. Methods of removal of existing tracks shall not cause damage to adjacent sidewalks or paved roadways. Damage to these facilities caused by the Contractor shall be restored at Contractor's expense.

3.1.3 Inventory of Track Materials

The Contractor shall keep a detailed inventory of excess and salvaged track materials stockpiled for the Government. Detailed inventory shall be recorded in appropriate format and furnished to the Contracting Officer.

3.1.4 Inspection and Reconditioning of Used Track Materials

Salvaged track materials shall be cleaned and inspected for defects to determine their suitability for further use.

3.1.4.1 Cleaning By Hand or Mechanical Means

Rail, joint bars, gage rods, tie plates, rail anchors, and other materials shall be cleaned by hand or mechanical means to remove all adhering dirt and heavy rusting so that the bare steel can be examined.

3.1.4.2 Visual Examination of Rails

Rails shall be visually examined for evidence of defects such as those illustrated on Form 402-A found in Chapter 4 Part 3 of AREMA Manual. Such defects shall be brought to the attention of the Contracting Officer who will be the final judge as to the serviceability of the rail. Rails having bolt hole cracks or end batter under paragraph TRACK REPAIR that can be reconditioned for use by cropping and redrilling shall be marked at the location of the defect with yellow paint. Rails with other defects or which cannot be reconditioned shall be rejected as scrap and shall be marked with bright red paint and stacked separately.

3.1.4.3 Visual Examination of Joint Bars

Existing joint bars and compromise joint bars which are removed and no longer required at that location due to rail replacement or other work may be cleaned and reused at other locations, subject to review and approval of the Contracting Officer. Joint bars and compromise joints that are not reused shall be salvaged or scrapped. Joint bars shall be visually examined for defects and wear. Joint bars with bolt hole or spike slot cracks shall be scrapped. Bars which do not fit tightly against the rail or bars in which the bolt holes are excessively corroded or worn shall be scrapped. The Contracting Officer will be the final judge of the serviceability of joint bars. Scrapped bars shall be marked with bright red paint and stacked separately.

3.1.4.4 Visual Examination of Gage Rods

Gage rods shall be visually examined for bends, cracks, or breaks. Bent, cracked, or broken gage rods shall be considered as scrap, marked with bright red paint and stacked separately.

3.1.4.5 Visual Examination of Tie Plates and Rail Anchors

Tie plates and rail anchors shall be visually examined for cracks, breaks, excessive wear, and excessive corrosion. Track material with these defects shall be considered scrap, marked with bright red paint and stacked separately.

3.1.4.6 Gage Rods

Gage rods which exist in tangent track and in curved track with a curvature of 10 degrees or less shall be removed and salvaged. Salvaged gage rods that have been inspected and cleaned shall be reused to the maximum extent possible.

3.1.4.7 Grade Crossing Materials

Existing premanufactured grade crossing panels, rail and other track materials shall be salvaged as indicated, or as designated by the Contracting Officer. All salvaged materials shall remain the property of the Government, and shall be reinstalled as indicated or shall be transported to the military installation storage yard. Grade crossing materials to be salvaged shall be removed, cleaned as required for proper reinstallation, marked or labeled as necessary for proper reinstallation, and transported to the reinstallation location or to the storage yard.

3.1.5 Transport and Stack Excess and Salvaged Materials

3.1.5.1 Material Not Used In Track Repair

Excess and salvaged materials which are not used in track repair work shall be stacked at a site on the military installation designated by the Contracting Officer.

3.1.5.2 Stacking of Rails

Rails shall be stacked on approved sills a minimum of 152 mm 6 inch above the ground. Rails shall be stacked with the heads up and with the ends even. Each layer shall be separated by at least three 50 by 100 mm 2 by 4 inch wood strips evenly spaced along the length of the rail. Rail shall be grouped by weight, section, drilling, condition, length, and amount of wear. The weight, section, drilling, and length shall be marked on one of the rails near the mid-height of the stack. These markings shall be painted neatly near one end of the rail.

3.1.5.3 Stacking of Joint Bars, Gage Rods, and Tie Plates

Joint bars, gage rods, and tie plates shall be sorted by section, punching and condition and shall be stacked on pallets. Each pallet stack shall be steel banded for forklift handling. The maximum weight on any pallet shall be 680 kg 1,500 lbs. Compromise joint bars shall be wired together in pairs and stacked on pallets, separate from other bars.

3.1.5.4 Containers

Rail anchors shall be sorted by type and size and placed in kegs, steel drums, or other approved containers. Containers shall be labeled with the rail weight and section.

3.1.5.5 Stacking of Special Trackwork Materials

Special trackwork materials shall be palletized and stacked as directed by the Contracting Officer. The rail weight, rail section, and length shall be marked on each switch point. The weight, section, and frog number shall be marked on the side of each frog casting. Other switch materials salvaged shall be placed in steel drums and labeled as to rail weight, section, length of points, and turnout size.

3.1.6 Material to be Scrapped

****
NOTE: Remove or edit above paragraphs and retain this paragraph when materials are to be scrapped.
****

[All material] [_____] shall be scrapped and shall become the property of the Contractor.

3.2 PLACEMENT OF BALLAST [AND SUBBALLAST]

Ballast [and Subballast] shall be placed to the lines and grades indicated. The average thickness shall be within 6 mm 0.25 inch of the thickness shown on the drawings Subgrade shall conform to the requirements of Section 31 00 00 EARTHWORK. Ballast [and Subballast] shall not be placed on soft, muddy, or frozen areas. Where the prepared subgrade (roadbed) is

soft, muddy, rutted, exhibits severe depressions, or is otherwise damaged, the ballast [and subballast] shall not be placed until the damaged subgrade has been repaired and the area has been approved by the Contracting Officer.

3.2.1 Subballast

****
NOTE: Remove these paragraphs when subballast is not required.
****

3.2.1.1 Subballast Placement

Subballast shall be placed in [two] uniform horizontal lifts of not more than 152 mm 6 inch for the full width of the cross-section to the total depth indicated. Each subballast layer shall be shaped to a section conforming to the subballast section shown on the drawings and shall be thoroughly compacted.

3.2.1.2 Subballast Compaction

Each subballast lift shall be compacted using approved compaction equipment. The roller weights, vibration frequencies (where applicable), tire pressures (where applicable), and number of passes shall be sufficient to obtain in-place densities across the full width of the subballast and throughout the entire depth of the layer of not less than 95 percent of the ASTM D 1557 laboratory maximum dry density for the subballast material. Prior to placement of subsequent subballast layers the top of the previous layer shall be scarified to a depth of approximately 50 mm 2 inch to insure proper bond of the layers.Density shall be field measured in accordance with ASTM D 1556(base plate, as shown in the drawing shall be used) [or ASTM D 2922. The calibration curves shall be checked and adjusted, if necessary, using only the sand cone method as described in paragraph Calibration, of the ASTM publication. Tests performed in accordance with ASTM D 2922 result in a wet unit weight of soil and, when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gages shall also be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gages shall be made by the prepared containers of material method, as described in paragraph Calibration, in ASTM D 2922, on each different type of material to be tested at the beginning of a job and at intervals as directed.] One field density tests shall be taken for each 1000 square meters yards of each layer of material placed in each area.

3.2.2 Ballast

3.2.2.1 Ballast Placement

****
NOTE: Show detail of ballast section on the drawings.
****

Number 5 AREMA ballast shall be placed in the tracks where indicated; 50 mm 2 inch of Number 5 ballast shall be used near turnouts and for 10 m 30 feet each side of the switch stand to provide a smooth walking surface for railroad employees. All other areas shall require size AREMA Number [4] [4A] ballast.

3.2.2.2 Ballast Distribution

****
NOTE: For projects where large amounts of track are being ballasted, ballast distribution from railcars is beneficial. The provision of a Government locomotive and crew to move ballast cars for the Contractor may result in a lower unit cost for ballast distribution. If the installation has a locomotive available for use, insert the point of contact and telephone number for arranging use of the locomotive. Examples would be "... Rail Movements Branch, Directorate of Logistics, extension 1234 at least 4 hours ..." If no locomotive is available indicate that Government locomotive is not available and the Contractor shall provide equipment to unload ballast in paragraph LOCOMOTIVE.
****

Ballast shall not be distributed until the [subgrade] [subballast] has been approved by the Contracting Officer. No payment will be made for ballast which is distributed without the Contracting Officer's approval.

a. Ballast distribution shall be to the depth indicated and may be from either trucks or railroad cars. [If available, the Government will furnish a locomotive for unloading ballast along the track if a carload or more is used. Arrangements for use of the locomotive shall be made by contacting [_____] at least [_____] hours in advance of the time the locomotive is needed.] [A government locomotive is not available for unloading ballast.]

b. Forming of ruts that would impair proper roadway drainage shall be prevented when distributing ballast from trucks and off track equipment. Any ruts formed greater than 25 mm 1 inch shall be leveled and graded to drain.

c. Ballast shall be unloaded as close as possible to the point of use so that unnecessary handling is prevented. Excess ballast shall be picked up and redistributed at the Contractor's expense. If additional ballast is required for dressing, it shall be added by the Contractor at no increase in unit price.

d. Ballast cars shall not be released until they have been inspected. Ballast cars may be weighed by the Government before and after dumping the ballast at no cost to the Contractor.

3.2.2.3 Ballast Below Ties

For new construction, the last 100 mm 4 inches ballast below the tie, the shoulder ballast and the ballast in the tie cribs shall be placed subsequent to the rail and tie installation. For surfacing existing track, the ballast shall be placed subsequent to rail and tie replacements.

3.3 TRACK CONSTRUCTION AND OUT-OF-FACE RELAY

Track construction not covered specifically herein shall be in accordance with AREMA recommendations and recommended practices.

3.3.1 Roadbed Preparation

****
NOTE: If the roadbed will require any major amount of preparation, such as compaction or provisions for drainage not covered by other sections of the specifications, this paragraph will be either revised or augmented to cover the work required, or Section 31 00 00 EARTHWORK will be added. If no roadbed preparation is required, delete this paragraph. If geotextiles are used, the "road crossing" tailoring option should be on to get the reference paragraph requirements for geotextiles.
****

Clearing and grubbing, grading, excavation, embankment preparation, and subgrade preparation shall be performed in accordance with Section [_____]. Roadbed surface, grade, and drainage shall be approved prior to any distribution of construction material. Where the subgrade or roadbed is damaged during distribution of materials, ruts and depressions shall be filled and compacted and the roadbed surface reapproved prior to track construction.

3.3.2 Geotextile for Track Construction

****
NOTE: Delete this paragraph if geotextile is not required.
****

Geotextile shall be installed between the subgrade and the ballast as shown. Installation shall be in accordance with subparagraph Geotextile Installation under paragraph Highway Crossings.

3.3.3 Unloading the Materials

The use of picks in the handling of ties will not be permitted. Rails shall be unloaded from cars with an approved derrick or crane and placed with the head up without dropping and with sufficient support under the base. Rails of proper length shall be distributed as necessary for road crossings, switches, joint spacing, and other special conditions.

3.3.4 Ties

****
NOTE: The center to center spacing will be inserted in the blank space in this paragraph in accordance with the following:

a. For main lines, access tracks, or other tracks where the movement may be classified as heavy or the desired speed is in excess of 12 km/hr (20 miles per hour), 480 to 560 mm (19.5 in.) spacing will be used.

b. For body tracks in yards, sidings, running tracks, and access tracks, where the train speed is less than 12 km/hr (20 miles per hour) and train movement is not classified as heavy, a 530 to 610 mm

(21 in.) spacing will be used.
****

Standard center-to-center spacing of crossties shall be [50][53] mm [19.5][21] inch. Switch ties and bridge ties shall be spaced as indicated on the drawings. Ties shall be laid perpendicular to the center line of the track with the grain up (heartwood side down) for wood ties. The best ties shall be used at the rail joints. The ends of ties on one side of the track shall be parallel to the rail and the center of the tie shall be on the approximate center line of the track. The ends shall be aligned on the inside of curves and shall continue on that side until reaching a curve in the opposite direction. On double tracks, the ties shall be aligned on the outside ends. The top surface of ties shall provide full bearing for the tie plates. Adzing of wood ties shall be restricted to that necessary to provide a sound true bearing for the tie plate. Adzing in excess of 5 mm 0.2 inch will not be permitted. Where adzing is necessary, the cut surface of the wood tie shall be completely saturated with creosote or other approved preservatives.

3.3.5 Tie Plates

****
NOTE: For track rehabilitation where the track does not currently have tie plates, plates should be installed on each new tie installed. As defective ties are replaced, tie plates are installed with the new ties and with time the entire track has plates.
****

Tracks shall be fully tie-plated. Tie plates shall be free of dirt and other foreign material when installed. Tie plates shall be placed so that the rails will have full bearing on the plate, and the plate will have full bearing on the tie. Tie plates shall be set at right angles to the rail with the outside shoulder against the base of the rail, and centered on the tie. Canted tie plates shall be installed to cant the rail inward.

3.3.6 Rail

The base of the rail and the surface of the tie and tie plate shall be free of dirt and other foreign materials prior to laying rail.

3.3.6.1 Laying Rail

Rail shall be laid without bumping or striking, to standard gage (1.435 m 4 ft 8-1/2 inch between points 16 mm 5/8 inch below the top of the rail) on tangents and on curves up to 12 degrees. For curves 12 degrees and greater, the gage shall be widened 3.2 mm 1/8 in for each increment of 2 degrees to a maximum of 1.448 m 4 ft 9 inch, in accordance with TABLE V. The track shall be gaged at every third tie as spikes are being driven.

TABLE V. TRACK GAGE FOR HIGH DEGREE OF CURVATURE

Degree of Curvature (per 30.5 m (100-ft) chord)

Equal to or Greater Than (Deg - Min)	But Less Than (Deg - Min)	Track Gage m (Ft - In.)
0 - 00	12 - 00	1.435 (4 - 8-1/2)
12 - 01	14 - 00	1.438 (4 - 8-5/8)
14 - 01	16 - 00	1.441 (4 - 8-3/4)
16 - 01	18 - 00	1.445 (4 - 8-7/8)
18 - 01	20 - 00	1.448 (4 - 9)

TABLE V. TRACK GAGE FOR HIGH DEGREE OF CURVATURE

Degree of Curvature per 100-ft chord

Equal to or Greater Than (Deg - Min)	But Equal to or Less Than (Deg - Min)	Track Gage (Ft - In.)
0 - 00	12 - 00	4 - 8-1/2
12 - 01	14 - 00	4 - 8-5/8
14 - 01	16 - 00	4 - 8-3/4
16 - 01	18 - 00	4 - 8-7/8
18 - 01	20 - 00	4 - 9

a. Jointed rails shall be laid, one at a time, with space allowance for expansion being provided between rail ends in accordance with TABLE VI.

b. Gaps between rail ends in insulated joints shall only be sufficient to permit insertion of standard end posts.

c. A standard rail thermometer shall be used to determine the rail temperature. The thermometer shall be laid close to the web on the side of the rail base which is shaded from the sun's rays in advance of the laying operation and left there long enough to accurately record the temperature. The Contractor quality control representative shall see that rail temperature is checked frequently and that proper rail expansion shims are used. All thermometers shall be calibrated against the Contracting Officer's rail thermometer which will have been accurately calibrated and will be considered as the standard.

d. Except through turnouts and at insulated joints, the staggering of the joints on one side shall not vary more than [460] [500] mm [18] [20] inch in either direction from the center of the opposite rail.

e. Rails less than 10 m 33 ft in length shall not be used in out-of-face rail relay. However, rails not less than 4 m 13 ft long may be used for final connections to existing rails to

prevent joints from occurring at prohibited locations or to provide the specified joint stagger in curves.

f. Rail joints shall not occur in or within 6 m 20 ft of a road crossing, alongside of or within 1.5 m 5 ft of the end of any switch or turnout guard rail, or the end of any open deck bridge.

3.3.6.2 Joints

The joints in opposite rails shall be staggered one-half the rail length but not less than 3.5 m 12 ft apart, except closer joints may be required at turnouts and insulated joints. Rail less than 4 m 13 ft in length shall not be installed in track. No joint shall be less than 2 m 6 ft from the ends of open-deck bridges, or less than 1 m 3 ft from switch points. No joint shall be installed within 6 m 20 ft of a road crossing, outer perimeter of any structure, or any location which restricts access to the joint. Where joints are required in these areas, the joints shall be welded.

3.3.6.3 Expansion Allowance

Allowance for expansion shall be provided at rail joints by using rail-expansion metal shims. Shims shall be removed to within 12 rails of the laying. Shims shall be of the thickness shown in TABLE VI. The temperature of the rail shall be determined by use of a thermometer placed on the rail base on the side away from the sun. Typical rail gap gages are as shown.

TABLE VI. SHIM THICKNESS

10.1 m (33 Ft) Rail 99 Joints per km		11.9 m (39-Ft) Rail 84 Joints per km		24.4 m (78-Ft) Rail 42 Joints per km	
Rail Temperature (degrees C)	Shim Thickness (mm)	Rail Temperature (degrees C)	Shim Thickness (mm)	Rail Temperature degrees C)	Shim Thickness (mm)
Below -23	8	Below -14	8	Below 2	8
-23 to -10	6	-14 to -4	6	2 to 8	6
-9 to 1	5	-3 to 7	5	9 to 16	5
2 to 15	3	8 to 18	3	17 to 23	3
over 16	2	over 19	2	over 24	2

TABLE VI. SHIM THICKNESS

33-Ft Rail 160 Joints per Mi		39-Ft Rail 135 Joints per Mi		78-Ft Rail 68 Joints per Mi	
Rail Temperature (degrees F)	Shim Thickness (in.)	Rail Temperature (degrees F)	Shim Thickness (in.)	Rail Temperature (degrees F)	Shim Thickness (in.)
Below -10	5/16	Below 6	5/16	Below 35	5/16
-10 to 14	1/4	6 to 25	1/4	35 to 47	1/4
15 to 34	3/16	26 to 45	3/16	48 to 60	3/16

TABLE VI. SHIM THICKNESS

33-Ft Rail 160 Joints per Mi		39-Ft Rail 135 Joints per Mi		78-Ft Rail 68 Joints per Mi	
Rail Temperature (degrees F)	Shim Thickness (in.)	Rail Temperature (degrees F)	Shim Thickness (in.)	Rail Temperature (degrees F)	Shim Thickness (in.)
35 to 59	1/8	46 to 65	1/8	61 to 73	1/8
over 60	1/16	over 66	1/16	over 74	1/16

3.3.6.4 Cutting Rail

Only rail saws or track chisels shall be used to cut rail. New holes shall be drilled using a standard template. Holes shall not be burned in rail. Holes cut with a torch will not be accepted. When drilling of rail is necessary, all chips and burrs shall be removed before applying joints.

3.3.6.5 Matching Rails

****
NOTE: Remove this paragraph when relay rail is not used.
****

Where relay rail is used, matching adjacent rails shall not cause lipped or uneven joints. Any mismatched rail ends shall be welded to provide proper match. Rail end mismatch shall not exceed 3 mm 1/8 in on gage or tread portions of rail.

3.3.6.6 Rail Replacement

The following procedures apply to rail replacement work:

a. Spot rail replacement is defined as replacement of 30 m 100 ft or less of contiguous rails, usually with rails of the same section. Installation of relief rail in place of defective rail is considered spot rail replacement. Replacement of more than 30 m 100 ft of contiguous rails shall be considered to be out-of-face rail relay.

b. If spikes are withdrawn, the holes shall be plugged with treated tie plugs of proper size to fit the hole, prior to replacement of rail. If spikes are withdrawn and spikes are to be redriven in existing spike holes, the holes shall be plugged with treated tie plugs prior to redriving the spike. Tie plugs shall not be installed in prebored holes unless spikes have been driven and withdrawn.

c. All ties shall be spiked with new spikes in accordance with paragraph Spot Tie Replacement.

d. The Contractor shall ensure that rail ends at joints are not lipped or uneven. Tread portion (vertical) or gage side (horizontal) rail end mismatch shall be no greater than 2 mm 1/16 inch. Rail end mismatch greater than 2 mm 1/16 inch shall be

corrected by welding and grinding on the smaller rail. Grinding the larger rail is not permitted unless approved by the Contracting Officer. Welded transitions shall be made at a rate of 1 to 80.

e. Rails removed from track will be designated by the Contracting Officer as relay (for use on project), reclaimer (to be salvaged and stockpiled), or scrap. Joint bars removed from track will be designated as relay, reclaimer, or scrap. The Contractor shall mark scrap materials as scrap using bright red paint, transport them off the military installation or to the military installation temporary scrapyard. Relay materials required to complete other repair work of this contract shall be transported to the location of need. Reclaimer materials shall be classified and inventoried and stacked at the military installation storage site, all as indicated for salvage materials in paragraph Removal, Salvage, and Disposition of Materials.

f. Metal rail expansion shims shall be used when laying rail. Wood sticks or other material shall not be used as shims. The Contractor shall have a sufficient supply of each shim available to permit rail laying to progress without delay.

3.3.6.7 Out-of-Face Rail Relay

The Contractor shall replace existing rail with the designated new or used rail between designated limits in a continuous operation. It is expected that replacement of one rail of a given track will be completed prior to replacement of the opposite rail. Used rail shall be laid [with previous gage side wear facing out, unless required to match existing wear patterns] [as directed by the Contracting Officer].

3.3.6.8 Spot Rail Replacement

Spot rail replacements shall be made where necessary to replace existing defective rails or to compensate for rail joint gap adjustments.

a. Replacement Rail: Replacement rail shall be of equal length or longer than the rail it replaces. The minimum length of rail used shall be 4 m 13 ft.

b. Spot Rail Replacement Resulting in Joint Staggers: Unless otherwise approved by the Contracting Officer on a case by case basis, spot rail replacement shall not result in joint staggers less than 1.33 m 4 ft.

3.3.7 Joint Bars

****

NOTE: The location of compromise joints will be shown on the drawings. Where compromise joints are required, the portion of this paragraph in brackets will be retained. If compromise joints are not required, the portion of this paragraph in brackets will be deleted.

AREMA Manual recommends an initial bolt tension of between 89,000 and 133,000 newtons (20,000 and 30,000 lbs) per bolt in order to overcome the

surface roughness and provide proper seating for the joint bars. After application of traffic, tension in the bolt is lost relatively rapidly and may lose from 22,000 to 44,000 newtons (5,000 to 10,000 lbs) per bolt in the first month. Therefore, retightening of all track bolts after some period of time is necessary. Bolt tension recommended for subsequent tightening is within the range of 67,000 to 111,000 newtons (15,000 to 25,000 lbs) per bolt. The torque required to develop the specified tension in a bolt is approximately as follows:

BOLT DIAMETER		TORQUE*	
(mm)	(in.)	(N m)	(ft-lbs)
19	3/4	340	250
22	7/8	408	300
25	1	476	350
29	1-1/8	544	400

***For well oiled bolts with clean threads.**

****

Joint bars shall be clean. Rail joints shall be installed so that bars are not cocked between the base and head of the rail. Bars shall be properly seated in the rail and the full number of correct-size bolts, nuts, and spring washers installed. Bolts shall be placed with nuts alternately on inside and outside of rail. A corrosion resistant lubricant shall be applied to the bolt threads prior to application of nuts. Bolts shall be tightened to torque of approximately [_____] N-m ft-lbs, beginning at the center of the joint and working both ways to the ends of the joint. After the track has been in service [, but before acceptance of the work,] all bolts shall be checked and retightened to a torque of approximately [_____] N-mft-lbs. [Rail of different sections shall be connected by properly fitting compromise joint bars. The mismatch for compromise joints for either tread surface or on the gage side shall not exceed 3 mm 1/8 inch]. Defective joint bars designated on the contract drawings, discovered by the Contractor during track repair operations, or as identified by the Contracting Officer shall be replaced with acceptable joint bars.

3.3.8 Spiking

3.3.8.1 Spiking Procedures

Rail shall be spiked promptly after being laid. Spikes shall be started and driven vertically and square with the rail. Engineered polymer composite ties shall be pre-drilled per manufacturer's recommendations for size and depth. Spikes shall be driven to allow approximately 3 to 5 mm 1/8 to 3/16 inch space between the underside of the spike and the top of the rail base. Spikes shall not be overdriven, or straightened while being driven. Spikes shall not be installed through the slots in skirted-type, slotted joint bars (angle bars). Spikes shall not be driven against the ends of joint bars.

3.3.8.2 Number of Spikes

Four rail-holding spikes shall be used on each tie on tangents and curves less than 4 degrees. Spikes on the gage side of the running rail shall be placed directly across from each other and the spikes on the field side of

the running rail shall be placed directly across from each other. Spikes on the gage side shall be offset longitudinally from the field spike and all four spikes shall be rail-holding spikes next to the base of the rail. This pattern shall be held consistent. On curves 4 degrees or greater, but not more than 36 degrees, six spikes shall be used on each tie with the spikes located as follows: One rail-holding spike on the field side and two rail-holding spikes on the gage side for both rails. [Curves 36 degrees and greater shall be spiked with eight spikes per tie, located as follows: One rail-holding spike and one plate-holding spike on the field side and two rail-holding spikes on the gage side for both rails.] Eight rail-holding spikes shall be used on each tie through road crossings.

3.3.9 Tie Plugs

If spikes are withdrawn from wood ties, the holes shall be swabbed with creosote and plugged with creosoted tie plugs of proper size to fit the hole. If spikes are withdrawn and spikes are to be reinserted in existing spike holes, the holes shall be swabbed with creosote and plugged with creosoted tie plugs prior to redriving the spike. Tie plugs shall not be installed in prebored holes unless spikes have been driven and withdrawn.

3.3.10 Rail Anchor Placement

****

NOTE: Coordinate this paragraph with paragraph Rail Anchors in PART 2.

****

Rail anchors shall be located as indicated on the project plans. Where the use of rail anchors is indicated, apply a minimum of [_____] anchors per 11.9 m 39 ft of rail in the pattern indicated on the project drawings. The rail anchors shall be spaced approximately uniformly along the rail length. Rail anchors shall be installed to the gage side of the rail against the same tie face on opposite rails. Rail anchors shall grip the base of the rail firmly and shall have full bearing against the face of the tie. Rail anchors shall not be moved by driving them along the rail. Rail anchors shall not be applied to track on an open-deck bridge. Where anchors are used on track approaching an open deck bridge, every third tie shall be box anchored for at least four rail lengths, off each end of the bridge. Rail shall be anchored immediately after spiking and before rail has experienced a large temperature change.

3.3.11 Inner Guard Rails

Guard rails shall be installed on bridges and trestles as indicated. Guard rails shall be approximately 280 mm 11 inch from the gage side of track rails and shall extend a minimum of 15 m 50 ft beyond the structure. The ends shall be curved inward and beveled. Guard rails shall be fully bolted. Guard rails shall not be higher than the running rail and shall not be more than 25 mm 1 inch lower than the running rail. Each guard rail shall be spiked with two spikes to each tie but shall not be tie-plated. Unfit track rail in short lengths may be used for guardrails.

3.3.12 Derails

Derails shall be properly installed where indicated. Derailed equipment shall not foul other tracks. Installation shall be in accordance with the manufacturer's instructions. Where no specific installation instructions are available for salvaged derails, reinstallation shall be in accordance

with good track construction practice to ensure proper performance of their intended function.

3.3.13 Superelevation

****
NOTE: Superelevation on military railroad track should not exceed 100 mm (4 inches). Superelevation for each curve will be shown on the drawings.
****

Curves shall be superelevated as shown on the drawings unless otherwise directed by the Contracting Officer. Superelevation shall be obtained by raising the outside rail of the curve. The inside rail shall be maintained at grade. The maximum superelevation will be [_____] mm inch. Full superelevation shall be carried throughout each curve, unless otherwise directed or shown on the drawings. Superelevation runoff shall be at a uniform rate, and shall extend at least the full length of the spirals. The normal rate of superelevation runoff will be 13 mm per 9.4 m 1/2 inch per 31 ft; however, this may be increased to 25 mm in 9.4 m 1 inch in 31 ft with the prior approval of the Contracting Officer.

3.3.14 Preliminary Surfacing

The preliminary alignment and surfacing gangs shall follow the unloading of the ballast. Rail renewal, tie renewal, bolt tightening, and ballast placement shall be complete prior to commencement of surfacing and alignment work.

3.3.14.1 Lifts

a. The track, after being aligned, shall be brought to grade and surface in lifts not exceeding 100 mm 4 in each. After each lift, the ballast shall be tamped. When using jacks, they shall be placed close enough together to prevent undue bending of rail or stress of rail and joint. Both rails shall be raised at one time and as uniformly as possible, except where superelevation is required. The track shall be so lifted that after a period of not less that 5 train operations (70 metric ton ton ballast car) after the last lift, it will be necessary to give the track a final lift of between 25 and 50 mm 1 and 2 inch to bring it to grade.

b. In areas where major track resurfacing is not required, the Contractor shall perform a "skin lift" tamping operation to ensure that the ties are adequately tamped, the ballast section is adequately compacted and dressed, and to correct minor deficiencies in surface and alignment. The rise in skin lift areas shall be 25 mm 1 in or less and usually will not require that additional ballast be placed.

c. A 50 mm2 inch rise shall provide an average 50 mm2 inch raise in the track being surfaced.

d. A 100 mm 4 in rise shall provide an average 100 mm4 inch raise in the track being surfaced, and shall be made in at least two lifts not to exceed 50 mm 2 inches per lift.

e. A 150 mm 6 inch raise shall provide an average 150 mm 6 inch raise in the track being surfaced, and shall be made in at least 2

lifts. The initial lift shall not exceed 100 mm 4 inch with the final lift not to exceed 70 mm 2-1/2 inch.

3.3.14.2 Tamping

Raising and tamping of track shall be performed with an automatic, vibratory, squeeze type power tamper with 16 tamping heads, capable of raising both rails simultaneously and maintaining cross-level. The equipment to be used for surfacing operations is subject to approval by the Contracting Officer. Every tie in the track shall receive two or more full insertions of the tamping heads. Ballast shall be power-tamped under both sides of ties from each end to a point [300 mm 12 inches inside each rail for 2.4 m 8-ft ties,] [380 mm 15 inches inside each rail for 2.6 m 8 feet-6 inch ties,] [and] [460 mm 18 inches inside each rail for 2.7 m 9 ft ties]. The center shall be filled with ballast, but tamping will not be permitted in the center of the tie between the above stated limits. Both ends of the ties shall be tamped simultaneously and tamping inside and outside of the rail shall be done at the same time. Tamping tools shall not be used with more than 35% wear and shall be worked opposite each other on the same tie. Ballast under switch ties and road crossing ties shall be tamped the entire length of each tie. All ties shall be tamped to provide solid bearing against the base of the rail after the track or turnout is raised to grade at final surfacing. All down ties shall be brought up to the base of rail and shall be machine tamped. The resultant track surface and alignment shall be uniform and smooth. Tamping of track in snow or frozen ballast conditions will not be permitted.

3.3.14.3 Replacement of Ties

After tamping has been completed and the jacks removed, all ties pulled loose shall be replaced to their proper position, respiked and retamped to provide full bearing against the rail.

3.3.14.4 Track Off The Ends of Open Deck Bridges

Track off the ends of open deck bridges shall maintain the same grade as the track on the bridge for a minimum of 8 m 25 ft beyond the bridge abutment and then transition smoothly to meet established track grades.

3.3.14.5 Runoff of Track Raises

The runoff at the end of a rise shall not exceed 13 mm in 9.4 m 0.5 inches in 31 ft of track unless otherwise approved by the Contracting Officer.

3.3.14.6 Horizontal Realignment

Horizontal realignment of curved track shall be established by the Contractor using manual or mechanical means as described in the AREMA Manual Chapter 5, Part 3 Section 3.2, "String Lining of Curves by the Chord Method".

3.3.15 Final Surfacing

After preliminary surfacing has been completed, grade and line stakes shall be checked and the track brought to grade and alignment.

3.3.15.1 Final Tamping

Track shall be brought to grade and the ballast retamped in the manner

described for preliminary surfacing, except that the tamping distance inside the rail shall be decreased from 300 to 250 mm for 2.4 m ties, 380 to 330 mm for 2.6 ties, and 460 to 410 mm for 2.7 12 to 10 inch for 8 ft. ties, 15 to 13 inch for 8 ft 6 inch ties, and 18 to 16 inch for 9 ft ties.

3.3.15.2 Final Alignment

The track shall be given a final aligning conforming to the established track centers.

3.3.15.3 Final Dressing

After the final alignment the ballast shall be dressed to the section indicated. After final dressing ballast shall not cover the tops of the ties. The portion of the subgrade outside the ballast line shall be left with a full, even surface and the shoulder of the subgrade shall be properly dressed to the indicated section to provide proper drainage away from the track.

3.3.15.4 Surplus Ballast

Surplus ballast remaining after final surfacing and dressing of the ballast section shall be distributed or otherwise disposed of as directed by the Contracting Officer.

3.3.16 Cleanup

Upon completion of the work, the Contractor shall [remove all rubbish, waste, and discarded materials generated by the work from the project area] [dispose of rubbish, waste, and discarded materials in an approved manner as directed by the Contracting Officer]. Areas where the Contractor has worked, including but not limited to, project areas, material storage sites, and borrow or disposal areas shall be left in a clean, well-graded, and well-drained condition.

3.3.16.1 Shoulder Removal and Reconstruction

Where track construction or rehabilitation operations result in deposition of materials along the track shoulders that would impede the free drainage of the geotextile and track structure, the Contractor shall remove the material. Where [undercutting] [ploughing] operations leave fouled shoulder materials that impede free drainage of the geotextile and the track structure, the shoulder material shall be removed, and the ballast shoulders shall be reconstructed using the materials and dimensions as indicated. Areas where shoulder removal and reconstruction are required [are] [are not] indicated on the drawings.

3.3.16.2 Spoil Materials

Spoil materials removed from the track shall be disposed of [as indicated] [off site at the Contractor's expense]. Spoil materials shall not be placed on the shoulders, in ditches, in drains, or in other areas where they would impede the flow of water away from the track.

3.3.17 Final Adjustments

Sixty calendar days after the track has been accepted and put into operation, the Contractor shall perform, at no cost to the Government, necessary resurfacing adjustments to leave the track in alignment and on

grade.

3.3.18 Tolerances for Finished Track

Completed track shall meet the following tolerances. Track not meeting the tolerances specified below shall be repaired to meet these requirements, at no additional cost to the Government.

3.3.18.1 Gage

Track gage shall be within plus 6 mm 1/4 inch or minus 3 mm 1/8 inch of standard gage.

3.3.18.2 Alignment

****
NOTE: The alignment and track surface tolerances for out-of-face surfacing of secondary track (less than 16 km/hour (10 MPH)) may be doubled from the values given below if alignment is not critical. Horizontal alignment and profile drawings are recommended.
****

Alignment shall be measured as the deviation of the mid-offset of a 18.9 m 62 ft line, with the ends of the line at points on the gage side of the line rail, 16 mm 5/8 inch below the top of the railhead. Either rail may be used as the line rail on tangent track; however, the same rail shall be used for the entire length of the tangent. The outside rail in a curve is always the line rail. Alignment on tangents shall not deviate from uniformity more than 13 mm 1/2 inch. Alignment on curves shall not deviate from uniformity more than 10 mm 3/8 inch.

3.3.18.3 Track Surface

Track surface shall meet the following requirements:

a. The runoff at the end of a raise shall not exceed 13 mm 1/2 inch in any 9.4 m 31 ft of rail.

b b. The deviation from design profile on either rail at the mid-ordinate of a 18.9 m 62 ft chord shall not exceed 13 mm 1/2 in.

c. Deviation from design elevations on spirals shall not exceed 13 mm 1/2 inch.

d. Deviation from zero cross level at any point on tangent or from designated superelevation on curves or spirals shall not exceed 13 mm 1/2 in.

e. The difference in cross level between any two points less than 18.9 m 62 ft apart on tangents, and on curves between spirals shall not exceed 13 mm 1/2 in.

3.3.18.4 Guard Face Gage

Guard face gage is the distance between the guard lines measured across the track at right angles to the gage line, and is measured at the point of frog on both sides of the turnout. The design value for guard face gage is

1340 mm 52-3/4 inch. Guard face gage shall be within plus or minus 3 mm 1/8 inch of the design value.

3.3.18.5 Guard Check Gage

Guard check gage is the distance between the gage line of a frog and the guard line of its guard rail, or guarding face, measured across the track at right angles to the gage line. The design value for guard check gage is 1388 mm 54-5/8 inch. Guard check gage shall be within plus or minus 3 mm 1/8 inch of the design value.

3.4 TURNOUTS AND TRACK CROSSINGS

Turnouts and crossovers shall be located as indicated on the drawings. Switch, frog and guardrail assemblies shall be complete. Stock rails shall be accurately bent. Changes in rail weight or section will not be permitted within the limits of the switch ties. Headblocks shall be at right angles to the main track and shall be securely spiked in place. Except where directed otherwise, switch stands shall be installed so that when the switch is set for the normal position, the connecting rod keeps the points closed with a pulling force. Switches shall be properly adjusted. Switch components and slide plates shall be lubricated.

3.4.1 Turnout Reconstruction

****
NOTE: List the turnout identification numbers and/or other identifying information, such as location or milepost on the drawings. Indicate the appropriate work required on each turnout.
****

3.4.1.1 Install Salvaged Turnouts

Turnouts shall be reconstructed using Government materials, except switch ties which are furnished and installed. This work includes transporting the turnout from the Government stockpile to the installation site and reconstruction of the turnout.

3.4.1.2 Salvage and Install Turnouts

Turnouts shall be salvaged (removed) and installed. This work consists of removal of the turnout, transporting to the installation site all turnout materials except the switch ties, and reconstructing the turnout using new switch ties.

3.4.1.3 Turnout Removal and Salvaged or Scrapped

Materials from turnouts that are removed from the track and that are not to be reinstalled, shall be either salvaged or scrapped as indicated on the drawings.

3.4.1.4 Trackbed

The trackbed shall be prepared by excavating and wasting existing ballast or subgrade materials and establishing a firm top of subgrade as indicated on the contract drawings. [Subballast shall be placed as indicated and compacted.] [Geotextile shall be placed to the limits indicated.]

3.4.1.5 Replacement Turnout

The replacement turnout shall be constructed at the location indicated on the contract drawings. Replacement turnouts shall be located so that the point of frog remains at the same location as the original turnout point of frog. Dimensions, details, and configuration of each turnout shall be as indicated on AREMA Track Plans, Plans Nos. 910 and 911. Switch ties shall be placed as indicated on AREMA Track Plans, Plans Nos. 112 and 912, except that even meter foot increments in length of switch ties may at Contractor's option be substituted for 150 mm 6 inch increments in length of switch ties. The end of a switch tie shall not be within 355 mm 14 inch of a spike. Connecting tracks shall be shifted to their new alignments as shown on the contract drawings and all tracks connected to the replacement turnout. Tracks shall be placed within 30 mm 0.1 ft of design alignment prior to ballasting work.

3.4.1.6 Matching

****
NOTE: Allow at least 50 mm (2 in.) of clearance between moving parts of the switch and the top of the ballast. One hundred mm (four in.) is the minimum clearance in Northern climates, where snow and ice accumulation and heaving occur. Select the appropriate clearance for the project location.
****

Switch points/stock rails, rail joints, frog castings, and other parts of the turnout that must fit together shall fit properly and be of the proper match. Both rail ends at all rail joints throughout the turnout and at the joints at the frog shall be matched on both the top (tread portion) and on the gage side of the rail. Rail end welding and grinding [are] [are not] acceptable methods to achieve a good match.

3.4.1.7 Placing of Ballast

Ballast shall be placed as required and the turnout brought to proper grade in a minimum of three lifts. The initial lift shall not exceed 100 mm 4 inch. The final lift shall not exceed 50 mm 2 inch and all tracks shall be brought into final alignment at that time. Tamping, ballast dressing requirements, and alignment tolerances shall be as indicated in paragraph TRACK CONSTRUCTION AND OUT-OF-FACE RELAY. Ballast level in cribs beneath the connecting rod, switch point rails, and switch rods shall be at least 100 mm 4 inch below any steel.

3.4.1.8 Existing Switch Stand

The existing switch stand, or a replacement stand if specified, shall be installed and the switch operating mechanisms adjusted so that the switch operates smoothly and without excessive force being required. All switch plates and connection points in the switch rod shall be lubricated with a switch lubricant, which does not allow sand or debris to adhere to the lubricant.

3.4.1.9 Rail Anchors

All switch ties shall be box-anchored to the extent possible. Ties shall be anchored only when box-anchors can be applied to every rail on the tie.

3.4.2 Turnout Repair

****
NOTE: Designer will list the turnout identification numbers and/or other identifying information, such as location or milepost, along with the requirements in a schedule on the drawings.
****

Turnouts which will remain in their existing location but require repairs shall be indicated in the "Schedule of Turnout Repairs" on the contract drawings and repaired as specified below.

3.4.2.1 Switch Ties

Defective switch ties shall be removed and replaced. Existing nondefective switch ties shall remain in place. Replacement switch ties shall be installed at a uniform spacing, but not greater than 530 mm 21 inch center to center. The end of a switch tie shall not be within 36 mm 14 inch of a spike. Switch ties shall not be interlaced, where one tie penetrates the crib area of another tie.

3.4.2.2 Bolt Tightening

All bolts in all turnouts within the project area shall be tightened. Any bolt that cannot be tightened shall be replaced with a bolt assembly of the proper diameter and length.

3.4.2.3 Rebuild Switch Points and Protectors, Frogs, and Guard Rails

Switchpoints, frogs, guard rails, or switch point protectors shall be rebuilt as specified in paragraph ELECTRIC ARC WELDING.

3.4.2.4 Regage Closure Rails

Track shall be regaged from heel of switch to the toe of frog. Regaging shall be performed as specified in paragraph TRACK CONSTRUCTION AND OUT-OF-FACE RELAY.

3.5 HIGHWAY CROSSINGS

****
NOTE: Subdrains are recommended on all highway crossings. Drawings should show location of outfall pipe. Density requirements can be deleted if a separate specification section is provided for subgrade preparation.
****

Highway and other grade crossings within the project shall be constructed as indicated on the contract drawings.

3.5.1 Subgrade

[For new construction, the subgrade in the crossing area and for 6 m 20 ft beyond each end of the crossing shall be bladed to a level surface and compacted to at least 90 percent CE55 maximum dry density for cohesive materials or 95 percent CE55 maximum dry density for cohesionless materials.] [For track rehabilitation, old contaminated ballast and

subballast shall be excavated a minimum 300 mm 12 inch below the design elevation of the bottom of the tie, 300 mm 12 inch beyond the ends of the ties, and for at least 6 m 20 ft beyond each end of the crossing. The subgrade shall be bladed to a level surface.] Drainage areas shall be cleaned and sloped away from the crossing in both directions along the track and the roadway. [Surface ditches] [Subdrains] shall be installed as indicated.

3.5.2 Geotextile Installation

****

NOTE: Coordinate these paragraphs with paragraph GEOTEXTILE. Delete these paragraphs if geotextile is not required.

The width of the geotextile should cover the entire width of the roadbed with no longitudinal seams or overlaps. Where mechanized geotextile laying equipment will be used to place the geotextile, the maximum diameter of the geotextile rolls should not exceed the capability of the equipment to be used on the project.

Prior to the placement of the cover material (ballast or subballast), the geotextile may be anchored in several ways, i.e., pins, small ballast piles, ballast bags, etc. If fixing of the geotextile is critical and adverse conditions exist, e.g., steep slopes or high winds, the specification can detail anchoring requirements, e.g., pin length and spacing. Care should be taken to prevent or quickly release any tension caused by anchoring and placement of the geotextile cover materials. Excessive tension can cause bridging of irregularities beneath the geotextile and increase the potential for puncture.

If there is reason to suspect movement which will reduce overlap, provision should be made in the specification to remove cover materials at selected areas in order to determine if required overlap is being maintained after cover placement.

****

Geotextile shall be placed between the subgrade and the ballast section in the crossing area and for 6 m 20 ft beyond each end of the crossing.

3.5.2.1 Preparation

Surfaces on which geotextiles will be placed shall be prepared in accordance with the applicable portions of this specification and shall be free of irregularities such as sags, cavings, erosion, or vegetation. Any irregularities shall be corrected to ensure continuous, intimate contact of the geotextile with the whole surface. Any loose material or debris shall be removed prior to geotextile placement.

3.5.2.2 Placement

****

NOTE: Delete paragraph "b." if a protective sand layer is not specified.

****

a. When geotextile is to be installed in an existing track following removal of the ballast by undercutting or ploughing, special care shall be taken to remove as many of the large ballast particles that remain on the roadbed surface as possible.

b. A protective sand layer 50 mm 2 inch thick [or subballast] shall be placed on top of the geotextile after it has been installed.

c. The geotextile shall be carefully placed on the prepared surface with the long dimension parallel to the prepared surface. The geotextile shall be placed free of wrinkles, folds, creases, and tension. The geotextile shall be held in place by pins, small aggregate piles or ballast bags, until it is completely covered. The geotextile shall be covered immediately after placement in track. The maximum exposure time for the geotextile, from removal of the protective shipping cover to placement of the ballast/subballast cover materials which prevent exposure to sunlight, shall be 2 consecutive days.

d. The minimum overlap of geotextile splicing seams shall be 900 mm 36 inch. If several geotextile units are placed with the required overlap prior to the placement of the [ballast] [subballast], the overlap distance of each overlap shall be checked as placement of [ballast] [subballast] approaches the overlap. The Contractor shall ensure that the required overlap exists when the geotextile is covered.

e. The geotextile shall remain free of any contamination such as mud, dust, sediment, debris, etc., that will impair its function. Contamination shall be removed without damage to the geotextile or to the prepared surface at the Contractor's expense. If the geotextile is damaged, its function impaired by the cleaning efforts, or if it cannot be properly cleaned, the Contractor shall repair the prepared surface, if necessary, and replace the damaged or impaired geotextile with geotextile meeting requirements of this specification. Equipment shall not operate in direct contact with the geotextile. Surface drainage, as much as possible, shall be directed away from the geotextile installation area to prevent accumulation of mud, debris, and sediment.

3.5.2.3 Placement of Cover Material

Placement of [ballast] [subballast] cover material in contact with the geotextile shall be performed ensuring intimate contact of the geotextile with the prepared surface and with the cover material. The placement shall be performed without damage to the geotextile including tears, punctures, or abrasion.

3.5.2.4 Equipment Operations on the Cover Material

A minimum depth of 200 mm 8 inch of cover material shall be placed over the geotextile before equipment is allowed to operate on the covered geotextile. Equipment operations on the covered geotextile shall be limited to those necessary for track construction and equipment turning will not be allowed on the covered geotextile.

3.5.2.5 Minimum Ballast Depth

The minimum depth of ballast between the bottom of the tie and the top of the geotextile shall be 300 mm 12 inch.

3.5.2.6 Tamping Operations

Tamping of ballast materials shall be performed by setting the tamping force and insertion depth to the minimum necessary to adequately tamp the track. The tamper operator shall monitor the depth of tamping and limit the depth to prevent detrimental effects of the tamper feet on the geotextile.

3.5.2.7 Double Layers

Double layers of geotextile will not be allowed, except for splicing overlaps at seams.

3.5.3 Ballast Placement and Surfacing

Ballast shall be placed and tamped as specified in paragraph TRACK CONSTRUCTION AND OUT-OF-FACE RELAY except that in crossings, the ballast between the ties shall be thoroughly compacted with a vibratory compactor, or other approved means, after each raise. The ballast shall be tamped for the entire length of the crossties for highway crossings. The track shall receive final alignment and surfacing prior to placement of the crossing surface. Final surfacing shall bring the track to the final grade and alignment as indicated on the contract drawings. Where the crossing involves two or more tracks, the top of the rail for all tracks shall form a plane with the adjacent roadway surface. The top of rail elevation shall be 50 to 100 mm 2 to 4 inches above surrounding pavement elevation, with a smooth transition of pavement. The ballast in the cribs and on the shoulders shall be compacted using a vibratory plate compactor or other approved means.

3.5.4 Ties

[Hardwood] [Concrete] [Polymer Composite] ties shall be used. Spacing shall be a minimum of 500 mm 20 inches center to center. For premanufactured grade crossings, ties shall conform to the manufacturer's recommendations for the type of grade crossing surface materials being used.

3.5.5 Tie Plates, Spikes, and Anchors

All ties within the crossing and for 6 m 20 ft beyond each end of the crossing shall be fully tie plated, and spiked with 4 rail-holding spikes per tie plate. [Each tie within the crossing shall be fully box anchored.] [Rubber tie pads shall be installed between the tie and tie plate on all ties within the crossing area and for 6 m 20 ft beyond each end of the crossing.]

3.5.6 Rail

Rail within the crossing area and for 6 m 20 ft beyond each end of the crossing shall be, at a minimum, [57] [_____] kg/m [115] [_____] lbs/yd. Rail [shall] [shall not] be protected from corrosion by application of an approved rust inhibitor. Bolted joints will not be permitted in any Type 2, Type 3, Type 4, or Type 5 crossing or within 6 m 20 ft of either edge of

the crossing surface. Bolted joints will be eliminated by either field welding the joints to form continuous rail throughout this area or by using 24.4 m 78 ft rail lengths.

3.5.7 Lining and Surfacing

Rail shall be spiked to line and the track mechanically tamped and surfaced to the grade and alignment of the existing track and roadway. Where the crossing involves two or more tracks, the top of rails for all tracks shall be brought to the same plane.

3.5.8 Crossing Surface

****
NOTE: Provide Typical Railroad Crossing cross section and details on the drawings.
****

The surface of the highway shall be [in the same plane as] [not greater than 6 mm 1/4 inch higher than] the top of the rails for a distance of 600 mm 2 ft outside of the rails for either single or multiple-track crossings. A smooth transition shall be made between the crossing surface and the adjoining pavement.

3.5.8.1 Type 1 Aggregate Crossings

Type 1 crossings shall be constructed by placing the aggregate material between the rails and outside of the rails to form an approach ramp as indicated in the contract drawings.

3.5.8.2 Type 1A Aggregate with Timber Flangeway Guards Crossings

The bond timber headers shall be installed with the edge of the timber solid against the edges of the tie plates prior to placement of the aggregate. Headers shall fasten to the ties as indicated using the appropriate size and length fasteners. After installation of the bond timber, the aggregate shall be placed in the track and on the outside approaches and compacted.

3.5.8.3 Type 2 Timber Plank Crossings

Type 2 Type 2 crossings shall be installed as shown or in accordance with the manufacturer's instructions for prefabricated timber crossing units. The surface of the crossing timbers shall form a smooth plane with the top of the rails and the adjacent roadway surface. Crossing timbers shall be attached to the ties as indicated in the contract drawings using the appropriate size and length fasteners, unless otherwise specified by the manufacturer's instructions.

3.5.8.4 Type 3a Asphalt Crossings

Type 3a crossings are full-depth asphalt crossings as shown in the contract drawings. The asphalt shall be placed in lifts not to exceed 50 mm 2 inch thick and shall be compacted with approved compaction equipment. General requirements for asphalt placement are specified in [_____] State Highway Specifications.

3.5.8.5 Type 3b Asphalt With Timber Flangeway Header Crossings

Type 3b crossings are full-depth asphalt crossings as shown in the contract drawings. The asphalt shall be placed in lifts not to exceed 50 mm 2 inch thick and shall be compacted with approved compaction equipment. General requirements for asphalt placement are specified in [_____] State Highway Specifications. the flangeway timbers shall be installed prior to the placement of the asphalt pavement. The timbers shall be installed with the dappled edge of the timber solid against the ends of the tie plates. Flangeway timbers shall fasten to the ties as indicated in the contract drawings using the appropriate size and length fasteners.

3.5.8.6 Type 4a Cast-in-place Concrete Crossings

Type 4 crossings shall be constructed as shown in the contract drawings using the materials specified herein. Concrete forming, reinforcement, and placement shall conform to the requirements of Section 03 11 13.00 10 STRUCTURAL CONCRETE FORMWORK, Section 03 20 01.00 10 CONCRETE REINFORCEMENT, and Section [03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE] [03 30 00.00 20 CAST-IN-PLACE CONCRETE].

3.5.8.7 Type 4b Prefabricated Concrete Panel Crossings

Type 4A crossings and crossing materials shall be installed in accordance with the crossing manufacturer's instructions. Tie spacings and track materials used in the crossing shall be in accordance with the installation instructions and manufacturer's recommendations.

3.5.8.8 Type 5 Full Depth Rubber Crossings

Type 5 crossings and crossing materials shall be installed in accordance with the crossing manufacturer's printed instructions. Tie spacings and track materials used in the crossing shall be in accordance with the installation instructions and manufacturer's recommendations.

3.5.9 Signs and Signals

The type and location of railroad-highway crossing warning signs and signals shall conform to the requirements of MUTCD, Part VIII.

3.5.9.1 Location and Positioning of Signs

Signs for both highway and railroad track installation shall be located and erected as shown. Unless otherwise shown, signs shall be erected so that sign face is vertical and at a deflection angle of 87 degrees from the center of the highway lane or track which the sign serves and facing the direction of travel. Where lanes or tracks are on curves, sign faces shall be on a deflection angle of 87 degrees to the tangent to the curve. Signs shall be erected so that specular reflection is minimized or eliminated. After installation is completed, the signs will be inspected during the day and at night by the Contracting Officer. If specular reflection is apparent on any sign, its positioning shall be adjusted to eliminate or minimize this condition. This adjustment and any subsequent adjustments shall be at no additional cost to the Government.

3.5.9.2 Traffic Control

During installation of highway signs, the Contractor shall provide for the safe and expeditious movement of traffic through the work area. Schedule

of lane closures, work zone safety and traffic control, and related items shall be provided.

3.5.10 Crossing Flangeways

Upon completion of the grade crossing installation, the flangeways through the crossing shall be a minimum of 50 mm 2 inch deep and between 65 and 75 mm 2-1/2 and 3 inches wide. The Contractor shall ensure that adequate flangeways are provided prior to installation of the final crossing surface.

3.5.10.1 Flangeway Filler

Except for Type I crossings all open crossing flangeways shall be filled with [asphaltic concrete and compacted as indicated on the drawings][preformed rubber filler].

3.5.10.2 Clean Grade Crossing Flangeways

Where grade crossing flangeways are obstructed (filled in), the Contractor shall remove foreign material to provide a minimum 50 mm 2 inch depth and 65 mm 2-1/2 inch width flangeways on the gage side of the rails.

3.5.11 As-Built Drawings

The Contractor sahll submit as-built drawings for each automatic crossing protection installation. The materials and methods used to produce these drawings shall meet the requirements of this specification and shall result in drawings which are easy to revise without damage to the drawing.

3.6 BONDING AND GROUNDING TRACK

****
NOTE: Whenever rail facilities are required for unloading fuel, ammunition, other flammable or explosive materials, or if the track is located adjacent to electrical equipment, the rails and related track materials capable of conducting electrical current must be bonded, grounded and insulated from the remaining track. See UFC 4-860-01FA for details on which track must be bonded and grounded.
****

Track shall be bonded and grounded as indicated. Where track is designated for bonding and grounding, the rails shall be bonded electrically continuous and effectively grounded. Connections shall be made by exothermite welds in accordance with the manufacturer's instructions.

3.6.1 Rail Joint Bond

Rail joints on both rails of designated track shall be bonded using an exothermic type bond. The bond shall be applied to the field side of the rail [head] [web] unless otherwise approved by the Contracting Officer. Track to be bonded and grounded shall be electrically insulated from the remaining track using one of the specified insulated joints.

3.6.2 Rail Cross-Bond and Ground

Rail cross-bond and ground shall be installed using an exothermic type

bond. The cross-bond shall be applied to the [rail head] [rail web]. One cross-bond and ground shall be [installed at 30.5 m 100 ft intervals along the designated tracks.] [provided for each section of bonded and grounded track.] Connections between grounding system or ground rods and rails shall be made with bare stranded copper cable, installed at least 300 mm 12 inch below the bottom of the ties. Ground rods shall be driven vertically full-length. The top of the ground rod shall be located at the toe of the ballast slope and shall be a minimum of 300 mm 12 inch below the top of the subgrade. Maximum resistance to ground from any grounded rail or structure shall not exceed 25 ohms. The Contractor shall make any corrections needed to reduce the resistance to below 25 ohms at no cost to the Government.

3.6.3 Inspection of Rail Bond and Ground

Loose, damaged, or missing rail bond wires, cross bond wires, ground connections, and ground rods shall be visually inspected. If there is a signal failure, bonding can be tested for current loss in the joints using a volt meter. Defective items shall be marked for repair.

3.6.4 Rail Bonds At Signalized Grade Crossings

Bolted rail joints within the approach circuits to signalized highway grade crossings shall be double-bonded using both a rail head bond and a web bond. Rail head and web bonds shall be installed in the locations indicated where the existing rail bonds are missing, broken, or otherwise ineffective.

3.6.5 Existing Bonds

The Contractor shall protect existing rail bonds, [cross-bonds,] [ground connections, and grounding rods] from damage. Except for bonds attached to rails which are designated to be replaced in this contract, replacement of bonds damaged or destroyed by the Contractor's operation shall be replaced at no cost to the Government.

3.6.6 Removal of Defective Bonds

Rail head pin-type and welded-type bonds shall be removed by shear cutting old cables immediately adjacent to the weld or pin. Rail web type pin bonds shall be removed by knocking the old pin out with a drift. Flames or torches shall not be used to remove defective bonds.

3.7 INSTALLATION OF MISCELLANEOUS TRACK MATERIALS

3.7.1 Tie Plates

Tie plates shall be furnished to the work sites as required. Excess tie plates, remaining at the conclusion of the contract, shall be delivered to the military installation storage site and stacked where directed by the Contracting Officer.

3.7.2 Insulated Joints

Insulated joints shall be installed where indicated and in accordance with the manufacturer's installation instructions.

3.7.3 Bumping Posts, Cushion Head, and Wheelstops

Bumping posts, cushion head, and wheelstops shall be [removed,]

[installed,] [or] [reinstalled] [_____]. Installation shall be in accordance with the manufacturer's instructions. Where no specific installation instructions are available for salvaged bumping posts and wheelstops, reinstallation shall be in accordance with good track construction practice to ensure proper performance.

3.7.4 Inner Guard Rails

Inner guard rails shall be installed as detailed in the contract drawings. Each rail shall be spiked to alternate crossties throughout the full length using two spikes per rail per tie; tie plates are not required. Guard rails shall be installed using acceptable joint bars of the proper size to fit the rails being joined. Each joint shall be bolted with at least two bolts and one fully tightened bolt per rail.

3.7.5 Gage Rods

One gage rod shall be installed in the crib immediately ahead of the switch point of all turnouts. Two gage rods shall be installed on the curved closure rail, one ahead of the joint, and one ahead of the toe of the frog in all turnouts.

3.7.6 Installation of Joint Bars

****
NOTE: For low traffic volume tracks that are equipped with six hole angle bars, the bars may be installed by placing bolts in only the four center holes. Modify paragraph as needed if six hole bars are used, and designate locations for four bolt use.
****

Joint bars shall be installed with their full number of bolt assemblies unless otherwise noted. Bars shall be properly seated on the rail and the bolts tightened beginning at the center of the joint and working toward the ends of the bars, alternating between rails. Bolts used shall be of the proper diameter and length for the rail and joint bars at the joint. The use of extra washers to shim out track bolt nuts is prohibited. Bolts with nuts shall be placed alternately on inside and outside of rail.

3.8 BRIDGE REPAIR

Bridge repair shall be as follows:

3.8.1 State and Local Government Permits

The Contractor shall obtain necessary permits from state and local governments for work over public roads. The Contractor shall prepare traffic maintenance and detour plans; submit them for approval to the appropriate authorities; erect and maintain signs, barricades, lighting, and other traffic control devices in accordance with MUTCD; pay for police details; and stage the work to provide for the continued safe public use of the roadways beneath the bridges.

3.8.2 Work Hours

The Contractor may be required by local or state authorities to work at night or on split shifts to avoid peak traffic hours at bridges [_____]. No additional compensation will be made for any costs associated with

meeting such requirements.

3.8.3 Schedule of Bridge Repair Work

The work of this project shall be scheduled to minimize the duration of interruptions to rail service. Bridge repair work shall be scheduled so that to the maximum practical extent, bridges on the same line are taken out of service and repaired simultaneously.

3.8.4 Timber Pile Repair

A timber pile can be spliced or shimmed to repair areas of deterioration or to compensate for settlement of the pile. Any spliced pile shall achieve a bearing adequate for its design loading. No more than 50 percent of the piles in a single bent shall be spliced, and no more than 25 percent of the piles in the entire substructure shall be spliced or shimmed.

3.8.5 Timber Pile Replacement

Any pile shall be replaced when it does not achieve adequate bearing, the pile has greater than 50 percent deterioration, or replacement is more economical. [Replacement pile shall be driven along side existing piles] [A two pile support pier shall be constructed under the bridge cap to carry the load of the deteriorated pile].

3.8.6 Bridge Tie Replacement Open-Deck Bridges

Where spot replacement of bridge ties is required, the existing tie shall be removed without permanently disturbing the track surface. New bridge ties shall be of the proper wood species, structural grade, and size for the intended application. Shimming of bridge ties will not be permitted.

3.8.7 Rivet Replacement

Where replacement is required, rivets shall be replaced with high-strength bolts as specified in Section 05 12 00 STRUCTURAL STEEL.

3.9 ELECTRIC ARC WELDING

****
NOTE: An electric flash butt mobile rail welder should be used on large projects.
****

Welding to repair or rebuild frogs, switch point, guard rails, switch point protectors and rails (engine burns, battered ends, etc.) shall be done in accordance with AREMA Manual, Chapter 5, Part 5,Section 5.10 and AWS D1.1/D1.1M.

3.9.1 Welding Supervision

Electric arc welding shall be performed under the direct supervision of an experienced welding supervisor or foreman and by a certified welder.

3.9.2 Weather Conditions

Welding shall not be performed in rain, snow, or other inclement weather without adequate protection of the welding from the elements.

3.9.3 Welding Manganese Frogs and Crossings

****
NOTE: Edit these paragraphs as needed to match the project requirements.
****

Bolts shall be tightened, spikes driven down and ties tamped under crossing and frogs for level surface, when welding manganese frogs and crossings. Chips and cracks shall be ground out with grinding machine or gouged out with arcair gouging device even if crack goes through the entire casting. When gouging device is used, no finished grinding of cracks or chips is required. If cracks are gouged out to bottom of casting, reinforcement strap shall be [placed underneath the hole.] [welded to the bottom of the hole in casting with the wire feed machine, allowing the frog or crossing to be welded back to level surface using the skip method.]

3.9.3.1 Manganese Overheating

Welder shall ensure that manganese is not overheated in this process. If manganese shows signs of overheating, casting shall be air cooled and then welding process continued, repeating the process as many times as necessary to prevent manganese from overheating. Flange carbons [shall] [shall not] be used to keep welding metal out of flangeways. Welded surface shall be built slightly higher than normal surface of casting so when ground, it will have sufficient weld metal to grind to a level surface. A 600 mm 24 inch straightedge shall be used to check this work. Edges of flangeways and sides of points shall be ground in a roll manner, using a frog and crossing flangeway gage as a guide.

3.9.3.2 Slotting

Manganese frogs and crossings shall be slotted with a 5 mm 3/16 inch slotting wheel. Connecting rail joints to frog shall also be welded, ground, and slotted in like manner. The grinding and slotting process shall be repeated approximately 6 weeks from the time the frog is put back in service and thereafter when overflow appears on points and flangeways.

3.9.4 Welding Switch Points

****
NOTE: Field welding of switch points is not recommended. Qualifications of welder are very important for this type of work.
****

Overflow of stock rail shall be ground off of ball of rail on both sides and switch point ground to where cracks and chips are ground out. All grease and rust shall be ground off of point as far back as point is to be welded. Switch point shall be adjusted tight against stock rail and check gage. If gage just ahead of switch point is tight, it shall be opened to where gage reads 6 mm 1/4 inch open. The following shall be done before starting to weld: 1) Open switch point and place rail flange carbon between switch point and stock rail. 2) Pull switch tight against carbon and hold with spike; another rail carbon can be placed just on top of reinforcement binding strap on point to use as guide for first welding pass; carbon can then be removed or left in place. 3) Grind switch point with surface grinder or utility grinder. 4) Apply graphite or oil to switch points and plates to prevent rusting and to make switch throw

easier. 5) Check with proper authority to ensure ample time to complete welding, grinding and cooling before traffic is due. Switch point shall be ground welded complete without chipping weld slag.

3.9.5 Welding Switch Point Protectors

3.9.5.1 In Track

The following operations shall be performed: 1) Check with proper authority to ensure ample time to complete welding, grinding and cooling before traffic is due. 2) Use a steel ruler to determine the amount of weld needed on manganese switch point protectors; measure the top of the protector any place where there is no wear. 3) Grind out the work hardened surface and any cracks or chips. 4) Weld the protector with the semi-automatic wire feed machine slightly wider than the width of a new switch point protector; run a string bead along the bottom of the wear surface on the protector guard; leaving flux on this bead continue with string bead until protector is built back to size without overheating the protector. If signs of overheating appear, use intermittent welding procedure. 5) Grind back the protector to the correct width. 6) Use roll method on top inside corner of protector.

3.9.5.2 Out of Track

The following operations shall be performed: 1) Use a steel tape to determine the amount of weld needed on manganese switch point protectors; measure the top of the protector any place where there is no wear. 2) Ground out the work hardened surface and any cracks or chips. 3) Weld the protector with the semi-automatic wire feed machine to just a little wider than the width of a new switch point protector; the protector can be laid on its side and three flat beads run on wear surface of the protector guard; ground back to the size of a new protector. 4) Use intermittent method and skip welding to keep protector from overheating. 5) Use the roll method on inside corner of running wear surface of guard.

3.9.6 Welding Engine Burns

The damaged steel of the rail shall be removed by grinding or arcair to get below the burn area into sound metal. Sufficient amount of metal shall be removed to eliminate all shatter cracks.

3.9.6.1 Depth and Length Limitations

Engine burns requiring welds greater than 10 mm 3/8 inch in depth below the top of the rail head shall not be repaired by welding and grinding. While grinding out the damaged metal, the operation shall be stopped when it is discovered that the necessary weld will go too deep into the rail head. The ground out portion shall be welded and joint bars shall be applied at the weld location with the rail undrilled at the middle bolt holes, centering the joint bars under the engine burn. The supervisor of maintenance shall be immediately notified so that the rail can be removed from track. These failed rails shall be disposed of in accordance with current instructions. Engine burns which would require a weld longer than 200 mm 8 inch shall not be welded.

3.9.6.2 Ambient Limitations

Welding and grinding engine burns shall be avoided when the air temperature is below 0 degrees C 32 degrees F. When welding is necessary below 0

degrees C 32 degrees F, the heated area shall be protected by covering with insulating material to retard cooling. Engine burns shall not be welded during rain or heavy snow.

3.9.6.3 Number of Welds

Contractor shall determine the maximum number of burns in a 12 m 39 ft rail, or equivalent, that can be economically welded. Unless otherwise directed, when a rail has more than 8 burns needing repair, the rail shall be replaced.

3.9.6.4 Welding Procedure

The burn shall be welded with semi-automatic wire feed machine. The skip method shall be used in this process because no preheating or post heating is needed. If engine burns are found in groups close together, ten to fifteen burns shall be ground out at a time, welding one pass at a time on each of the burns. The process shall be repeated until all of the burns are completed to a surface just higher than the normal ball of the rail. The burn shall then be cooled until hand can be placed on it. Welds shall be ground to a level surface with cup wheel attachment grinder.

3.9.7 Welding Rail Joints

****
NOTE: Remove this paragraph when not required.
****

Bolts in the joint bars shall be tightened and the joint pulled to a level surface. Joint bars shall be checked for wear and replaced if they are badly worn. Six hole bars shall be used if available. A straightedge shall be placed across the joint to determine the amount of batter. The straightedge shall be a minimum of 450 mm 18 inch in length. A rail joint with less than 3 mm 0.012 inch of batter shall not be welded. If batter is 3 mm 0.012 inch or more, the rail joint shall be built up. If rail cracks or chipped out places are present in rail ends, they shall be melted out with acetylene torch, gouged out with arcair or ground out with grinder. If cracks or chips extend below ball, rail shall be replaced. If horizontal crack in ball of rail extends more than 200 mm 8 inch rail shall be replaced. Rail ends shall be preheated to approximately 93 degrees C 200 degrees F before welding. Starting 40 mm 1-1/2 inches from the end, the rail shall be built back as follows: A strip shall be welded 25 mm 1 inch into bead; the rail ends shall be ground to a level surface with surface grinder or cup wheel attachment; and rail joint shall be cross slotted with 5 mm 3/16 inch grinding stone to keep rail ends from overlapping and chipping out.

3.10 THERMITE WELDING PROCEDURES

Thermite welding procedures shall be performed by a technician certified to meet ASNT CP-189, level II or III qualifications and comply with the following paragraphs:

3.10.1 End Preparation

Rails to be welded shall meet the requirements Section 2.2, "Specifications for Fabrication of Continuous Welded Rail" given in Chapter 4, Part 2 of AREMA Manual. The rail ends shall be aligned in accordance with paragraph GAP AND ALIGNMENT. Rail ends shall show no steel defects, dents, or

porosity before welding. Bolt holes shall not be made in, or permitted to remain in, the ends of the rail to be welded. One handling hole may be made in each end of welded string. Rail ends containing such holes shall be cut off during track construction. Rail which must be cut for any reason shall be cut square and clean by means of approved rail saws or abrasive cutting wheels in accordance with Chapter 5 of AREMA Manual, Section 10.3, "Recommended Practice For Use of Abrasive Wheels".

3.10.1.1 Cleaning

The rails to be welded shall be cleaned of grease, oil, dirt, loose scale, and moisture to a minimum of 150 mm 6 inch back from the rail ends, including the railhead surface. Cleaning shall be accomplished by use of a wire brush, to completely remove dirt and loose oxide and by use of oxygen-acetylene torch to remove grease, oil and moisture. A power grinder with an abrasive wheel shall be used to remove scale rust, burrs, lipped metal and mill brands which would interfere with the fit of the mold, for 50 mm 2 inch on each side of the ends.

3.10.1.2 Gap and Alignment

The minimum and maximum spacing between rail ends shall be as specified by the rail welding kit manufacturer and the approved welding procedures.

a. The ends of the rails to be welded shall be properly gapped and aligned to produce a weld which shall conform to the alignment tolerances below. Alignment of rail shall be done on the head of the rail. The rail gap and alignment shall be held without change during the complete welding cycle.

b. Vertical alignment shall provide for a flat running surface. Any difference of height of the rails shall be in the base.

c. Horizontal alignment shall be done so that any difference in the width of heads of rails shall occur on the field side. Horizontal offsets shall not exceed 1 mm 0.04 in. in the head and/or 3 mm 0.12 inch in the base.

3.10.2 Surface Misalignment Tolerance

Combined vertical offset and crown camber shall not exceed 3 mm/m 0.04 inch/feet at 315 degrees C 600 degrees F or less. Combined vertical offset and dip camber shall not exceed 1 mm/m 0.01 inch/feet at 315 degrees C 600 degrees F or less.

3.10.3 Gage Misalignment Tolerance

Combined horizontal offset and horizontal kink camber shall not exceed 3 mm/m 0.04 inch/feet at 315 degrees C 600 degrees F or less.

3.10.4 Thermite Welding

Welding shall be done in accordance with Chapter 4, Part 2,Section 2.5 of AREMA Manual, articles "Thermite Welding - Rail Joints" and Section 2.2 "Specification for Fabrication of Continuous Welded Rail", except as modified by these specifications. All welds shall be visually inspected at the time of welding.

3.10.4.1 Thermite Weld Preheating

The rail ends shall be preheated prior to welding to a sufficient temperature and for sufficient time as indicated in the approved welding procedures to ensure full fusion of the weld metal to the rail ends without cracking of the rail or weld.

3.10.4.2 Thermite Weld Cooling

The molds shall be left in place after tapping for sufficient time to permit complete solidification of the molten metal and proper slow cooling to prevent cracking and provide a complete weld with proper hardness and ductility.

3.10.5 Weld Finishing and Tolerances

Welded joints in the finished track shall be brought to a true surface and alignment by means of a proper grinding or planing machine (shear). Finish grinding shall be performed with an approved grinder operated by a skilled workman grinding evenly and leaving the joints in a smooth and satisfactory condition. Finishing shall eliminate all cracks. The completed weld shall be finished by mechanically controlled grinding in conformance with the following requirements:

a. A finishing deviation of not more than plus or minus 1 mm 0.01 in of the parent section of the rail head surface will be allowed. The gage side of the rail head shall be finished to plus or minus 1 mm 0.01 in of the parent section.

b. Welds produced by welding kits which are specially designed to produce reinforced welds need not be ground in the finishing area except as necessary to remove fins, burrs, cracks, etc.

3.10.6 Weld Quality

Each completed weld shall have full penetration and complete fusion and be entirely free of cracks or fissures. Welds shall meet the acceptance criteria given in AWS D1.1/D1.1M.

3.10.7 Weld Numbering

The Contractor shall semi-permanently mark a sequential weld number on the rail immediately adjacent to the weld, using a quality lead paint marker at the time the weld is made. Welds shall be numbered sequentially in the order in which they are made. The Contracting Officer will provide the Contractor with the initial weld number. Defective welds which are replaced shall be assigned a new sequential number by adding a letter to the defective weld number (e.g., defective weld 347 would be replaced by 347A).

3.11 TRACK REPAIR

3.11.1 Cutting and Drilling of Rail

The Contractor shall use only rail saws and abrasive cutting wheels for this operation. Other methods for cutting rail will not be acceptable. Cuts shall be square and clean. When given the option of cutting existing rail or new rail being installed, the existing rail shall be cut. When new holes are necessary, they shall be drilled. Holes shall not be punched,

slotted, or burned with a torch. Holes shall be of the size and located as shown on the contract drawings. Drilled bolt holes shall be peened or ground to remove sharp edges.

3.11.2 Rail Joints

In areas which do not require out-of-face rail replacement, the Contractor shall tighten all track bolts. Defective track bolts, nuts and lock washers ("bolt assemblies"), and those that cannot be tightened shall be replaced. This work shall include both spot replacement of assemblies at locations to be determined by the Contracting Officer ("Spot Bolt Assembly Replacement") and out-of-face replacement of all bolt assemblies within a rail joint ("Joint Repair").

3.11.2.1 Used Bolt Assemblies

Used bolt assemblies removed from rail joints shall become the Contractor's property and shall not be reincorporated in the work. Existing bolt assemblies designated to be replaced shall be removed by methods which shall not damage joint bars or rails.

3.11.2.2 Joint Repair

****

NOTE: List locations where out-of-face joint repairs are required on the drawings.

****

Replacement of defective joint bars and correction of rail-end mismatch, as designated or directed by the Contracting Officer, shall be defined as joint repair work. At designated joint repair locations, both joint bars shall be removed from the rails and the rail ends inspected for damage or defects.

3.11.2.3 Cleaning of Finishing Area

The finishing area shall be cleaned of mill scale, rust, and dirt by wire brushing, compressed air, solvents, or a combination of these or other methods.

3.11.2.4 Rail Ends

The clean rail ends shall be jointly examined by the Contractor and the Contacting Officer for the presence of any rail defects that would make the rail unsuitable for further use at the location. If a rail is determined to have an end defect, the Contractor shall either crop or replace the rail.

3.11.2.5 Joint Gap

Where pull-aparts have occurred, whether currently gapped or not, or where the rail joint gap exceeds 19 mm 3/4 inch, the joint gap shall be adjusted to the rail joint gap specified in TABLE VI. Rail joint gap adjustment work shall be performed in conjunction with spot rail replacement work and bolt renewal work.

3.11.3 Spiking

The proper gage, as indicated in this section, shall be verified immediately prior to spiking.

3.11.4 Spot Tie Replacement

The Contractor shall replace defective ties as marked in the field and as directed by the Contracting Officer.

3.11.4.1 Paint Markings and Tie Inspection

Paint markings may exist on the existing rails and crossties. Such markings do not necessarily indicate work within the scope of the contract. The Contractor shall participate in a walk-through tie inspection with the Contracting Officer prior to commencement of tie replacement work. The scope of the tie replacement work will be determined at that time and relevant paint markings made or touched up as required.

3.11.4.2 Additional Tie Work

In areas where existing ballast inhibits tie inspection, additional ties may be required beyond those marked. The scope of such additional tie work will be identified by the Contracting Officer as adjacent work progresses.

3.11.4.3 Old Spikes, Rail Anchors, tags and Tie Plates

Old spikes shall be pulled and scrapped. Rail anchors shall be removed, sorted, and salvaged. Tie plates shall be removed, inspected and classified as either relay or scrap. Scrap tie plates shall be marked scrap and shall not be reinstalled in the track. Acceptable relay tie plates may be reused at that location or at other locations as required. Old stationing tags will be removed and replace on the new tie.

3.11.4.4 Humped Track

Where the track will not be surfaced, in order to prevent permanent distortion ("Humping") of the line and surface of the track when performing spot tie replacement, the tie cribs and ends shall be excavated, the old ties removed, and the new ties installed without jacking the rails. Humped track shall be resurfaced at the Contractor's expense.

3.11.4.5 Minimal Humping

For spot or out-of-face tie replacement, where the track will be surfaced and aligned under this Contract, a minimal amount of humping will be allowed, provided the surfacing tolerances can be met.

3.11.4.6 Fouled or Muddy Ballast

Fouled or muddy ballast, as identified by the Contracting Officer, shall be excavated and wasted outside of the track area where it will not interfere with drainage of the track.

3.11.4.7 Insertion of New Ties

New wood ties shall be inserted in track with the heartwood down, square to the line of the rails. Engineered polymer composite ties shall be inserted with the flat (tie plate) surface up, square to the line of the rails.

a. Ties shall be inserted so that the average tie spacing in any one rail length does not exceed 530 mm 21 in and so that the maximum spacing between any two ties does not exceed 610 mm 24 in and the

maximum spacing is not less than 460 mm 18 in.

b. Crosstie position at joints shall result in a "suspended joint" arrangement unless otherwise directed by the Contracting Officer.

3.11.4.8 Positioning of Tie Plates

Tie plates shall be positioned on the tie so that the shoulder has full bearing against the base of the rail. The plate shall be centered on the tie width, except that the plate shall be positioned up to 13 mm 1/2 in off-center if necessary to avoid spiking into an existing tie split. The Contractor shall ensure that all tie plates in a given stretch of track are either canted or flat. Canted and flat tie plates shall not be mixed within a given stretch of track.

3.11.4.9 Re-spacing of existing ties

Re-spacing of ties is required to straighten slewed ties or to correct uneven tie spacing. Crib and shoulder ballast shall be removed as required to facilitate sliding crossties to their final position or to insert new ties. Spike mauls or sledges shall not be used to slide ties. Rail anchors and ballast shall be installed immediately after ties are re-spaced.

3.11.4.10 Track Gage

Track gage shall be set at the time of spiking.

a. Tangent Track. For track rehabilitation or spot rail replacement on tangent, the track shall be regaged if the existing gage is less than 1420 mm 56 in or is equal to or greater than 1460 mm 57-1/2 in. These sections of track shall be regaged to conform with the gage of the adjacent track, but the gage after regaging shall be between 1430 and 1450 mm 56-1/4 and 57 in.

b. Curved Track. Curved track shall be gaged as shown in TABLE V.

3.11.5 Joint Respiking

Many joints in track will be found with nonstandard spiking patterns and other deficiencies. These include joints with no tie plates, plates which are positioned so that it is not possible to spike through the plate on both sides of the joint, spikes driven against the ends of skirted joint bars, and similar deficiencies. The Contractor shall respike such joints in accordance with the following.

3.11.5.1 Substitution of Tie Plates

When tie plates are available which will permit spiking through the tie plate at the edge of the joint bar skirts on both sides of the rail, they shall be substituted for existing plates.

3.11.5.2 Respiked Joints

All joints which are respiked shall have existing spike holes plugged.

3.11.6 Regaging

Where the existing track gage is less than 1420 mm 56 in or is equal to or grater than 1460 mm 57-1/2 in, or as designated by the Contracting Officer,

the track shall be regaged. These sections of track shall be regaged to conform with the gage of the adjacent track; the track gage after regaging shall be between 1430 and 1450 mm 56-1/4 and 57 in.

3.12 SAMPLING AND TESTING

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by an approved commercial testing laboratory, or by the Contractor, subject to approval. If the Contractor elects to establish testing facilities, approval of such facilities shall be based on compliance with ASTM D 3740. Work requiring testing will not be permitted until the Contractor's facilities have been inspected and approved. The first inspection of the facilities will be at the expense of the Government and any subsequent inspections required because of failure of the first inspection shall be at the expense of the Contractor. Such costs will be deducted from the total amount due the Contractor.

3.12.1 Ballast [and Subballast] Samples

Periodic sampling and testing of ballast [and subballast] material shall be performed to ensure continued compliance with this specification. During construction, one representative sample of the ballast [and subballast] material shall be taken from each 1818 metric tons 2,000 tons of ballast [and subballast] delivered to determine the material gradation. For each 9090 metric tons 10,000 tons or a fraction thereof of ballast delivered, an additional amount of material shall be obtained in order to perform the quality and soundness tests specified. Samples for material gradation, quality, and soundness tests shall be taken in conformance with ASTM D 75. Test samples shall be reduced from field samples in conformance with ASTM C 702. Sample sizes shall be sufficient to provide the minimum sample sizes required by the designated test procedures. If any individual sample fails to meet the gradation requirement, placement shall be halted and immediate corrective action shall be taken to restore the specified gradation. If any individual sample fails to meet the specified quality and soundness requirements, placement shall be halted and immediate corrective action shall be taken to restore the specified quality.

3.12.2 Ballast [and Subballast] Tests

3.12.2.1 Sieve Analyses

Sieve analyses shall be made in conformance with ASTM C 117 and ASTM C 136. Sieves shall conform to ASTM E 11.

3.12.2.2 Bulk Specific Gravity and Absorption

Bulk specific gravity and absorption tests shall be made in conformance with ASTM C 127.

3.12.2.3 Percentage of Clay Lumps and Friable Particles

The percentage of clay lumps and friable particles shall be determined in conformance with ASTM C 142.

3.12.2.4 Degradation Resistance

Resistance to degradation of materials shall be determined in conformance with ASTM C 131 and ASTM C 535. Materials with gradations having 100 percent passing the 25 mm 1 in sieve, shall be tested in conformance with

ASTM C 131. Materials having gradations with particles larger than 25 mm 1 in shall be tested in conformance with ASTM C 535.

3.12.2.5 Soundness Test

Soundness tests shall be made in conformance with ASTM C 88.

3.12.2.6 Percentage of Flat or Elongated Particles

The percentage of flat or elongated particles shall be determined in conformance with ASTM D 4791.

3.12.3 Tie Inspection

The Contractor shall be responsible for the quality of the treated ties. Each tie shall be permanently marked or branded by the producer in accordance with AWPA M6. Each treated wood tie shall be inspected, in accordance with AWPA M2, for conformance with the specified AWPA standards. The 100 percent inspection shall be performed by an independent inspection agency approved by the Contracting Officer. Inspection shall be made at the wood treatment site. The agency's report of inspection shall accompany delivery of the ties. The Contractor shall core and check preservative treatment once per 1000 ties delivered to the construction site.

3.12.4 Examination of Geotextile

****

NOTE: The amount of geotextile being installed and the criticalness of the installation determine the size and scope of the geotextile testing and quality control/quality assurance program. Small jobs with minor importance may not warrant extensive preconstruction testing of the geotextile, and the manufacturer's Certificate of Compliance may be adequate for assuring that the physical properties are met. However, for large projects and critical installations, regardless of size, a complete regimen of preconstruction and quality control testing should be specified.

****

[The Contractor shall sample the geotextile upon delivery to the project site. Sampling procedures used shall be those detailed in ASTM D 4759and ASTM D 4354 with the number of sample units selected from TABLE II of ASTM D 4354. An independent testing laboratory shall perform the index property tests specified in TABLE II on each of the sample units and determine conformance with the minimum requirements of TABLE II. Conformance shall be determined in accordance with ASTM D 4759.] [Geotextile seams expected to perform a reinforcement function shall be tested in accordance with ASTM D 4595.] The Contracting Officer may examine any geotextiles for defects, damage, or nonconformance prior to installation. Any geotextile not meeting the minimum property requirements of paragraph GEOTEXTILE, or geotextile that is determined to be damaged or defective shall be removed from the site and shall be replaced with additional geotextile meeting the requirements of this specification at no additional cost to the Government.

3.13 INSPECTION AND FIELD TESTING

Quality control inspection and field testing shall be performed by the Contractor.

3.13.1 Track

Inspection shall be performed to ensure that all the requirements of these specifications are met. Bolted joints shall be inspected for loose bolts and for smooth transitions between rails of different sections. Rail, tie plates, and ties shall be checked to ensure that the rail is properly seated and has full bearing on the tie plate and tie. Upon completion of construction, measurements of track gage, cross level, and alignment shall be taken and recorded at least once every [30] [60] [_____] m [100] [200] [_____] feet of track centerline length. A copy of these measurements shall be provided to the Contracting Officer.

3.13.2 Welded Joints - Visual Inspection

Quality control inspection and field testing shall be performed by a technician certified to meet ASNT CP-189 level II or III qualifications with a minimum of one year experience in testing rail for defects. Each welded joint shall be inspected by the Contractor in the presence of the Contracting Officer after removal of the mold and grinding of excess metal. The Contractor shall pay particular attention to surface cracking, slag inclusion, gas pockets, and lack of fusion. The Contractor shall correct or replace, at no extra cost to the Government, any weld found defective. The method of correction shall be as approved by the Contracting Officer.

3.13.3 Electric Arc Welding Inspection

Electric arc welds shall be inspected to determine that the item welded conforms to the desired contour and contains no visible cracks or voids.

3.13.4 Thermite Weld Joints Testing

Each thermite weld joint shall be [ultrasonically tested] [dye tested] following the visual inspection. The method of inspection and acceptance shall be in accordance with AWS D1.1/D1.1M. The Contractor shall correct or replace defective welds, at no additional cost to the Government. The method of correction shall be as approved by the Contracting Officer. Ultrasonic testing [shall] [will] be performed by the [Contractor] [Government] after the rail has been installed in track. The testing will determine whether or not each weld meets the criteria of paragraphs Gap and Alignment, Weld Finishing and Tolerances, and Weld Quality. Welds made in the track which the Contracting Officer determines to be unacceptable shall be cut out of the rail and replaced by a section of new rail and two new welds. Saw cuts shall be made at least 150 mm 6 in from the centerline of the faulty weld. Replacement welds and replacement rails shall be at the sole expense of the Contractor. Replacement welds shall be renumbered as indicated. Replacement welds made in track [shall] [will] be ultrasonically tested.

3.13.5 Electric Arc Weld Testing

The welds shall be visually inspected and the contours checked after completion and later tested by the ultrasonic method. The [Government will] [Contractor shall] have the welds tested by the ultrasonic method. The testing will determine whether or not each weld meets the quality

criteria. Defective welds will be removed and the item rewelded at the Contractors expense.

3.13.6 Inspection of Geotextile

At the direction of the Contracting Officer, the Contractor shall remove the cover material from the geotextile at 3 locations per km mile so that the geotextile may be inspected for damage. At each location, the cover material shall be removed to expose a 1.2 by 1.2 m 4 by 4 feet section of the geotextile. If punctures, tears, improper installation, other impairment or damage are found within this section, additional sections shall be excavated to determine the extent of the damage. Damaged geotextile shall be repaired or replaced and recovered with ballast/subballast at the Contractor's expense.

3.13.7 Testing Relay Rail

3.13.7.1 Testing for Wear

Each relay rail shall be checked for wear by the Contractor's quality control representative in the presence of the Contracting Officer after the material is delivered to the construction site. The Contractor shall monitor the installation of track for defects in rail and joint bars being installed. Rail and joint bars that are found to be defective shall not be installed in track.

3.13.7.2 Testing for Defects

Upon completion of the track construction, the Contractor shall have the rail tested by ultrasonic methods. Ultrasonic testing shall be done by a Contractor normally engaged in this type of testing with a minimum of 5 years of experience. The Contractor shall schedule a rail testing machine and notify the Contracting Officer of the type of machine and schedule. Contractor furnished rails which are found to have any detectable defect at that time shall be removed and replaced by the Contractor at no additional cost to the Government. Contractor furnished joint bars and compromise joint bars that are found to be cracked or broken shall be removed and replaced at no additional cost to the Government.

TABLE VII

RECORD OF ITEMS REPAIRED OR REBUILT BY THE ELECTRIC ARC WELDING METHOD AND GRINDING

INSTALLATION _____ TURNOUT NUMBER _____

(Circle)

DATE_____ TIME_____AM/PM AIR TEMP _____C* WEATHER_____

ITEM REBUILT	DESCRIPTION	WEIGHT	LENGTH	LH RH	REINFORCED
Switch Point	[_____]	[_____]	[_____]	[_____]	[_____]
Frog	[_____]	[_____]	[_____]	[_____]	[_____]
Railroad Crossing	[_____]	[_____]	[_____]	[_____]	[_____]
Guard Rails	[_____]	[_____]	[_____]	[_____]	[_____]

TABLE VII

RECORD OF ITEMS REPAIRED OR REBUILT BY THE
ELECTRIC ARC WELDING METHOD AND GRINDING

INSTALLATION _____ TURNOUT NUMBER _____

(Circle)

DATE_____ TIME_____AM/PM AIR TEMP _____C* WEATHER_____

ITEM REBUILT	DESCRIPTION	WEIGHT	LENGTH	LH	RH	REINFORCED
Switch Point Protector	[_____]	[_____]	[_____]	[_____]		[_____]
Rail (Ends)	[_____]	[_____]	[_____]	[_____]		[_____]
Rail-Engine Burns	[_____]	[_____]	[_____]	[_____]		[_____]
[_____]	[_____]	[_____]	[_____]	[_____]		[_____]

*NOTE: Determination will be made to the nearest 1/2 degree.

RECORD OF FIELD WELD

INSTALLATION_____ WELD NUMBER _____

FINAL INSTALLED
LOCATION _____ TRACK _____
STATION _____ RAIL Left Right (Circle)

DATE _____ TIME _____ AM PM (Circle)

AIR TEMPERATURE _____ F*. WEATHER _____
RAIL TEMPERATURE _____ F*. _____

WELD KIT MANUFACTURER _____
RAIL GAP
NEAREST 1.6 MM 1/16 IN _____
RAIL CUT REQUIRED? YES NO (Circle)
BACK RAIL
MANUFACTURER _____ USED RAIL? YES NO (Circle)
YEAR/MONTH ROLLED _____ HEAT NUMBER _____
_____

AHEAD RAIL
MANUFACTURER _____ USED RAIL? YES NO (Circle)
YEAR/MONTH ROLLED _____ HEAT NUMBER _____
_____

REMARKS_____
_____
_____

ULTRASONIC TEST DATE & RESULTS _____

KIT MFG. REPRESENTATIVE
PRESENT _____ WELDING FOREMAN _____
(Initial) (Signed)

CONTRACTING OFFICER'S
REPRESENTATIVE
PRESENT _____ RECORDER _____
(Initial) (Signed)

_____ RECORDER _____
(Initial) (Signed)

FOR GOVERNMENT USE ONLY

ULTRASONIC TEST DATE AND RESULTS _____

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*NOTE: Determination will be made to the nearest 1/2 degree.

-- End of Section --