TECHNICAL SPECIFICATIONS

FOR

INSTALL TWO (2) RAILROAD CROSSING GATES AT BIMT

Project No.: B2021-10

Contract No.: C-1791

BLOUNT ISLAND MARINE TERMINAL

Division 34 **Transportation**

SECTION 341125 - RAILROAD TRACK BALLAST

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes the requirement for grading and other significant physical properties of mineral aggregates for prepared track ballast. The suppliers governed by this specification, shall have, or establish a quality system that complies with DOT, AAR Specification for Quality Assurance, M1003 (AAR M-1003), or International Quality Standard ANSI 9000 Series (ISO 9001).

B. Related Requirements:

1. Section 012100 "Allowances" for products selected under an allowance.

PART 2 – PRODUCTS

2.1 TYPES OF BALLAST

A. Quarried Granite, Trap Rock, and Dolomite Limestone produced in a crushing-screeningplant designed to satisfy the specifications listed herein.

2.2 GENERAL REQUIREMENTS

A. The type and sizes of prepared ballast shall be designated by the Owner in conformance to approved standards. The mineral aggregate shall be clean, hard, durable, free from any frozen lumps, deleterious matter, and harmful adherent coatings. No materials subject to regulation as hazardous wastes as defined in the administrative code of the state where thematerial will be used shall be allowed.

2.3 HANDLING

A. Processed ballast shall be handled at the producing plant in such a manner that it is kept free from segregation. It shall be loaded only into trucks/railcars which are clean and freefrom rubbish or any substance that would foul or damage the ballast. The producer shouldnot make repeated passes of equipment over the same levels in stockpiled ballast.

B. Track ballast shall be washed prior to loading in truck/railcars.

PART 3 - EXECUTION

3.1 INSPECTION

A. The Owner reserves the right to reject any car of ballast arriving at the site for unloading that does not conform to the specification as determined by methods of test.

B. If material loaded does not conform to these specifications, the Chief Engineer must notifythe supplier to stop loading until the fault has been corrected and to dispose of all defectivematerial without cost to the Owner.

3.2 TESTING

A. Determinations of deleterious substances resistance to abrasion and soundness shall bemade at a testing laboratory approved by the Chief Engineer. These tests will be conducted when adding a new supplier, renewing contract, opening a new quarry or strata, and at least annually. It is the supplier's responsibility to furnish copies of the annual test results and AAR M-1003, ISO 9001, or DOT certification to Chief Engineer.

B. Visual inspections and gradation test shall be made at the place of production prior to shipment as often as considered necessary. (Minimum of 1 sample per 1000 tons of ballast produced but may be reduced if material consistently meets specification.) Gradation test results will be transmitted by e-mail to Owner's Chief Engineer for validation. The reports shall be forwarded in a consolidated monthly summary of testsin an electronic format such as Excel. The supplier shall retain the details of gradation for a minimum of one year after the test is performed.

C. Railroad retains the right to conduct on-site inspection for compliance to this specification. Deviation from these requirements will require the supplier to utilize anOwner prescribed five step corrective action process designed to identify and permanently eliminate the root cause(s) of the problem.

- Define the problem.
- Fix the problem.
- Identify the root cause of the problem.
- Implement corrective action to eliminate the root cause.
- Establish a follow-up plan to assess effectiveness and permanence.

Ineffective corrective action plans can result in the supplier being removed from the Owner approved supplier list.

D. Samples of the finished product for all tests shall be representative and of sufficient weight for testing.

3.3 QUALITY ASSURANCE REQUIREMENTS

A. Deleterious substances shall not be present in prepared ballast in excess of the following amounts:

1. Material finer than No. 200 sieve (Track ballast only) = 1%Clay lumps and Soft or Friable pieces = 0.5%

2. (If clay lumps and soft or friable pieces exceeds 0.5%, the supplier must test and certify that clay lumps do not exceed 0.5% and soft or friable pieces do not exceed2%. Action plan must be submitted to reduce this material.)

B. The percentage of wear of prepared ballast tested in the Los Angeles Machine shall not be greater than:

Granite = 32%

Dolomite = 28%

Except as otherwise specified by Owner.

C. Granite ballast is predominately considered the Owner Standard. Any deviation mustbe approved by the Owner's Chief Engineer. The following guidelines should be followed in determining the type of ballast application for each territorial location:

1. Granite ballast should be used on lines having tonnage in excess of 10 MGT annually.

2. Dolomite Limestone will not be used on Owner owned tracks without adeviation approved by the Owner's Chief Engineer. Dolomite Limestone ballast with maximum 28% loss (L.A. abrasion) can be used on lines having less than 10 MGT annually.

3. Dolomite = $MgCo^3$ More Than 36% - Approved Dolomite Limestone = $MgCo^3$ 28-36% - Approved Limestone = $MgCo^3$Less Than 28% - Not Approved Slag Ballast - Not Approved

D. It is the Chief Engineer's responsibility to evaluate annual tonnage application when ordering weekly ballast requirements (based on the above guidelines). The Owner's Chief Engineer's office will determine the best solution to be administered.

E. The soundness of prepared ballast for use in regions where freezing temperatures are expected shall be such that when tested:

1. In the sodium sulfate soundness test, the weighted average loss shall not be in excess of 7% after 5 cycles; or

2. In the magnesium sulfate soundness test, the weighted average loss shall not bein excess of 11% after 5 cycles.

3.4 GRADING REQUIREMENTS

A. The grading of prepared track ballast shall be determined by test with laboratory sieves having square openings and conforming to current ASTM Specifications, Designation E- 11.

3.5 PREPARED RAILROAD TRACK BALLAST AND SUB-BALLAST FOR OWNERSHALL CONFORM TO THE FOLLOWING GRADING REQUIREMENTS

SCREEN SIZE	MAIN LINE AREMA #4A	YARD AREMA #5
2-1/2"	100%	
2"	90 - 100%	
1-1/2"	60 - 90%	100%
1"	10 - 30%	90 - 100%
3/4"	0 - 10%	40 - 75%
1/2"		15 - 35%
3/8"	0 - 2%	0 - 15%
NO. 4		0 - 5%
NO. 8		
NO. 10		
NO. 60		
NO. 200		

3.6 METHODS OF TEST

A. The supplier shall certify the ballast delivered to the Owner is typical of that upon which specified tests have been made.

B. Samples shall be secured in accordance with the current ASTM methods of sampling. Designation D-75.

C. Sieve analysis shall be made in accordance with current ASTM method of test. Designation C-136.

D. Material finer than the No. 200 sieve shall be determined in accordance with the current ASTM of test. Designation C-117.

E. The percentage of clay lumps and soft particles shall be determined in accordance with the current ASTM method of test. Designation C-142.

F. The resistance to abrasion shall be determined in accordance with the current ASTM method of test. Designation C-131, or C-535, using the standard grading most nearly representative of the size of ballast specified.

G. Soundness test shall be made in accordance with the current ASTM method of test. Designation C-88.

H. The weight per cubic foot shall be determined in accordance with the current ASTM method of test. Designation C-29.

3.7 SUBMITTALS

A. Submittals will be reviewed for general conformance with the intent of the Contract Documents. This review will not relieve the Contractor of final responsibility for the means, methods, procedures, and sequences to be utilized.

B. Submit name and location of proposed ballast supplier.

C. Submit name and qualifications of testing laboratory.

SECTION 341126 - WELDING OF RAIL

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Contractor shall be responsible for all aspects of the rail de-stressing process, including, but not limited to: thermal expansion calculations, rail cutting and removal, marking and recording quarter points and rail temperatures, thermal expansion of rail, furnishing and installing temporary 6-hole joint bars, furnishing, furnishing and installing thermite welding of all joints, testing and documentation related to thermite welding and CWR heat records for installation/de-stressing documentation of CWR.

B. Related Requirements:

1. Appendix A – MWI 801-09 Welding Manual

2. Appendix B – Continuous Welded Rail

1.3 GENERAL

A. The work specified in this section shall include the fabrication of continuous welded rail (CWR) strings and all other welding of running rail, including testing, inspection, transportation of rail andCWR, and qualification of welding and welders. Rail welds shall be of two types:

1. Electric Flash-butt Welds: Tee rail for tracks outside the limits of special trackwork shall be welded into continuous strings using the electric flash-butt welding process.

2. Thermite Welds: Thermite welds shall be used only where it is impractical to perform Electric Flash-butt Welds, usually in the following locations: joining continuous welded rail strings; joining rails of different rail sections (compromise welds).

B. Electric Flash-butt welding may be performed using either a fixed electric flash-butt welding plant or a mobile welding machine designed for rail welding.

C. Electric flash-butt welds may be substituted for thermite welds, where applicable.

1.4 REFERENCE STANDARDS

A. CSX Maintenance of Way Regulation and Instruction Maintenance of Way, Welding Manual MWI801-09

B. American Railway Engineering and Maintenance of Way Association (AREMA) Manual for Railway Engineering, Vol. 1A, Chapter 4, Part 3:

1. Section 3.10 - Specification for the Quality Assurance of Electric-Flash Butt Welding of Rail

2. Section 3.11 - Specification for Fabrication of Continuous Welded Rail

3. Section 3.12 – Inspection and Classification of Secondhand Rail for Welding

4. Section 3.13 - Specification for the Quality Assurance of Thermite Welding of Rail

C. American Society for Testing and Materials (ASTM International):

1. ASTM E164 – Standard Practice for Contact Ultrasonic Testing of Weldments

2. ASTM E1032 - Standard Test Method for Radiographic Examination of Weldments

3. ASTM E709 - Standard Guide for Magnetic Particle Testing

D. American Welding Society (AWS) D1.1 Structural Welding Code - Steel

E. American Society for Nondestructive Testing (ASNT) Recommended Practice No. SNT-TC-1A Personnel Qualification and Certification in Nondestructive Testing

1.5 SUBMITTALS

A. General:

1. Ultrasonic inspection procedure, equipment description and calibration methods and procedure for dry powder magnetic particle inspection.

2. Magnetic particle and ultrasonic inspection records for each weld.

3. Inspection records of each weld for straightness as per AREMA requirements.

4. Daily calibration of ultrasonic inspection equipment.

5. Certification of ultrasonic and magnetic particle test personnel.

6. Testing Laboratory: Employ an independent testing laboratory which shall perform all indicated weld testing.

7. Quality Control procedures to be followed.

B. Electric Flash-butt Welds:

1. A list of all equipment and calibration methods, method of rail end alignment, method of rail straightening, and a schedule of lengths of rail strings to be fabricated. The schedule of lengthsof rail strings shall include the location of any insulated joints within the string.

2. Welding Machines Performance: Submit Electric Flash-butt welding machine performance standards as provided by the manufacturer. During welding production, a recorder shall be attached to each welding machine to record platen movement and current impulses on the form"Record of Field Welds", a copy of which is attached to the end of this Specification. A recordof machine performance for each weld shall be submitted to the Design Engineer. If the record indicates performance which is not in conformance with the approved standards, the weld willbe considered defective and shall be rejected.

3. Details of the equipment and procedure proposed for straightening welds if required.

C. Thermite Welds:

1. The method and procedure specified shall comply with that of the weld kit manufacturer and shall include the name of the manufacturer and details of the operations. The manufacturers recommended procedure for welding high strength rail if different from requirements for standard rail.

2. Submit detailed procedure specification of the step-by-step methods to be employed in making the welds for review and approval by Engineer. Include complete description of each of the following items:

   a. Manufacturer's trade name for the welding process.

   b. Method used for cutting and cleaning the rail ends.

   c. Minimum and maximum allowable = rail gap between ends prior to welding.

   d. Methods used for cleaning multiple-use crucibles and removing moisture, and the procedures for tracking the number of welds made. Cleaning methods and moisture removal procedures for single-use crucibles are not required.

   e. Method used for pre-heating, including time and temperature.

   f. Method used for removing the upset metal and finishing the weld to the final contour, including am description of special tools and equipment.

   g. Quality control procedures.

3. Submit welder qualifications and certification from weld-kit manufacturer for Engineer's approval.

4. Record of Thermite Welds: Maintain a complete and current record of all thermite welds and their locations.

PART 2 – PRODUCTS

2.1 RAIL FOR CONTINUOUS WELDED RAIL

A. Rail for the Work shall be furnished in accordance with the CSX Maintenance of Way Regulation and Instruction Maintenance of Way, Welding Manual MWI 1101-05 CSX Maintenance of Way Regulation and Instruction Maintenance of Way, Welding Manual MWI 801-09

2.2 THERMITE WELDING MATERIALS

A. Thermite type rail welds shall be formed utilizing one of the following brands of rail welding kits oran approved equal.

1. Thermit - as manufactured by Orgo-Thermit, Inc., Manchester, New Jersey.

2. Boutet - as manufactured by Railtech Boutet, Inc., Napoleon, Ohio.

B. The rail welding kits used when welding fully heat treated (or head hardened) rail shall conform to the process manufacturer's recommended standard for such work.

PART 3 - EXECUTION

3.1 QUALITY CONTROL

A. Rail Straightness: Check rail for end straightness before welding. Examine both ends and tops of allrails using a 3 foot metal straightedge. Deviations from straight shall be measured with a metal tapergauge. Rails which are at or exceed the tolerances in AREMA Chapter 4, Part 2, Specifications forSteel Rails, Sections 2.1.13.1.c through 2.1.13.1.e shall not be welded.

B. Qualification of Testing Technician: Testing shall be performed by a technician certified to have met ASNT procedure SNT-TC-1A, Level II or III qualifications.

C. Field Testing: Production flash-butt and/or thermite welds shall be visually, magnetic particle and ultrasonically tested in the field for defects in accordance with paragraphs D and E below. Visual testing will be in accordance with AREMA standards. Any rail weld showing surface cracks will be rejected.

D. Magnetic particle testing shall be performed in accordance with ASTM E709. Testing shall be conducted with the rail temperature below 800oF. Acceptance Criteria: Particles shall form a regular longitudinal pattern indicating homogeneity of the weld and freedom and defects, surface irregularities and internal discontinuities.

E. Ultrasonic Testing:

1. Ultrasonic inspection of welds shall be performed in accordance with ASTM E164. Prior to testing of welds, the technician certified in accordance with ASNT procedure SNT-TC-1A, Level II or III shall be tested to ensure his ability to detect defects in rail. The test shall be conducted with the calibration rail as specified below serving as the test specimen. The technician shall locate all the holes in the calibration rail by ultrasonic testing. This test will beobserved by an independent technician, certified in accordance with ASNT procedure SNT-TC-1A, Level II or III and experience in ultrasonic examination of rail welds. Failure to pass this test will result in the disqualification of the technician.

2. The following equipment shall be used for ultrasonic testing:

   a. Ultrasonic, pulsed echo, instrument normally used for inspection of rails with calibrated decibel gain control of minimum 2db increments, operating in the range 1-5 MHz, with CRT screen and scale. Equipment shall be capable of detecting a 3/64-inch discontinuity 6-1/2 inches below top of rail.

   b. Calibrated paper tape recording attachments to record accurately the CRT screen indications when a non-complying weld is located.

   c. 2.25 MHz angle beam transducers 1/2" x 1" at 70 degrees and 45 degrees.

   d. Suitable high viscosity couplets of good wetting characteristics.

   e. Standard IIW calibration blocks of rail steel for primary reference response and to construct distance-amplitude correction curve, and DSC Blocks of rail steel for calibration checks.

f. A "calibration rail", a piece 136RE rail, 18 inches long with a 3/64-inch diameter round bottom hole 6-1/2 inches below top of rail and in which other 1/8-inch diameter flat bottomhole patterns have been drilled.

3. Incorporate the following in the test procedure:

a. Scanning level shall be +20 dB minimum.

b. Scan the rail in a zigzag pattern twisting probe, on one side of the weld only at a rate not exceeding 6 inches per second, so that the full weld is scanned. Each pass will overlap a minimum 10 percent and the scanning is carried out longitudinally to the rail.

c. Calibrate the equipment at the start and end of each day's work, and at least every four hours during examination, and hourly checks with DSC blocks. If any point on the distance-amplitude curve has been changed by more than 20 percent, all results since last calibrationcheck shall be void and all welds re-examined. If the curve has moved on the sweep line bymore than five percent, all non-complying welds since last calibration check shall be re- examined.

d. When a reflection of greater amplitude than the acceptance criteria is found, scan around thefull perimeter of the weld from both sides, to ensure full weld coverage and determination of size, type, and location of discontinuity.

e. Make permanent trace recording of discontinuity indications.

f. Paint the rail web at non-conforming welds on both sides across the weld.

4. All welds shall be free from defect or flaw giving a reflected display of greater than 20% of distance-amplitude correction curve at calibration level or will be as listed in Table 1.

B. TABLE 1

C. MINIMUM ACCEPTANCE LEVELS (DECIBELS)

D. WELD THICKNESS (in.) AND TRANSDUCER ANGLE

REFLECTOR	**5/16 TO 3/4**	**3/4 TO 1-1/2**	**1-1/2 TO 2-1/2**		**2-1/2 TO 4**		**4 TO 6**	
SEVERITY	**70°**	**70°**	**70°**	**45°**	**70°**	**45°**	**70°**	**45°**
Large Reflectors	+8	+3	-1	+4	-4	+1	-7	-2
Small Reflectors	+9	+4	+1	+6	-2	+3	-5	0
Minor Reflectors	+10	+5	+3	+8	0	+5	-3	+2

1. Use an ultrasonic test report form that records 20 inspected welds per sheet. The form shall include the location of the weld in track, the results of the ultrasonic inspection including size of defects found in the head, web or base of rail, shape identity and location of all reflections, trace record, the results of the visual inspection, name of inspector, and other information as needed. Welds found defective by ultrasonic, magnetic particle, or visual inspection shall be replaced at no expense to Owner/Railroad.

3.2 PREPARATORY WORK FOR ALL WELDS

A. Rail, which must be cut for any reason shall be cut square and clean by means of rail saws or abrasive, cutting wheels in accordance with AREMA Chapter 4, Part 2, Specifications for Steel Rails. Torch cutting of rails is prohibited. Rail ends not within 1/32 inch of square shall be cut square.

B. Rails shall conform to the AREMA Chapter 4, Part 2, Specifications for Steel Rails, for straightness. Rail ends shall show no steel defects, dents, or porosity before welding.

C. Clean rails to be welded of grease, oil, dirt, loose scale, and moisture to a minimum of six (6) inchesback from the rail ends, including the railhead surface. Use a wire brush to completely remove dirtand loose oxide, and use oxygen-acetylene torch to remove grease, oil, and moisture.

D. Rails shall be straightened cold in a hydraulic press or roller machine to remove twists, waves, andkinks until they meet the surface and line requirements specified herein before. The method of permanent straightening shall be submitted to Engineer for approval.

E. Rail that cannot be straightened permanently shall be cut back a sufficient distance to achieve the required alignment. Burrs shall be removed. The method of end finishing rails shall be such that therail end shall not be metallurgically or mechanically damaged.

F. Align the rail ends using a rail beam specifically designed for this purpose or a 36-inch straight edge.

G. Use a power grinder with an abrasive wheel to remove scale, rust, burrs, lipped metal, and mill brands which would interfere with the fit of the mold for two (2) inches on each side of the ends. Rail ends shall show no steel defects, dents, or porosity before welding.

3.3 FABRICATION OF CONTINUOUS WELDED RAIL (CWR) STRINGS

A. Welded rail strings shall be of the longest lengths practical to fabricate and handle. String length shall not be less than 700 feet except as required by the joint location, etc.

B. The schedule shall indicate which strings or which portions of strings will be high strength rail. The schedule shall indicate which strings or portions of strings will be "A" rails, if applicable.

C. The schedule shall indicate the locations of the proposed field cuts, if any. The rail schedule shall minimize thermite welds between standard rails and high strength rails.

D. No rail string containing "A" rails shall be fabricated until all rail has been received. All "A" rails shall be used in one string and shall be used in tangent sections of track.

3.4 ELECTRIC FLASH-BUTT WELDING

A. Electric Flash-butt welding shall be in accordance with the AREMA Chapter 4, Part 3, Specificationfor the Quality Assurance of Electric-Flash Butt Welding of Rail and Specification for Fabrication of Continuous Welded Rail except as modified hereinafter.

B. Mismatched or jagged rail ends shall be either sawed or cut with an abrasive rail cutter. Mating railends by flashing shall not be accepted.

C. Rails shall have the scale removed down to bright metal in areas where the welding current-carrying electrodes contact the rail. Grind down raised rail brands in electrode areas. The weld and adjacentrail for a distance clearing the electrodes shall be rejected if in the areas of electrode contact there isnot more

than 95 percent of the mill scale removed. Electrode contact areas shall be examined forevidence of electrode burn. Where metal is displaced or where the oxidized areas exhibit checks orsmall cracks the weld shall be rejected, and the rail cut back clear of the electrode burn.

D. Welds shall be forged to point of refusal to further plastic deformation and shall have a minimum upset of 1/2-inch, with 5/8 inch as standard.

E. If flashing on Electric Flash-butt welds is interrupted, because of malfunction or external reason, with less than 1/2-inch of flashing distance remaining before upsetting, rails shall be reclamped in the machine and flashing initiated again.

F. Whenever possible, grinding shall be accomplished immediately following welding at an elevated temperature. When grinding must be done at ambient temperature, care shall be taken to avoid grinding burns and metallurgical damage.

G. Alignment of rail in the welding machine shall be at the head of the rail.

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

2. Horizontal alignment shall be accomplished in such a manner that any difference in the width ofheads of rails shall be divided equally on both sides of the head. Where the difference, when divided, exceeds 0.040 inches, 0.020 inches of the difference shall be placed on the gauge sideand the remaining differences in the width of heads shall be on the field side.

3. In any case horizontal offsets shall not exceed 0.040 inch at the head and/or 0.125 inch at the base.

H. Surface and Gauge Misalignment Tolerances: Shall meet the alignment tolerances given in the AREMA Manual, Chapter 4, Part 3, Specification for Fabrication of Continuous Welded Rail.

I. If, at any time, 7 or more of a series of 12 consecutive welds made on one machine exceed 75 percent of the stated surface misalignment tolerances that machine shall be shut down and adjustedbefore work continues.

J. Re-welds shall be cut out beyond the heat affected zone of the previous weld.

K. Weld Finishing:

1. A finishing deviation of the parent section of the rail head surface shall not exceed plus 0.010inch of the lowest rail.

2. The sides of the rail head weld shall be finished to plus or minus 0.010 inch of the parent section. The top and bottom of the rail base shall be finished to within 0.010 inch of the lowestrail.

3. The web zone including the underside of the head, the web, and both fillets on each side, shallbe finished to within plus 0.090 inch to plus 0.010 inch of the parent section. Finishing grindingshall eliminate all cracks.

4. Notches created by minor offset conditions, twisted or misshapen rails shall be eliminated by minimal grinding to blend the variations.

5. Fins on the weld due to grinding or shear drag shall be removed prior to final inspection.

L. One handling hole may be made in each end of a CWR string. Rail ends containing such holes shallbe cut off during track construction as indicated.

3.5 PRODUCTION, INSPECTION, AND TESTING OF ELECTRIC FLASH-BUTT WELDS

A. A chart recorder shall be used to monitor all significant welding parameters. The recorder shall identify each weld in each string. In addition, the rail schedule designation for each string shall beincluded on the recording with a notation to indicate the beginning and ending of each CWR string.Each recorder employed shall be calibrated daily. Recordings shall become the property of owner atthe time the welded rail is released for installation.

B. Inspect all electric flash butt welds by the dry powder magnetic particle method in accordance with ASTM E 709. Subsequently, inspect all electric flash butt welds ultrasonically in accordance withthese specifications.

C. Inspect all electric flash-butt welds in accordance with the AREMA Specifications.

D. Defective electric flash-butt welds shall be repaired immediately during production. Other defectiveweld findings shall be repaired as specified in the Repair of Defective Welds Section of this Specification.

E. Hardness - The hardness of the weld measured on the head of the rail in the center of the weld shallbe equal to the Brinell hardness of the parent metal with a tolerance of plus or minus 20 Brinell hardness numbers. Brinell hardness testing shall be conducted only on test welds by an approved Testing Technician.

F. Weld testing shall be carried out by an independent testing laboratory. The testing service and their testing program and procedures are subject to approval as specified herein.

G. The testing service shall certify whether or not each weld meets the quality acceptance criteria detailed and shall submit reports. At the time of testing the testing service shall mark their findingsas to acceptability or rejection on the weld itself.

H. Identifying Electric Flash-butt Welds and Rail Strings: At the completion of welding each string of CWR, a record shall be submitted documenting production of the string. Included shall be the heat numbers of the first and last pieces of rail in the string, the number of welds in the string, the heat numbers of rail on each side of welds which have been cut out and re-welded, a record of machine performance for each weld, and reports for all magnaflux and ultrasonic testing. Reports shall be bound in pad or notebook form for ease of handling and retention as permanent record.

3.6 THERMITE WELDING

A. CWR rail sections in track shall be joined in the field by thermite welding. Electric flash-butt weldsmay be substituted for thermite welds.

B. Except at Special Trackwork locations, thermite welds shall not be located within the following location:

1. Within 15 feet of a field weld in the same rail.

2. Within 15 feet from the center of any bolted or bonded (glued) joint.

3. Within 10 feet of a transition from embedded or direct fixation track to ballasted track.

4. Within 5 feet of an electric flash-butt weld.

C. Bolt holes and handling holes shall not be permitted to remain in the ends of the rail to be welded.Rail ends containing such holes shall be cut off during track construction.

D. Preparation of Rail Ends: Rail ends shall be either saw-cut or ground at right angles to the rail to provide a smooth and clean surface. The surface of the rails for a length of approximately 6 inchesfrom the end of the rails shall be cleaned by grinding to remove all grease, dirt, loose oxide, oxidized metal, scale, and moisture. All burrs and lipped metal which would interfere with the fit of the moldshall be removed.

E. Weld Gap: At the time of thermite welding, the rails shall have the rail gap recommended by the manufacturer of the weld kit and shall be aligned to produce a weld which, with respect to alignment, shall comply with the AREMA Specifications. Would the rail gap be larger than the manufacturer's recommended gap after the rails have been adjusted for zero thermal stress, then sufficient rail shall be removed from one or both rails to permit insertion of a rail not less than 19 feet long which shall provide the recommended gaps at each end for field welding. At a location where the rail gap is smaller than the manufacturer's recommended gap, the recommended gap shallbe obtained by sawing a piece from one rail.

F. Thermite Weld Pre-heating - The rail ends shall be pre-heated prior to welding to a sufficient temperature and for sufficient time as indicated in the approved welding procedure to ensure full fusion of the weld metal to the rail ends without cracking of the rail or weld.

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

H. Weld Finish: Rail shears shall be used to trim upset weld metal from the rail after removal of the mold. Trimming and grinding of the weld shall result in the weld being within the following tolerances:

1. The top, field and gauge side of the rail head shall be finished to within plus or minus 0.010 inchof the parent section.

2. Notches created by offset conditions shall be eliminated by grinding to blend variations. Protrusions and gouges in the welded area shall be removed, and the weld area shall be blendedinto the rail contour by grinding in a manner which will eliminate fatigue crack origins. Defectsvisible to the unaided eye shall be removed by grinding, except that if removal by grinding cannot be accomplished without damaging the rail, the weld shall be removed. Grinding pressure which would overheat the rail surface shall not be permitted.

3. Heavy grinding of the weld shall be completed while the weld is still hot from welding.

I. Inspect one out of every 10 thermite welds in standard track and two thermite welds in each item of special trackwork ultrasonically in accordance with AREMA Specification and CSX Maintenance of Way Regulation and Instruction Maintenance of Way, Welding Manual.

J. Defective thermite welds, as specified in section Defective Thermite Welds of this specification, shall be repaired as specified in section, Repair of Defective Welds of this specification.

K. Inspect all thermite welds utilizing magnetic particle testing procedures, testing only the head of the rail and in accordance with the Quality Control Section of this Specification; applicable AREMA specification sections; and CSX Maintenance of Way Regulation and Instruction Maintenance of Way, Welding Manual.

3.7 DEFECTIVE THERMITE WELDS

A. Defective thermite welds shall be determined as follows:

1. Weld quality, finishing alignment not in accordance with the above mentioned standards.

2. Welds showing a response at any level that is identified as a crack or lack of fusion shall not be acceptable.

3. Welds showing a response that is less than 50 percent of the primary reference level shall be acceptable.

4. Welds showing a response greater than 50 percent but that do not exceed the primary referencelevel are acceptable, provided that all of the following apply:

a. The defects are evaluated as slag or porosity.

b. The largest defect does not exceed 0.180 inch in its largest dimension.

c. The total area of the defects does not exceed 0.009 square inch.

d. The sum of the greatest dimension of defects in a line does not exceed 3/8-inch.

5. Welds showing a response that exceeds the primary reference level shall not be acceptable.

3.8 REPAIR OF DEFECTIVE WELDS

A. Electric Flash-butt welds rejected during final track inspection or testing by Rail Defect Car shall becut out and rewelded if possible or replaced with at least a 19-foot rail welded in its place by two thermite welds in accordance with this specification.

B. Thermite welds rejected during inspection or testing shall be cut out and rewelded if possible or replaced with at least a 19-foot rail welded in its place by two thermite welds in accordance with this specification.

C. Special Thermite Welds

D. Should a defective thermite weld replacement using an inserted piece of rail and two welds not be practical because of limitations due to adjacent special trackwork parts, Contractor shall cut out the defective weld and replace it with a special wide thermite weld. Prior to use in track this special weld shall be tested and accepted in accordance with applicable AREMA specification sections andCSX Maintenance of Way Regulation and Instruction Maintenance of Way, Welding Manual MWI801-09.

Appendix A

MWI 801-09
Welding Manual
Issued: 1/27/97 Revised: 9/29/17
Page 1 of 1

PURPOSE: To establish uniform procedures for all welders performing work for the Engineering Department on track appliances, buildings, bridges or other structures using the thermite, oxy-propane, or electric-arc methods of welding.

SAFETY: Observe all applicable Safety, Operating Rules and Regulations; and Safe Job Procedures.

LOCATION: All owner tracks and property.

ENVIRONMENTAL: Observe all applicable Federal, State and Local environmental rules and regulations.

I. DISCUSSION

A. The *Welding Manual* is prepared and issued to you for your benefit. It is your duty to study and understand it and perform your work in accordance with these instructions.

B. This manual should always be considered jointly with the other Rules, Regulations, and Instructions affecting the employees of the Engineering Department.

II. PROCEDURE

The *Welding Manual* follows:

Approved: _____

Welding Manual

ISSUED: March 21, 2007
Revised: September 29, 2017

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A. SAFETY

GENERAL

1. Safety is of the first importance in the discharge of duty. This section is intended to supplement the Owner's safety policy, not replace it.

2. The title Welder, as used in this Manual, is intended to include Welding Forman, Welder, Welder Helper, and those individuals specifically qualified by the Manager-Welding to operate a burning torch.

3. The Welder is responsible for compliance with the *Owner's safety policy*, this *Welding Manual*, and all other Owner policies. If the meaning of a rule or policy is uncertain or any conflicts between rules or policies exist, it must be brought to the attention of the Manager-Welding for explanation and resolution.

4. Job Briefings that cover welding, cutting, and grinding activities must include a fire prevention and response plan. Before stepping off the ballast line, check area for plants that may cause an allergic reaction and have insect spray applied.

5. Welding, cutting, and grinding will be done only by or under the direct supervision of a qualified employee. There are several categories of welding used by the Engineering Department. Employees must not do or supervise work in any category that the Manager-Welding has not qualified them for.

6. Protective clothing, shoes, and gloves, which will give the **full body protection**, must be worn during all welding, cutting, and grinding operations.

    a. Aluminum or shin guard protection leggings **that fully wrap around and cover the entire pant leg** must be worn for surface grinding with plate mounted or cup wheels. When combination leggings (welding leggings) are available, they may be used for all grinding, sawing, and torch cutting procedures. Aluminum or leather shin guard protection leggings must be used for other grinding work.
    b. Clothing must be kept free of grease, oil, and other flammable materials. When performing these operations, employees must keep shirt sleeves rolled down and collar fastened. Caution must be exercised at all times to keep sparks or slag from being caught in cuffs, pockets, sleeves, under gloves, and out of shoes, eyes, and ears. Frayed clothing must never be worn. Synthetic fabrics that are readily combustible must never be worn.
    c. Welding gloves must be worn during any welding or grinding procedure.

7. Safety glasses must be worn at all times. Employees observing, working near, or performing any grinding, welding, or cutting operations must wear necessary approved face shields, helmets, goggles with approved lenses, and cover glasses.

8. When possible, welding and/or cutting should not be done near combustible material. Either

the work or the combustible material should be moved to a safe place.

9. The use of cutting or welding equipment to perform maintenance work on or in a structure without authorization by or without the knowledge of the person in charge of the structure is prohibited.

10. When welding or cutting close to wooden beams, partitions, flooring, or scaffolding, a guard of sheet metal or other non-combustible material should be used. Fire resistant guard curtains (not tarpaulins) should be large enough, tight, and weighted down to prevent sparks rolling underneath or through openings. Every precaution must be taken to provide suitable protection against flying sparks. Before work is started, all surfaces in the area should be carefully cleaned of any readily ignitable material, and combustible surfaces, such as floors, partitions, etc., should be wetted down before the operation is started, and constantly wetted while the work is going on.

11. An employee should be assigned as a "fire watch" to extinguish fires started by sparks, molten metal, or hot slag. A careful inspection of the area, where hot work has been performed, must be made before leaving the work area to detect and extinguish any live sparks or smoldering fires.

12. Suitable fire extinguishers, readily accessible, in ample numbers in close proximity of where the equipment is being used, to provide a quick response. Before beginning grinding, if a water hose is provided, off track area must be dampened with plain water and have hose at the ready for possible pop up fires. Beware of smoke and avoid being in line of smoke so as not to breathe it in. If available on the welding truck in use, the 12 volt pump sprayer must be kept in good working order. If the 12 volt pump sprayer is not available, the 5 gallon Indian pump water sprayer is the best substitute. Always spray from the ballast line when possible.

13. The use of cutting and/or welding equipment, in the performance of maintenance work in structures containing combustible materials, should be avoided. Where the use of welding or cutting equipment is permitted in these facilities, every precaution must be taken to minimize the risk of fire. The supervisor or manager will be contacted to assign someone to patrol the area for several hours after the hot work ceases as a "fire watch."

14. Welding equipment must be positioned so that flames and sparks do not fall on cylinders, hoses, electric welding cables, hydraulic hoses, and other equipment.

15. Welders working on bridges, scaffolds, platforms, and other such work areas higher than the surrounding ground will comply with FRA and other governmental regulations in the use of lifelines, safety belts, or other safeguards as protection against falling.

16. Welding or cutting must not be done from any platform suspended by rope subject to burning or damage by fire.

17. Welding or cutting in "confined spaces" may only be performed by employees qualified to enter confined spaces.

a. Welding or cutting in a closed or confined space rapidly burns up breathable oxygen. Adequate ventilation must be provided when working in closed or confined spaces. Equipment must be tested for leaks prior to entering confined area. A person must be in position to see the Welder and near welding equipment to turn it off in case of emergency. Oxygen, propane, or other fuel tanks must not be taken into a confined space.
b. When the welder must enter a confined space through a small opening such as a manhole, a lifeline and safety belt are required. The welder is to adjust the lifeline and safety belt in such a manner that will allow the welder to be pulled from the confined area without having the welder's body jam in the opening.
c. One cannot enter a confined space without a trained rescue team. A life line and safety belt alone is not a suitable extraction plan.

18. Adequate ventilation must be provided when welding or cutting certain metals or using certain welding rods or fluxes as toxic fumes may be produced. Among the metals or items that may produce toxic fumes are beryllium, brass, bronze, cadmium, chromium, fluxes containing fluorides, galvanized iron, lead, lead based paint, manganese, mercury, and zinc. It is mandatory when welding or grinding on manganese to use a power blower. If electricity is available, a power blower is **mandatory** for any welding or grinding operation. If adequate ventilation cannot be provided, a suitable metal fume or HEPA filter respirator must be used.

19. When necessary to obstruct the track(s), the welder must first **know** that full protection is provided in accordance with Operating Rules.

20. The Welder is to report equipment defects or safety hazards to their Roadmaster and Welding Manager. The equipment should not be used until it has been checked for safety. Only qualified personnel will make repairs to welding equipment.

21. Hands, whether gloved or otherwise, must not be used to brush slag or metal from material being welded or cut.

OXY-PROPANE WELDING AND CUTTING

1. Refer to propane as “propane” not “gas”. The word “gas” is a general term and confusion is dangerous.

2. Welding and cutting equipment must be kept clean, free of oil and grease, and in good condition. This equipment will be equipped with flash back arrestors and reverse flow check valves to ensure that the gasses mix at the torch. Exception: If using a Victor HD310C torch handle, add on reverse flow check valves must **not** be used, as they are built in this torch handle.
3. Daily inspection must be made on all equipment. Leaky cylinders, hoses, or connections must not be used. Any odor must be traced and all precautions taken against sparks.

4. For optimum performance of grinding cups/stones and saw blades, ensure they are rotating

per the manufacturer's rating. Use the Daily RPM Check Log located on the Engineering Standards website under the 800 series of documents.

5. The use of SNOOP is the preferred method and the only approved liquid for locating leaks. Where SNOOP is not available the following pressure loss method may be used to detect leaks:

    a. Connect equipment.
    b. Open cylinder valves, set pressures, and purge hoses.
    c. Close torch and cylinder valves.
    d. Watch gauges for approximately one minute.
    e. If the pressure indicated by the gauges remains the same, there are no leaks.
    f. If the gauge indicating tank pressure shows a drop, there is a leak between the cylinder and the regulator.
    g. If the gauge indicating hose pressure shows a drop, there is a leak between the torch and the regulator.
    h. If a leak is indicated, check the fittings and hose in the appropriate area.

6. Keep oil and grease away from cylinders, cylinder valves, and hoses. Grease and oxygen is a highly explosive mixture.

7. Open cylinder valves slowly.

8. Purge oxygen and propane lines and hoses before lighting the torch.

9. Cylinders must not be roughly handled and must never be handled with a magnet. Cylinders must be transported, stored, and used in a vertical position. A special cradle can be used to ensure proper cylinder positioning.

10. Never use a cylinder or its contents for other than their intended purpose.

11. Protect cylinder valves from bumps, falls, falling objects, heat, and the weather. Use cylinder safety caps when moving any cylinder.

12. It is an OSHA and DOT requirement that all compressed gas cylinders **MUST** have safety caps protecting the valves when they are transported over public roadways. The APPROVED protector cylinder valve caps will fulfill this requirement and the regulators may be left on the cylinders. Some state and local laws may vary so always follow the most restrictive laws. If the protective valve caps are not available, the solid safety cap must to be used. Propane cylinders must have a screw-in safety plug in the valve outlet when being transported unless the solid safety cap design does not provide adequate room to accommodate the safety plug.

Description	Item Number
Protector Cylinder Valve Cap – Oxygen	
Protector Cylinder Valve Cap – Propane	
Safety Plug – Propane	

13. Before moving the cylinders, purge the hoses by closing the cylinder valves, opening the torch valves to release pressure on the gauges, and release the regulator valve screw.

14. **Gauges must be removed from the cylinder at the end of <u>every</u> work day.**

15. Mark empty cylinders 'empty' or 'M.T.' with a removable material, such as chalk or crayon. Do not place marking on top of numbers stamped into or stenciled onto cylinders.

16. Send empty cylinders back to supplier promptly. Never attempt to refill any cylinders.

17. Storage of cylinders.

    a. Cylinders shall be kept away from radiators and other sources of heat.
    b. Inside of buildings, cylinders shall be stored in a well protected, well ventilated, dry location, at least 20 feet from highly combustible materials. Cylinders should be stored in definitely assigned places away from elevators, stairs, or gangways. Assigned storage places shall be located where cylinders will not be knocked over or damaged by passing or falling objects, or subject to tampering by unauthorized persons. Cylinders shall not be kept in unventilated enclosures such as lockers and cupboards.
    c. Inside a building, cylinders except those in actual use or attached ready for use shall be limited to a total gas capacity of 2,000 cubic feet or 300 pounds of liquefied petroleum gas.
    d. Oxygen cylinders in **storage** shall be separated from propane cylinders or combustible materials (especially oil or grease), a minimum distance of 20 feet or by a noncombustible barrier at least 5 feet high having a fire resistance rating of at least one-half hour.
    e. In vehicles, if the cylinders are kept in a locker or cabinet, the locker or cabinet must be ventilated. Openings both top and bottom must be provided or the locker or cabinet fitted with a louvered door that will permit any oxygen or propane leaking from a cylinder to disperse freely.

18. Keep valves closed on empty cylinders.

19. Use only approved wrenches for opening cylinder valves not equipped with handles.

20. Never use oxygen for any purpose other than welding. Oxygen is not a substitute for compressed air and should never be used to blow off clothing.

21. Cylinders must be fitted with twin Grade "T" hoses for propane and oxygen with an inside diameter of ¼" or 3/8". Hoses with an inside diameter of 3/8" must be used to preheat the

rail ends when making field welds with a length not to exceed 100'.

21. Flashback arrestors must be used between the tank gauges and the hose (Propane and Oxygen) and reverse flow check valves must be used between the torch gauges and the torch handle except the Victor HD310C (Propane and Oxygen).

    a. Gauges for Propane and Oxygen must have a Flashback Arrestor installed between the Gauge and the T Grade hose.

    b. Hoses for propane and oxygen will be fitted with reverse flow check valves at the torch end, unless using a Victor HD310C torch handle. Note that the placement of additional external reverse flow check valves on the Victor HD310C torch handle can cause fuel starvation and a possible blowout of the mixer assembly.

    c. Flashback arrestors and reverse flow check valves must be inspected in accordance with manufacturer's instructions at least every six months unless required more often by the manufacturer.
        i. In the absence of manufacturer's instructions for testing flashback arrestors and reverse flow check vales, the following procedure must be followed.
        ii. Turn off both regulator adjusting valves. Remove the reverse flow valves from the torch and the flashback arrestors from the regulators.
        iii. Attach the reverse flow valves onto the regulators. Pay particular attention to attach the oxygen valve to the oxygen regulator and the propane valve to the propane regulator.
        iv. Turn on each cylinder with the "T" handle until the pressure reaches 65 psi for oxygen and 15 psi for propane. If either valve allows their respective gases to flow, the valves are defective and must be immediately replaced before proceeding.
        v. Remove the reverse flow valves from the regulators and attach only the hoses to the regulators.
        vi. Attach the flashback arrestor to the torch end of the hose (with the torch not attached). Pay particular attention to attach the oxygen flashback arrestor to the oxygen hose and the fuel gas flashback arrestor to the fuel gas hose.
        vii. Turn on each cylinder with the "T" handle until the pressure reaches 65 psi for oxygen and 15 psi for propane. If either flashback arrestor allows their respective gases to flow the flashback arrestor is defective and must be immediately replaced before proceeding.

    d. Victor HD310C torch handles will be checked for reverse flow using the following procedure.

        i. Turn off both regulator adjusting valves.
        ii. Disconnect one hose from one of the regulators.
        iii. Open all torch control valves.

iv. Plug the tip end.
v. Turn on the regulator that is NOT DISCONNECTED until a 2 to 5 psi reading appears.
vi. Put the end of the hose that is DISCONNECTED from the regulator under water or cover the end of the hose with an approved leak detector solution such as SNOOP.
vii. Bubbles will appear if the check valve is leaking. There should be no more than two bubbles in 10 seconds.
viii. If the check valve leaks, reconnect the hose to the regulator and unplug the cutting tip. Flush for 3 to 5 seconds with 10 psi of propane or 30 psi of oxygen (depending on the valve being tested).
ix. Retest the check valve using steps i thru vii above. If there is still a leak, replace or repair the torch before proceeding.
x. Reconnect the hose that was disconnected for the first test. Repeat steps i through ix with the other hose.
xi. After both check valves test good, purge both the oxygen and propane lines before lighting the torch. Test all hose connections for leaks.

22. Quick disconnect hose couplings are **not** to be used.

23. Repair hoses and connections **only** with crimp style welding hose repair kit and perform Snoop test prior to use. This is a temporary repair until hose is replaced.

    a. Never attempt to repair hoses with friction tape, hose clamps or other types of tape or with wire.
    b. Do not use Teflon tape or pipe dope on any of the system's compression fittings. (eg. Regulator to cylinder valve, flashback arrestors, reverse flow check valves, test gauges, hose connections, etc.)

24. Before cutting through sheet metal, plate, or other material, employees must be certain that no persons are in a position to be burned or injured from falling material.

25. Do not use wooden or flammable material to support work for welding and cutting.

26. Only approved vendors will perform other than routine adjustments and maintenance to regulators.

ELECTRIC ARC WELDING

Mandatory use of wire feeder.
Any welding repair to frogs, switch points, engine burns, rail ends, etc. that require more than a 30 minute repair (minor repair) will be done with a wire feeder,
All welding teams, other than a dedicated thermite Welding Team, that have a wire feeder are required to use it. If a team does not have a wire feeder, or it is broke down, the Welding Manager for that area is to be contacted and he will handle accordingly. The wire and gun must be removed at the end of each day's use.

This instruction applies to sections:

C. Repair of Engine Burns
D. Repair of Rail Ends
E. Repair of Rail Ends for Glued Bonded Insulated Joints
F. Repair of Switch Points
G. Repair of Frogs and Railroad Crossings

1. Avoidance of electric shock is largely within the control of the Welder. Most welding voltages are not high enough to cause severe injury by electric shock; however, a mild shock from normal working voltages may cause involuntary muscular action that might cause a person to lose balance. Wet clothing reduces the resistance of cloth and increases the effect of a normally small shock. Notwithstanding, under certain conditions, the voltages produced by an electric welder can be dangerous to one's life.

2. Live metal parts of an electrode holder must not be allowed to touch bare skin or wet clothing.

3. An electrode holder must not be permitted to touch any metal that contacts the welding ground. This will cause a dead short circuit on the welding generator resulting in damage to the equipment.

4. The jaws of the electrode holder must be kept clean.

5. Welding Cables:

   a. Cable capacity must be matched to the welding machine.
   b. The standard length of cables connected to the welding machine is 50 feet. Shorter or longer lengths may be used with permission of the Manager-Welding.
   c. On territories where track access is limited by terrain, an additional 50 feet of cable may be added using insulated cable connectors.

6. Always be sure that the cables are in good condition and all cable connections are tight.

7. Cable splices must be 10 feet or greater from the electrode holder.

8. Cable is to be uncoiled before welding. It should be strung out on the ground without crossing itself. Do not leave cable coiled up and hanging from a hook or coiled up one layer upon another while welding.

9. Do not coil or loop electrode cable around the body while welding.

10. All ground connections must be mechanically strong, close to the work, and of adequate size electrically. Never attach ground clamp to the rail base. Use of a magnetic ground clamp that attaches to the ball of the rail is recommended.

11. Never operate a gasoline or diesel powered welder in a confined space or without adequate

ventilation.

12. Never strike an arc on, or touch an electrode against oxygen, propane, or other cylinders used for the storage of compressed gas.

13. Electrodes must be removed from holders when not in use. Electrode stubs should be disposed of into a metal container.

14. Other than routine maintenance, only qualified individuals or vendors will make repairs to welding machines.

15. Where practical, the work should be enclosed with a fire proof screen to protect the eyes of others from the glare of welding rays. Welders working along the line of road must take precautions to protect the public and others employees not involved in the welding process from glare.

16. When the use of a wire feeder is complete, both the 15 feet welding gun and the roll of wire must be removed from the feeder.

17. Remove the wire and gun from the mig box at the end of each day's use to allow for proper storage of the mig gun and to lighten the weight of the mig itself for proper storage.

18. Ensure when inserting the mig gun into the mig box, the gun is pushed all the way into the brass bushing and secured with the thumb screw. (**at this time inspect the brass bushing for tightness and for any loose bolts).**

ELECTRIC ARC WELDING IN TRACK CIRCUIT TERRITORY

1. High amperage current (100 to 300 amperes) used for welder operation, which flows through a section of rail during the arc welding process, has a tendency to leak to earth and unbalance the track circuit.

2. Stray electrical current could damage sensitive signal equipment that is used for train operation and active grade crossing warning devices.

3. Unbalancing of the track circuit may affect the operation of track relays resulting in signal interruptions.

4. Sufficient stray current could flow through the track relay to hold it energized with the track circuit occupied if the return current of the welding outfit is allowed to flow through only a short section of rail.

5. Operation of the electric arc welder on bridge guard rails, or on non-bonded tracks, such as sidings or non-signaled running tracks, running parallel to or in close proximity to main tracks equipped with track circuits, will also affect the proper operation of the track circuit. The following instructions must be followed when using electric arc welding equipment on

any track or guard rail in track circuited territory.

6. Before proceeding with the use of an electric welder on tracks in track circuited territory, the Signal Maintainer must be notified a sufficient time in advance to install circuit fuses to protect signal equipment.

7. The location of insulated joints must be ascertained before any work is undertaken. If there is a question as to the limits of any track circuit, a signal employee must identify the limits prior to the start of work.

8. Electric arc welders (generators) must be properly insulated, and insulation kept in good condition.

    a. All electrical equipment must be grounded at the source, and all connections must be clean and tight.
    b. The ground clamp must be clean, fit well, and make full contact without any current resistance. Use of a magnetic ground clamp is recommended.

9. Do not disturb the ground clamp while welding. Welders equipped with mechanical ground bars must not be moved during welding, nor stopped with the ground spanning an insulated joint.

10. Care must be exercised to see that the ground plates are never allowed to touch the opposite rail of the track on which welding is performed as this will cause serious damage to signal apparatus.

11. The welding electrode and ground plates must never be dropped in the ballast or be permitted to come in contact with the ground while the generator is running. When the welder is not in operation, they should be carefully laid on the end of a tie.

12. At points where the wires are run under or over the rails of any track, additional protection of the insulation must be provided by sliding a short section of rubber hose or placing an insulating mat between the wire and rail.

13. When performing electric arc welding operations on or about bridge structures, the use of guard rails or bridge members for completing the "Hot" side of the circuit between generator and welding electrode must be avoided. An insulated cable conductor must be used for this purpose. When welding guard rails or bridge members, extreme care must be taken to prevent tools, tie plates, or other metallic objects from making contact between main track rails and the member on which welding is performed.

14. Equipment such as grinders, slotters, push cars, and hi-rail vehicles must be properly insulated to prevent shorting the track circuit.

15. In track circuit territory, multiple operator welding systems where two or more welding circuits are connected electrically to the same source must not be operated.

16. No more than two single arc-welding machines may be operated within the limits of any track circuit. This applies to territory having one or multiple tracks.

17. Automatic and semi-automatic wire feed systems must be fully insulated from the unit frame.

18. For the welding of conventional insulated joints, standard joint bars shall be applied on only one joint at a time. (When the insulated joint is on the closure rail, the installation of standard joint bars may short the track circuit.)

19. Protect bond wires during preheating, post heating, welding heat, surface grinding, and cross slotting.

20. The polarity switch must be in the "OFF" position while traveling or when removing the welding machine from the track. Some welding machines do not have a polarity switch with an "OFF" position. These welding units must be turned off while traveling or when removing the machine from the track.

THERMITE WELDING

1. Daily inspection must be made of all equipment to ensure that the equipment is kept clean and in good condition.

2. All equipment and personnel, not directly involved in making the weld, will be moved to a safe distance of 20 feet (30 feet if snow on the track) during the weld reaction and pour, as well as during the grinding operations. In particular, equipment will be far enough from the work to ensure that it is not showered with sparks from these operations.

3. The slag basin shall have 3/4" of dry sand placed in the bottom of the basin during the preheat process.

4. For the best quality product, no batter on either rail end is preferred. However, if batter is present, only one rail end may contain batter not to exceed 1/8" (approximately 0.125") and grinding must be complete on rail run off. *See Section I Finish Grinding of Thermite Welds, Part 2 Section E.

5. At any time the ballast or surface under a field weld is wet, a safety pan will be placed directly under the weld. The safety pan is a metal container approximately 8" x 18" x 6" with 3" of dry sand in the bottom as illustrated in Sketch A-1.

6. When a weld must be made on an open deck bridge: A safety pan will be placed directly under the weld. The safety pan is a metal container approximately 10" x 26" x 6" with 3" of dry sand in the bottom as illustrated in Sketch A-2.

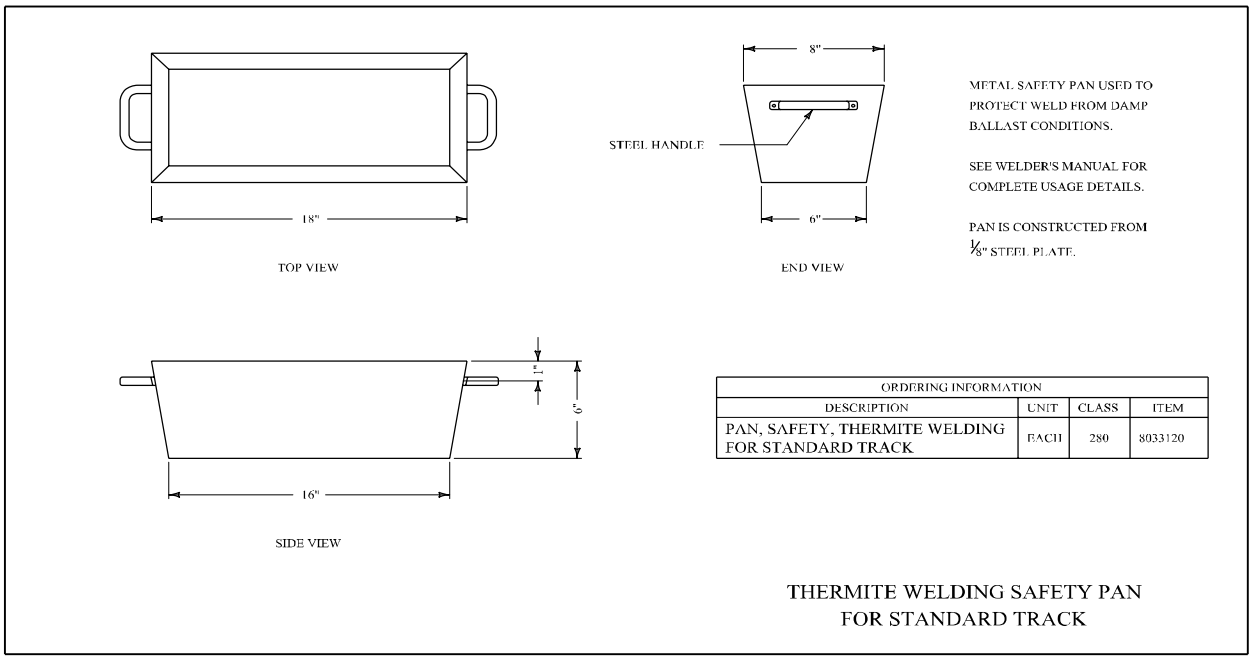
7. A full face shield, welding gloves and long sleeves are required when handling hot slag basins and during the tear down process of a poured weld. This face shield and welding

gloves are required during the shearing process.

8. **Do not remove the slag basins until five minutes (six minutes for wide gap welds)** have passed since the pour. After five minutes, move the slag basin at least fifteen feet (eight to ten ties) and place on level ballast. **After twenty minutes have passed, empty slag basin in designated location.**

9. Never throw hot metal or slag into water, snow, or ice because an explosion may occur.

10. The contents in the slag basin(s) and safety pans should be dumped only after they have completely solidified, and in a dry place where it will not cause a fire or personal injury.



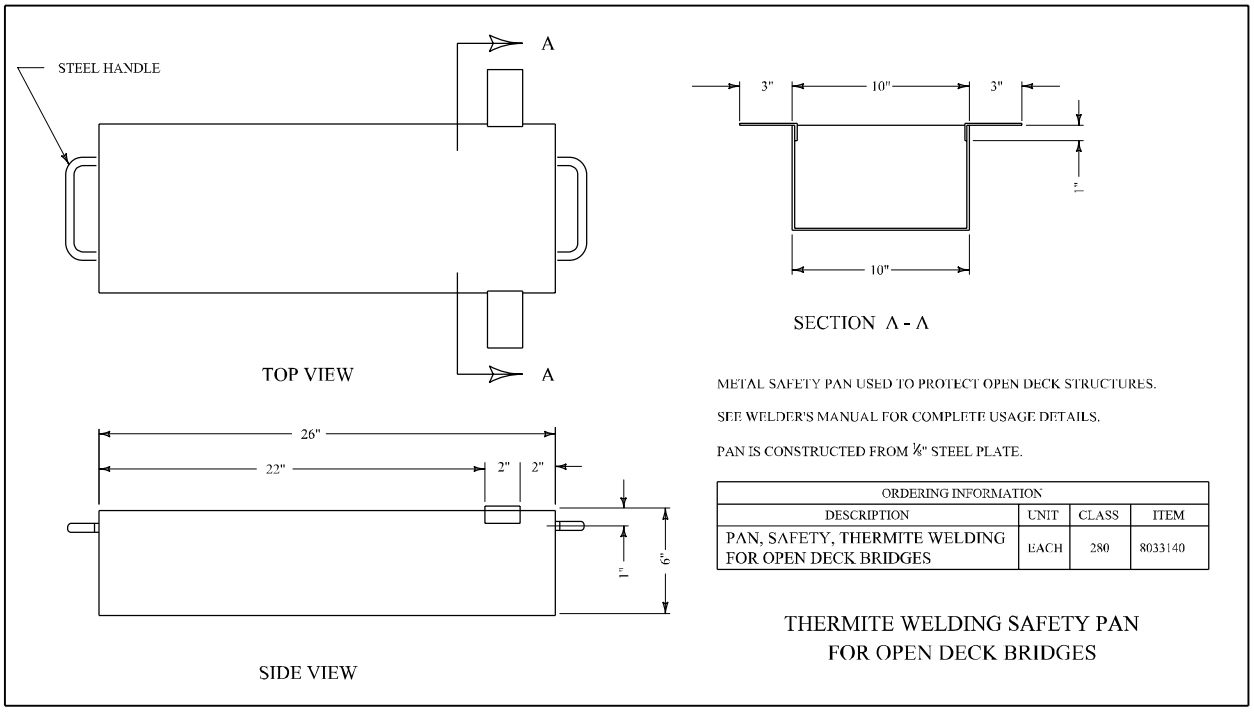
Sketch A-1

11. One method for removing weld risers is the weld riser removal tool (Boutet welds and Orgo-Thermite welds). Insert the tool vertically with the large opening over the riser and the notch toward the weld. Pull the end of the tool smoothly to the desired angle in accordance with the welding procedure. When breaking of a riser, completely insert the tool onto the riser and use the tool defensively due to the snapping effect. After breaking off a riser, the riser may be handled with the tool and placed in the disposal area.


Risers shall be removed when the weld temperature reaches 900 degrees, or approx. 25minutes. Riser removal tool or light taps with sledge is to be used
Communicate RED ZONE!!
Face shield and leggings must be worn.
Caution: Do not use excessive force to remove risers.
Top of running surface can now be finished ground. (900deg)


Risers should be bent down at right angles to the rail allowing for profile grinding.

12. If using a sledge hammer or hot cut chisel to remove the weld risers or sand, a full face shield and welding leggings must be worn. Always stand on the opposite side of the rail from the riser that is being struck. A hot cut chisel can be used to gently remove the sand mold from around the base of the risers to allow for cooling. Use care and ensure the hot cut chisel **DOES NOT** strike the rail or the weld causing gouges into the parent metal or weld. The risers should not be removed until approximately 25 minutes after the end of the pour. Be sure to clear the "red zone" before lightly tapping the risers and use only light taps with the hammer.



Sketch A-2

HAND TOOLS

Using Hot Cut Chisel:

1. Hot cut chisel may be used for clean up of sand mold debris around base risers and side of weld areas, but will not be struck doing this clean up task. Employee must stand on opposite side of rail to be cleaned and with light downward strokes, remove sand away from risers. When done cleaning on first side, step over the rail to clean other side of rail. All required PPE is stated below. Use care and ensure the hot cut chisel **DOES NOT** strike the rail or the weld causing gouges into the metal. Hot cut chisel MUST not be used as a sledgehammer.

2. In case of emergency, such as weld shear failure, the hot cut chisel will be used to cut risers from side of ball and clean up top of ball after torching off head. This will be done only after the hot cut chisel has been inspected as explained below.

3. Hot cut chisel handle will be inspected for cracks, the chip protector will be removed, and head of hot cut chisel will be inspected for cracks, overflow, or missing pieces.

4. The tool will be ground if not found in compliance and if pieces are missing, the hot cut chisel will be removed from service.

5. After the head of the hot cut chisel has been inspected and corrected, the chip protector will be put back in place.

6. The cutting edge of the hot cut chisel is to be properly sharpened using the procedure outlined in MWI 1702.

   Chip Protector – 3 lbs. Hot Cut Chisel
   Chip Protector – 5 lbs. Hot Cut Chisel
   Hot cut handle – 36" long

Note: When using a hot cut chisel to cut away excess metal from the sides of the railhead, the following procedure must be followed:

1. Head of the hot cut chisel must be turned to a perpendicular angle between 10 to 15 degrees away from vertical in relation to the ball of rail. See photo A-1.

2. Cutting point of chisel must not strike risers squarely rather at an angle. See photo A-2.

3. Head of chisel must be hit squarely and MUST NOT be used as a hammer. See photo A-3.

4. Chip protector is correctly sized. See photo A-4.

Photo A-1

Photo A-2

Photo A-3

Photo A-4

Required PPE:

If the hot cut chisel does have to be used due to weld shear failure, the following PPE will be worn by both holder and striker:

- Hardhat,
- Safety Glasses,
- Face Shield with chin guard,
- Welder's Gloves and,
- Metal Leggings
- Leather/Metal Metatarsal Leggings

1. Handles must be maintained tight on all hammers, sledges, mauls, chisels, etc.

2. Ensure everyone is standing clear of the red zone before swinging any wide arching sledge or maul.

3. All burrs, chips, and battered metal must be ground off all hand hammer driven tools, such as sledges, spike mauls, hot cut chisels, wedges, drift pins, etc.
   The use of a dead blow hammer or dead blow sledge is required when striking alignment wedges to crown rail ends for welding.
   The SCN's for the striking end of the dead blow hammers can be found in the back of the manual. Two are needed for each hammer.

4. When striking and struck tools are repaired, they must be ground to an approved contour, checked with an approved template and fitted with a chip protector. See MWI 1702 for more information on repairing hand tools.

5. The *Owner's safety policy* and applicable Safe Job Procedures contain additional precautions concerning tool use.

CUTTING RAIL AND TRACK BOLTS AT DERAILMENT SITES

1. Do not use welding or cutting equipment at the scene of a derailment until the person in charge of re-railing operations advises that it is safe to do so. Material leaking from damaged cars may be explosive or highly flammable and the use of open flames must be controlled.

2. Twisted and bent rails may shift to a new position with little or no warning when cut. Before making the cut, all personnel not involved in making the cut shall be clear of the Red Zone. Use heavy equipment to stabilize the rail before cutting and during the entire cut. The torch must be at least 36 inches or longer (Harris 1003400 36" torch or Harris 1003481 48" torch). Welders must be positioned properly so they won't become caught between the rail and other objects if the rail does shift.

3. Joint bars on twisted and bent rails may be propelled a considerable distance when the bolts are cut. A chain loosely wrapped several times around the joint will restrain the joint bars when the bolts are cut. If the bolts are under pressure, they may also fly when cut. If in doubt, cut the rail first and then remove the joint bars.

B. QUALIFICATIONS FOR WELDERS

GENERAL:

1. All Welders performing work for the Engineering Department on track appliances, buildings, bridges, or other structures using the Thermite, Oxy-propane, or Electric-arc methods of welding must be qualified by a Welding Instructor or Manager–Welding.

2. The qualification test will consist of actual welding and grinding, as well as a written or oral examination on safety precautions and welding procedures. The test will be specified by the Chief Engineer–Maintenance of Way and administered by a Welding Instructor or Manager–Welding.

3. The Manager–Welding will maintain a record of each person who qualifies as Welder and supply a copy of this record to the appropriate Roadmaster. The record will indicate:

    a. The welding category(s) in which an individual is qualified,
    b. The date each qualification was granted,
    c. Qualification as a Welder, and
    d. The person who qualified the individual

4. No person will perform any welding without being qualified. **Exception:** Persons in training to become Welders may perform work specified by a Welding Instructor or Manager–Welding under the direct supervision of a qualified Welder.

5. It is understood that when an employee accepts the position of Welder Helper, they will progress toward becoming qualified as a Welder. In the absence of the Welder, the Welder Helper should progress to advancing their skills to acquire track time and be proficient in thermite welding, electric arc welding, and other welding activities.

QUALIFICATIONS CATEGORIES:

1. Welding work performed for the Engineering Department will be divided into the following categories:

    a. Structural; Electric-Arc Method
    b. Track Appliance; Electric-Arc Method; Using Electrodes
        1) Repair engine burns
        2) Repair battered rail ends, regular and insulated joints
        3) Repair switch points
        4) Repair frogs and crossings
    c. Track Appliance; Electric-Arc Method; Using Wire Feed
        1) Repair engine burns
        2) Repair battered rail ends, regular and insulated joints
        3) Repair switch points
        4) Repair frogs and crossings
    d. Field Welding of Rail Ends; Thermite Method

1) 1" Gap Welds
    a) Boutet
    b) Orgo-Thermit
2) 2 ¾" Gap Welds
    a) Boutet
    b) Orgo-Thermit

e. Rail piling; Electric-Arc Method Welding
f. Air arc metal removal
g. In track electric flash-butt welding of joints
h. Slice
i. Basic cutting with burning torch

ACCEPTABLE TRAINING INCLUDES:

1. Work under a qualified Welder.

2. Classroom training directed by a Welding Instructor or Manager–Welding.

3. Railroad Education & Development Institute (REDI) Center or Commercial Trade School.

4. A representative from our welding suppliers (Railtech Boutet, Lincoln Electric) can also be used.

AWARDING OF WELDER POSITIONS:

1. To be awarded a bid position of welder, a person must qualify under these rules prior to the expiration of qualification time as called for in the appropriate Labor Agreement.

QUALIFICATION REQUIREMENTS:
KNOWLEDGE AND UNDERSTANDING RAILROAD RULES

1. A person must obtain a copy of the Engineering Department *Welding Manual* and must demonstrate to a Welding Instructor or Manager–Welding a general knowledge of its contents.

2. A person must obtain a copy of the *Owner's Field Manual* and demonstrate to the Roadmaster, or designee, a general knowledge of the rules.

3. A person must obtain a copy of the *Owner's Operating Rules* and must be examined and qualified as required by these rules.

4. A person must obtain a copy of *The Owner's Safety Policy* and demonstrate knowledge of the rules to the proper company officer.

5. A person must obtain a copy of the *FRA Track Safety Standards* and become qualified in accordance with §213.7.

6. A person must submit a welding report on the Engineering Gateway at the completion of each work day.

QUALIFICATION REQUIREMENTS: DEMONSTRATION OF WELDING SKILLS

1. The qualification will be based on actual work performed under the personal observation of a Welding Instructor or Manager–Welding for all track appliances and structural welding. Qualification for bridge welding will also comply with American Welding Society Bridge Welding Code (AWS D1.5).

2. Certain welding procedures require that test samples, made in accordance with American Welding Society specifications, be prepared for qualification. Test material will be mild steel plate (ASTM A36 structural steel or equal) 3/8" to 1" thick. A test sample will qualify a person only for the welding process used to make the test sample.

3. Test samples may be required in the flat position for track application on a ¾" flat plate. For structural welding, the person will be required to have vertical and overhead weld samples.

4. The Welding Instructor or Manager–Welding may require qualified Welders in structural or track appliance to make additional test samples if steel plates ¾" thick or greater, or high strength steel are required. Test samples will be made with the welding process and the type and thickness of steel to be used. The Welding Instructor or Manager–Welding will specify the welding positions.

5. The Welding Instructor or Manager–Welding may require qualified Welders who have not performed welding for the Railroad for a period of one (1) year or longer to make test samples in one or more positions to demonstrate that they have retained their welding skills.

6. The Welding Instructor or Manager–Welding will provide materials for the test samples and see that the samples are tested in accordance with American Welding Society's Specification for Compliance (Structural D1.1, Bridge D1.5), maintain records of results, and maintain a list of qualified Welders by welding categories.

7. The Welding Instructor or Manager–Welding will observe the person requesting qualification under actual work conditions to verify the welder's work habits and methods are consistent with safe welding practices. Proper welding procedure is a requirement for qualification.

8. The Welding Instructor or Manager–Welding will examine welds for durability made by a person requesting qualification after they have been subjected to service for a period of time; however, the period of time must not exceed the time referred to in Labor Agreements. Durable welds are a requirement for qualification.

9. Persons that have successfully completed a commercial trade school course in welding which required the preparation and examination of test welds in accordance with American Welding Society's Specification may be relieved by a Welding Instructor or Manager–Welding from making similar test samples for the Railroad, provided the following conditions are met:
   a. The person desiring to be qualified has a written statement from the instructor of the

course stating the welds met proper standards.

b. A copy of the laboratory examination of the test samples showing they met American Welding Society's specifications.
c. Not over one (1) year has passed since the samples were made and tested.

C. REPAIR OF ENGINE BURNS.

GENERAL

1. Engine burns in carbon steel rails will be repaired through the use of the electric-arc welding process with the mandatory use of either heating blocks or a Teleweld heater.

2. Engine burns in alloy rail will not be repaired. For description of alloy rail, see page H-2.

3. Engine burns should be repaired as soon as practicable. The impact of wheels on the defect will increase the metal flow, secondary batter, and thermal cracking.

4. The size and number of engine burns, that may be repaired in a given rail, depend upon the weight and condition of rail to be repaired and the availability of replacement rails. Generally, defects, which will be deeper than 3/8" after grinding, should not be repaired (See Sketch C-1). Also, engine burns requiring a weld longer than 10" should not be repaired.

5. Engine burns will not be repaired:
   - In a rail with shelly spots in the burn area.
   - In a switch point.
   - In a stock rail.
   - In the guardrail area of a turnout.
   - Within three (3) feet of a plant or thermite weld.

6. When repairs are necessary in cold weather, the heated area must be protected to prevent rapid cooling, as follows.

Rail Temperature	*Weather Conditions*	
	Clear	*Wind, light rain, or snow*
40°F or greater	• Air Cool • Weld Cooling Cover is not required	• Apply Weld Cooling Cover immediately after shearing. • Leave cover in place until weld is cooled below 800°F (about 35 minutes).
Between 40°F and 0°F	• Prior to installation of molds, preheat railhead and base to 100°F (hand hot) for a distance of 3 feet on both sides of the weld gap. • Complete weld and unmold normally. • Apply Weld Cooling Cover immediately after shearing. • Leave cover in place until weld is cooled below 800°F (about 35 minutes).	
0°F and less	• Welding is not recommended	

7. The Signal Maintainer will be notified in advance whenever welding is to be performed in track circuit territory.

8. See *Section "A", Safety*, for instructions for electric arc welding in track circuit territory.

PROCEDURE FOR REPAIRING ENGINE BURNS:

1. Check to see if rail can be repaired with a weld less than 10" long.

2. Before welding, three (3) ties on each side of the repair area will be inspected to determine if the rail can expand during the repair. Nip spikes and remove rail anchors if necessary.

3. Shim rail with a crown of 1/8" at the center of the engine burn using a 36" straight edge. See sketch in Section "I", Thermite Welding.

4. Mark the limits of the repair. The repair limits should be marked at an angle across the railhead so that the length of repair on the gage side will be approximately one inch (1") longer than on the field side on each side of the repair.

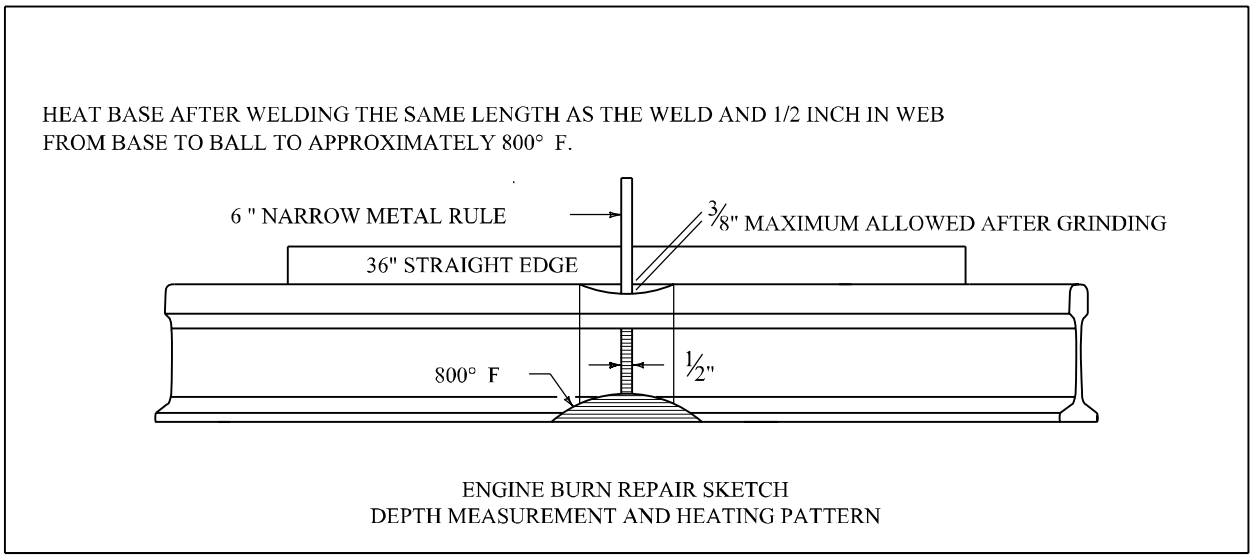
5. Grind out all damaged metal down to sound, clean parent metal. The removal shall not be accomplished through the use of a torch. Special care must be used to remove enough metal to eliminate all shatter cracks.

6. If during the repair work, it is found that the rail requires removal of more than 3/8 inch in depth of damaged metal by grinding; it will be repaired, protected by joint bars, and removed from track as soon as possible.

7. Preheating

    a. Orgo-Thermit Heating Blocks - Before welding, the heating blocks are to be secured on each side of the rail in the web area and ignited. After the rail is heated to 800°F, carefully examine the rail for cracks. Cracks will appear as dark hair lines in the heated area. If cracks are present, further grinding is required. Heating blocks must remain in place until the repair has been completed.

        1) Heat block for 90# to 119# rail
        2) Heat block for 122# to 140# rail
        3) Heat block are not currently available for 141# rail or greater



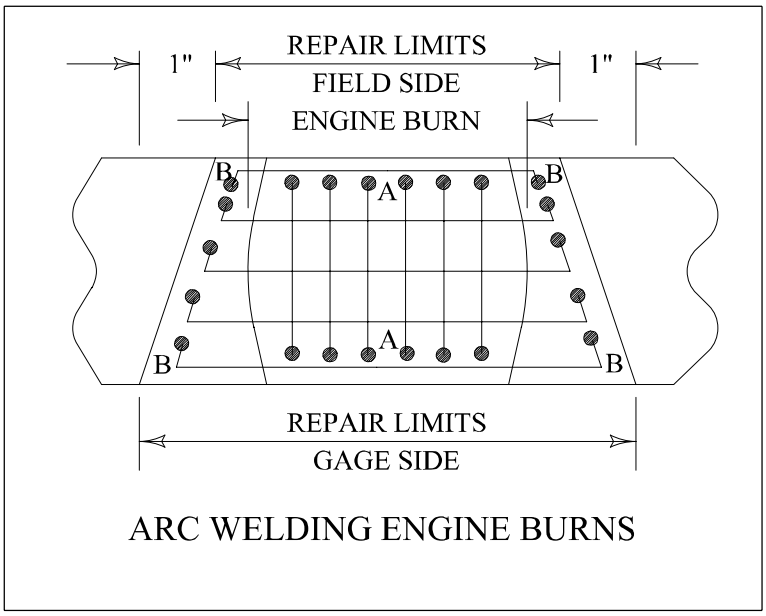
Sketch C-1

b. Other Heating Devices – An approved heater must be used to heat the rail to 800°F. The temperature will be verified using a Tempilstick or digital thermometer. Position the heater so that the pre-heated area includes the repair and four inches (4") to both sides of the repair. One approved heater is the Teleweld Single Propane heater.

8. Repair of the engine burn must start immediately after the ground out area has been inspected for cracks and must continue without stopping until all weld material has been deposited. When welding with approved wire or stick, welded area must be post heated to 800°F before grinding.

9. Approved welding rods and wires for the electric-arc process are listed on page N-2.

10. Welding of engine burns should start on the gage side (not gage corner) and proceed to the field side in beads deposited lengthwise according to Sketch C-2.



A. First few beads are 90° across the rail head to fill the deepest area ground.

B. All finish beads are run length wise with the rail between repair limits.

Sketch C-2

11. Each bead must be peened while the deposit is hot to relieve welding stresses that can cause cracking. Enough weld material should be deposited so that the un-ground surface will be higher than the rail and that the grinding will eliminate the visible welding marks and seams.

12. The weld area must be protected against rain, snow, etc., and be allowed to cool as slowly as possible. Leave heating blocks in place until rail temperature is below 500°F. Verify by using a digital thermometer or a Tempilstick.

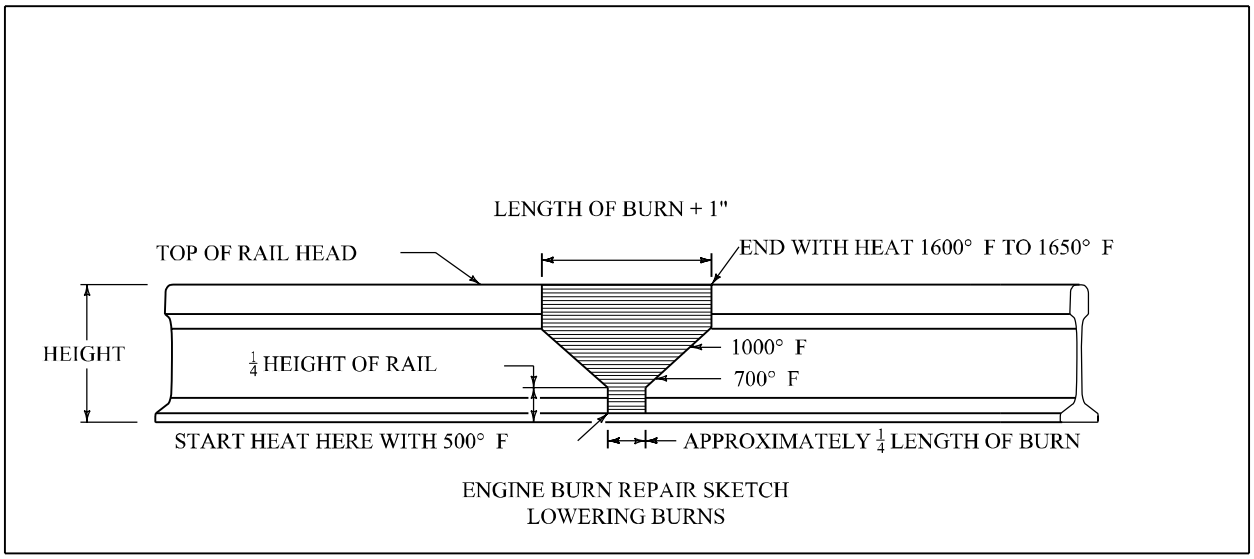
13. Use the surface grinding attachment to grind the weld area to a smooth surface and true rail contour.

14. After the welds are made and allowed to cool, an inspection must be made to determine the straightness of the running surface of the rail. Use an approved 36" straightedge. Surface tolerance is – 0" / + 0.030" (crown).

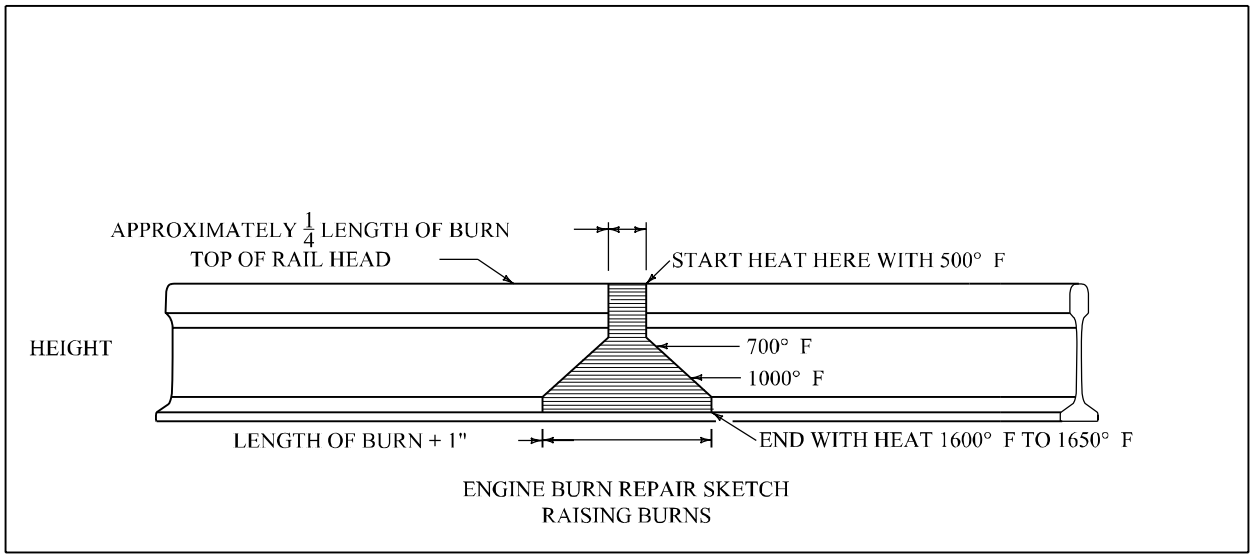
15. Remove shims from one tie and tamp that tie before removing the shims from the next tie. Replace any rail anchors that were removed.

CORRECTING VERTICAL DISTORTION:

If the repair has caused a dip, the rail alignment can be corrected by heating the rail as shown in the Sketches C-3 and C-4. Allow the repair area to cool slowly.



Sketch C-3



Sketch C-4

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D. REPAIR OF RAIL ENDS

GENERAL

1. Rail end batter in carbon steel rails will be repaired through the use of the electric-arc welding process.

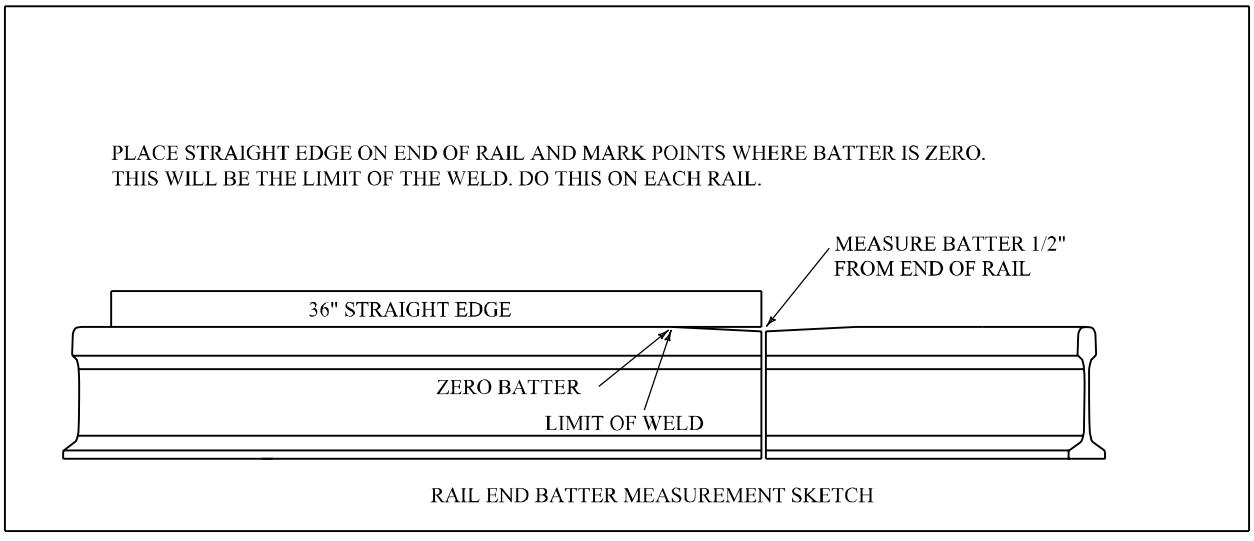
2. Rail ends that have been repaired by welding will not be thermite welded until the rail end has been cropped to remove the entire previously repaired area.

3. Rail ends, that are battered, chipped or spalled, should be repaired to prevent further damage to the rail ends and accelerated deterioration of the other track components.

4. Rail end repairs should be made when the batter reaches the limits as listed below:

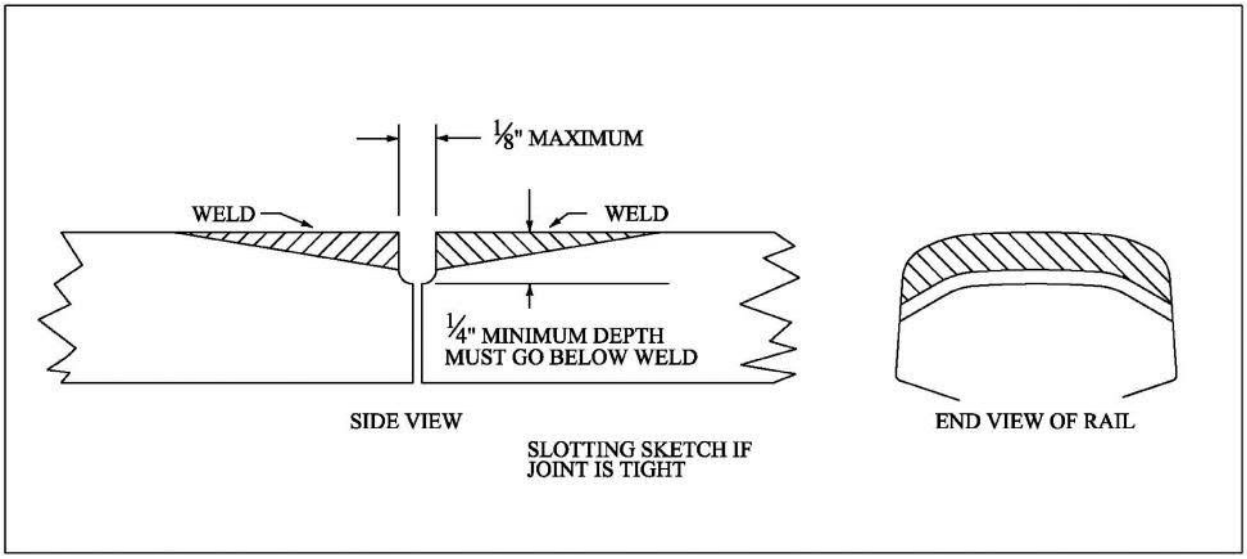
   1/8 inch (0.125") where freight train speed exceeds 60 MPH
   1/4 inch (0.250") where freight train speed exceeds 40 MPH
   3/8 inch (0.375") where freight train speed exceeds 10 MPH
   1/2 inch (0.500") where freight train speed is 10 MPH or on excepted track.

5. Batter is the distance, measured in thousandths of an inch, between an approved 36" straightedge and the top of rail 1/2 inch in from the end of the rail as shown in Sketch D-1.

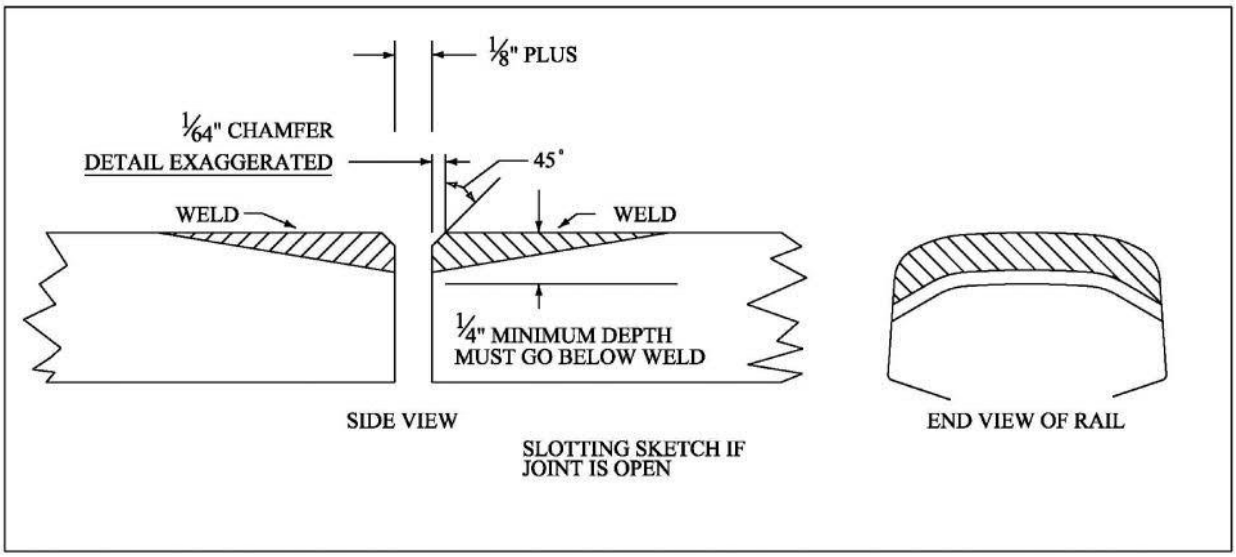


Sketch D-1

6. Rail ends will be slotted by grinding to prevent chipping due to overflow. For rail gaps of 1/8" or less see Sketch D-2. For rail gaps greater than 1/8" see Sketch D-2A.



Sketch D-2



Sketch D-2A

7. Before repairing the rail ends, the track near the repair should be inspected for excessive expansion at the rail ends, joint bar condition, ties in the joint area, ballast in the joint area and surface. Tamp the joint as necessary.

8. The Signal Maintainer will be notified in advance whenever welding is to be performed in track circuit territory.

9. See *Section "A", Safety*, for instructions for electric arc welding in track circuit territory.

PRELIMINARY WORK

1. Use an approved 36" straightedge to mark the limits of the repair. The repair limits should be marked at an angle across the top of rail so that the length of the repair on the gage side will be approximately one inch (1") longer than on the field side.

2. Rail ends to be repaired must be clean, free from dirt, dust, oil, grease or other foreign substance. Grind out all damaged metal down to sound and clean parent metal. The removal will not be accomplished through the use of a torch.

3. Before welding, preheat the ground railhead to approximately 800°F for a distance of 8" beyond the weld area in each rail requiring repair. Carefully examine it for cracks. Cracks will appear as dark hairlines in the heated area. If cracks are present, further grinding is required.

4. During welding, excessive heat must be avoided, especially near manganese castings. Heat in excess of 500°F could be transferred to and damage manganese castings.

PROCEDURE FOR REPAIRING RAIL ENDS:

ELECTRIC ARC PROCESS

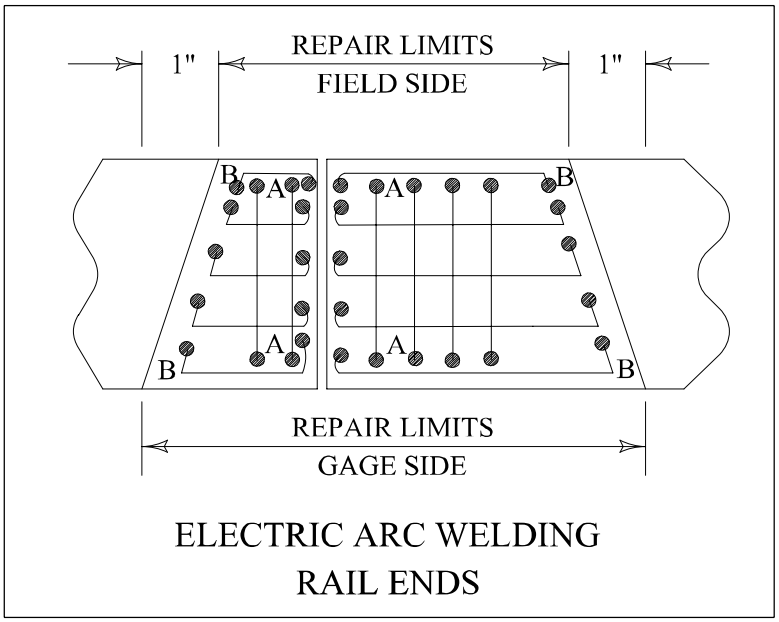
1. Approved welding rods and wires for welding of rail ends are shown on page N-2.

2. Welding must begin immediately after preheating and the 800°F preheat maintained in the area surrounding the repair.

3. First welds are to be made across the railhead until level and then lengthwise from the gage to field side. See Sketch D-3.

4. The welding should proceed lengthwise with the railhead.

5. Each pass must be peened while the deposit is hot to relieve welding stresses. The weld should be extended beyond the rail end and the excess metal removed by slotting after the weld is completed.



A. First few beads are 90° across the rail head to fill the deepest area ground.

B. All finish beads are run length wise with the rail between repair limits.

Sketch D-3

6. Enough weld material should be deposited so that the unground surface will be higher than the rail and that the grinding will eliminate the visible welding marks and seams.

7. With carbon steel rail, post-heat the welded area to approximately 800°F immediately after the welding operations. After post-heating, the weld area must be allowed to cool as slowly as possible and protected against rain, snow, etc.

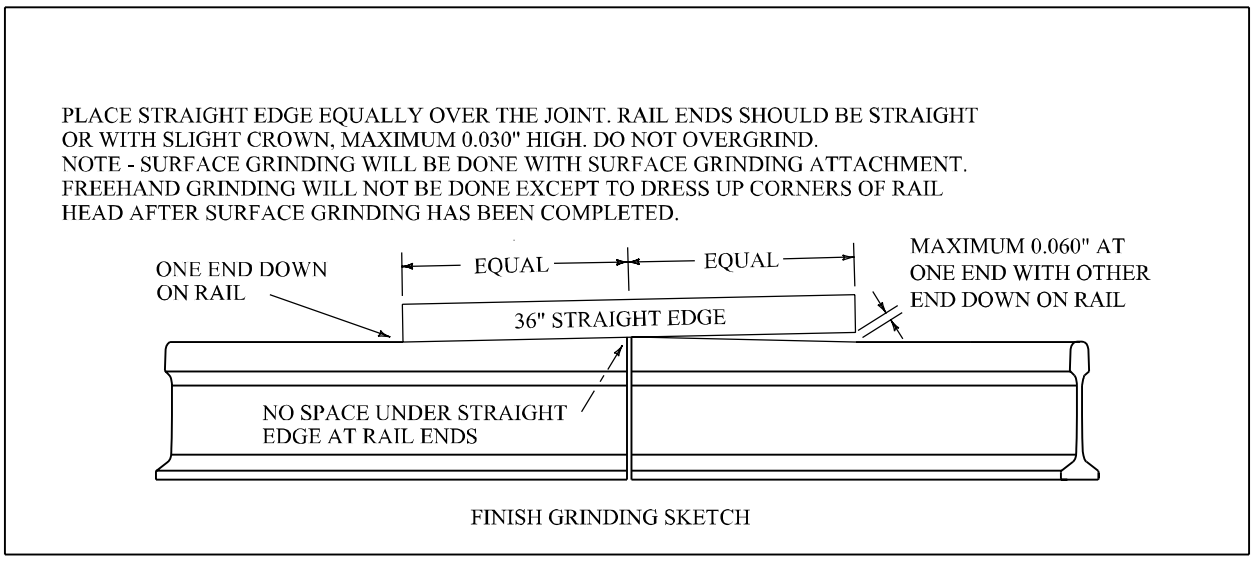
8. With fully heat treated and head hardened rails, post-heat the welded area to approximately 800°F immediately after the welding operations. After post-heating, it is most important that the rail cool slowly to 200°F. It may be necessary to protect the weld area with insulation, such as an insulated blanket to obtain the desired slow cooling and against rain, snow, etc.

9. **It is very important that preheating and post-heating be diligently performed to obtain a quality repair weld**.

GRINDING

1. Use the surface grinding attachment to grind the weld area to a smooth surface and true rail contour.

2. After the welds are made and allowed to cool, an inspection must be made to determine the straightness of the rail. Use an approved 36”straightedge. Surface tolerance is -0 IN./+0.030 IN. See Sketch D-4.



Sketch D-4

3. If the rail ends are of different heights and are being built up to match surfaces, there should be a 10 inch runoff from each 1/4 inch difference in height but the runoff must not extend beyond the furthest bolt hole from end of rail.

   Note: It is preferable to build up the low rail end in a permanent joint, instead of grinding the high rail end, unless a thermite weld is to be made.

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E. REPAIR OF RAIL ENDS IN GLUE-BONDED INSULATED JOINTS

GENERAL

1. Glue-bonded insulated joints will be repaired through the use of the electric-arc welding process.

2. Before repairing the rail ends, the track near the repair should be inspected for ties in the joint area, ballast in the joint area and surface. Tamp the joint as necessary.

3. Glue-bonded insulated joints are structural units that are composed of rail, insulated bars, end post, bolts, and adhesive. As a structural unit, they must be treated differently from individual rail ends. Therefore, some differences exist between these techniques and those used for rail ends.

4. Approved welding rods and wires for the repair of glue-bonded insulated joints are listed on page N-2.

5. Care must be taken to ensure that the welding ground cable clamp is securely grounded to the running surface of the rail being repaired. Use of a magnetic ground clamp is recommended.

6. The Signal Maintainer will be notified in advance whenever welding is to be performed on glued-bonded insulated joints.

7. See *Section "A", Safety*, for instructions for electric arc welding in track circuit territory.

PROCEDURE FOR REPAIRING GLUE-BONDED INSULATED JOINTS

1. Use an approved 36" straightedge to mark the limits of the repair. The repair limits should be marked at an angle across the top of rail so that the length of the repair on the gage side will be approximately one inch (1") longer than on the field side.

2. Rail ends to be repaired must be clean, free from dirt, dust, oil, grease, or other foreign substance. Grind out all damaged metal down to sound and clean parent metal. The removal will not be accomplished through the use of a torch.

3. Before welding, preheat the rail end not to exceed 150°F. The preheat torch flame should be applied in a uniform circular motion on the rail end, beginning at a point two inches (2") from the rail end and proceeding to a point two inches (2") beyond the repair limits. Welding must commence immediately after preheating. If welding is interrupted, allow the rail to cool, then preheat must be repeated.

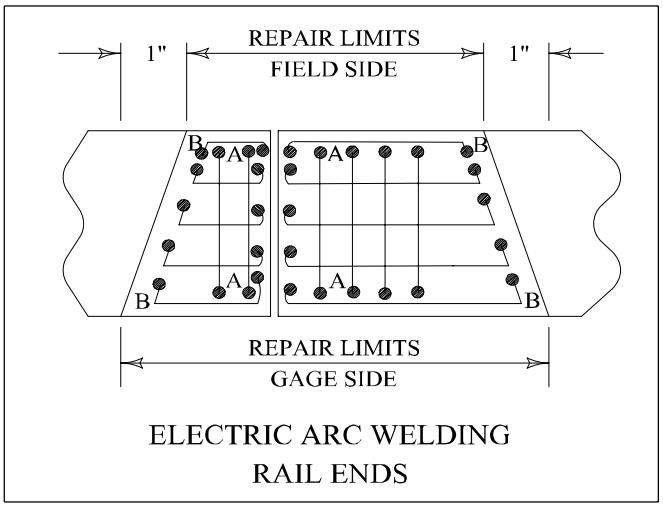
4. The area to be repaired should be welded in multiple layers. Each welding bead must be peened and enough time allowed between beads to keep the rail end within the allowable

maximum temperature of 300°F degrees in the glue-bonded insulated area. A Tempilstik or other approved temperature measuring device must be used on both sides of the railhead to check the temperature.

5. The final layer of welded material will be deposited as follows:

   a. Start the weld bead on the field side one inch (1") from the rail end.
   b. Progress the weld to the rail end and across the end of the rail to the gage side.
   c. Continue to bead parallel to the gage line to a point one inch (1") beyond the visible end hardened area.
   d. Turn diagonally and return toward the field, slightly overlapping the first bead.
   e. Continue this pattern, diagonally turning each bead just short of the previous bead at the weld limit, with as many beads as necessary to cover the welded area of the railhead.

6. When the weld is completed, the arc should be broken by crossing back into the welded surface.



A. First few beads are 90° across the rail head to fill the deepest area ground.

B. All finish beads are run length wise with the rail between repair limits.

Sketch E-1

7. The completed weld pattern should be such that it will provide a gradual transition for the car wheels from the parent metal to the welded surface.

8. Grind the repaired area to a smooth surface and a true rail contour immediately after completing the weld. Use an approved 36" straightedge to check the surface. The tolerance is - 0 IN /+ 0.030 IN (See Sketch D-4 for reference).

9. The rail ends should be slotted and cleaned of all charred end post material and grinding dust. Then the gap between the rails filled with a clear 100% silicone caulking.

F. REPAIR OF SWITCH POINTS:

GENERAL

1. Switch points will be maintained and repaired through the use of grinding and the electric-arc welding process.

2. **Main track switch points are not to be repaired by any welding process.** In the event that it becomes necessary to repair a switch point in an emergency situation, a 10 MPH temporary speed restriction must be placed on the turnout with speed boards posted until the point is replaced. The speed restriction will only pertain to the route affected by the repaired point.

3. Switch points are made from either carbon steel rails or fully heat treated steel rails (former standard with many still in use), deep head hardened steel rails (current standard), or may have manganese steel tips installed on the point. A magnet or magnetic rail thermometer may be used to differentiate between steel rails and manganese insofar as the magnet will not stick to manganese.

4. New switch points and stock rails should be inspected frequently in the first few months after installation. When the metal flow starts to form a lip, it should be removed by grinding. This grinding must be done several times until the top surface has work hardened to the maximum hardness and flowing has stopped. The time to reach maximum hardness depends on the tonnage passing over the track component.

5. The wearing and mating surfaces of switch points and stock rails **must be ground periodically** to remove flowed metal which may cause the switch point to chip or cause an improper fit between the switch point and stock rail.

6. **Before** beginning repairs to the switch point, the stock rail must be inspected to ensure that the undercut or recess is correct, that there is no overflow material present and the switch is adjusted properly. **If any item is out of tolerance, it must be corrected.**

7. **Arc or torch cutting is not permitted**.

8. Generally yard and non-mainline switch points should not be repaired in the field by welding if the repair would be greater than about 24" in length. Switch points requiring more repair should be replaced and sent to the designated location for repair if the switch point is not scrap. The availability of replacement points will influence the decision also. If no replacements are available, the point may be repaired but arrangement should be made to replace the repaired point in a reasonable time period.

9. Any knife blade switch that has not been recessed into the stock rail will be recessed prior to repairing the switch point.

10. Sketches F-1 through F-5 (located at the end of this section) depict details of the switch

point, stock rail, and stock rail recess for both Samson and knife type switch points.

11. Approved welding rods and wires for rail steel switch point repairs are on Page N-2 and manganese steel tip insert repairs are on Page N-1.

12. The Signal Maintainer will be notified in advance whenever welding is to be performed in track circuit territory.

13. See *Section "A", Safety*, for instructions for electric arc welding in track circuit territory.

PRELIMINARY WORK

1. Inspect condition of complete switch.

    a. Check to see that switch stand is firmly fastened to ties; a loose stand may allow points to move into the path of the wheel flange and be chipped.
    b. Check condition of connecting rods, switch rods, rod bolts, and other switch parts for wear that could cause play in the switch points. Make sure that moving parts do not bind on switch ties. All bolts designed for cotter pins must have cotter pins in place.
    c. Check heel block for missing or worn bolts and thimbles, worn bolt holes, and condition of switch ties. Vertical play of the switch heel could allow the switch point to rock under traffic exposing the point end to contact with the wheel flange.
    d. Check to see that the base of the stock rail is seated in the switch plates and wedges are tight.
    e. Check to see that the switch point is not twisted and rests flat on the switch plates.

2. All cracked, chipped, work hardened, spongy, fatigued, spalled, or otherwise defective metal will be removed by grinding to clean parent metal. Special care must be taken to ensure that all cracks and breaks are removed.

3. **Both Stock Rails are to have all overflow removed by grinding prior to beginning the repair.**

PROCEDURE FOR REPAIRING SWITCH POINTS:

1. Preheat and maintain the weld zone for at least 8" beyond the weld area to a temperature of 800°F as determined by a Tempilstik or other approved device.

    Exception: Do not preheat switch points with manganese steel tip inserts.

2. When working on switch points, use a wood chock or other physical obstruction to block the switch point in the open position before welding. Weld all switch points in the open position, starting at the point and working toward the heel. A copper plate (1/8" thickness or 1/4" thickness) and or carbon block may be placed behind the switch point, if needed, to help protect against overflow. The use of C clamps or C clamp vice grips can be used to hold the

copper plates or carbon blocks in the weld position to hold weld metals. This copper backing plate and or carbon block must be 1/16" off of the point to allow sufficient weld for grinding in order to eliminate seams.

3. The contour of the weld should be kept uniform. The switch point should be built up slightly in excess of the dimensions required by the standard plans, then ground to final size and shape. Do not leave any seams between the welding beads and the parent metal.

4. After the weld repair is completed but before grinding, post heat the repaired area to a temperature of approximately 800°F for 8" beyond the welded area. Heat the base and back of the point an equal amount to prevent the point from warping.

   Exception: Do not post heat switch points with manganese steel tip inserts.

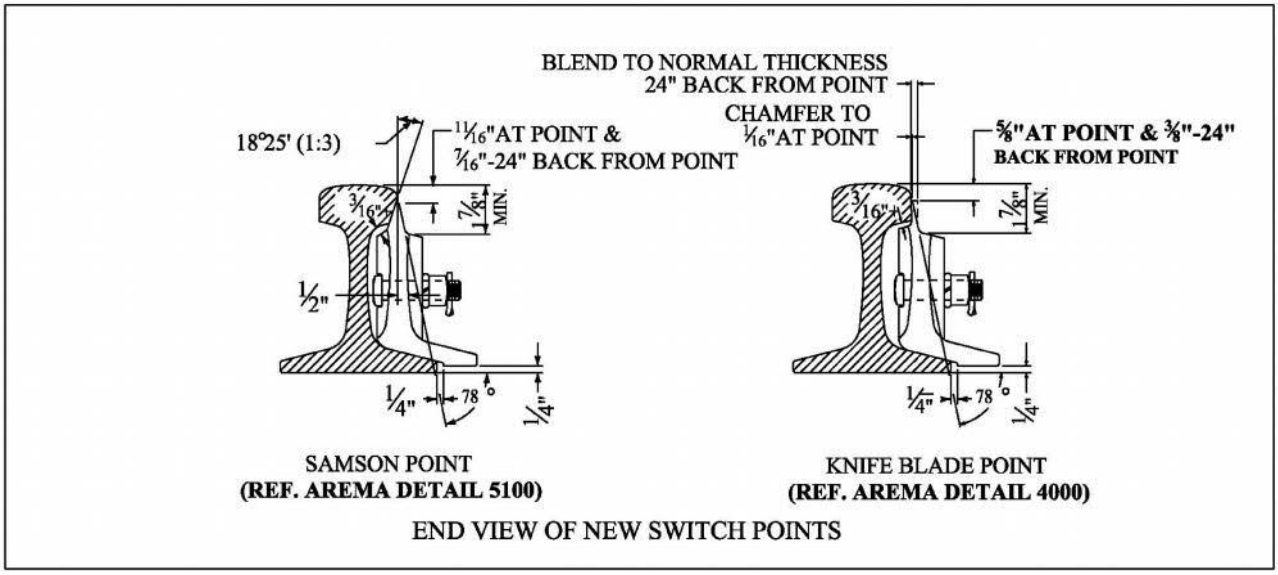
5. Grinding procedures.

   a. First, grind the back side of the point. Check with a 36" straightedge after grinding. Check for proper fit with the stock rail by throwing the switch.
   b. Second, grind the gage face of the point. Check with a 36" straightedge after grinding.
   c. Third, grind the top of the point. Check with a 36" straightedge after grinding. The end of the switch point should be ground to a thin edge 5/8" lower than the top of the stock rail. See Sketch F-1.
   d. Fourth, finish grind at the end of the switch point. At the point, all sharp edges should be slightly rounded toward the stock rail. There should be a radius of about 5/8" between the top and gage face of the point starting where the point becomes 5/8" thick.
   e. Fifth, check the gage face alignment. **With the switch point closed, place 36" straightedge on the gage face of the stock rail sliding the straight edge towards the point verifying clearance of switch point. Check to see that the point is <u>not</u> sticking out and hitting straight edge straight on. See Photo F-1 below.**

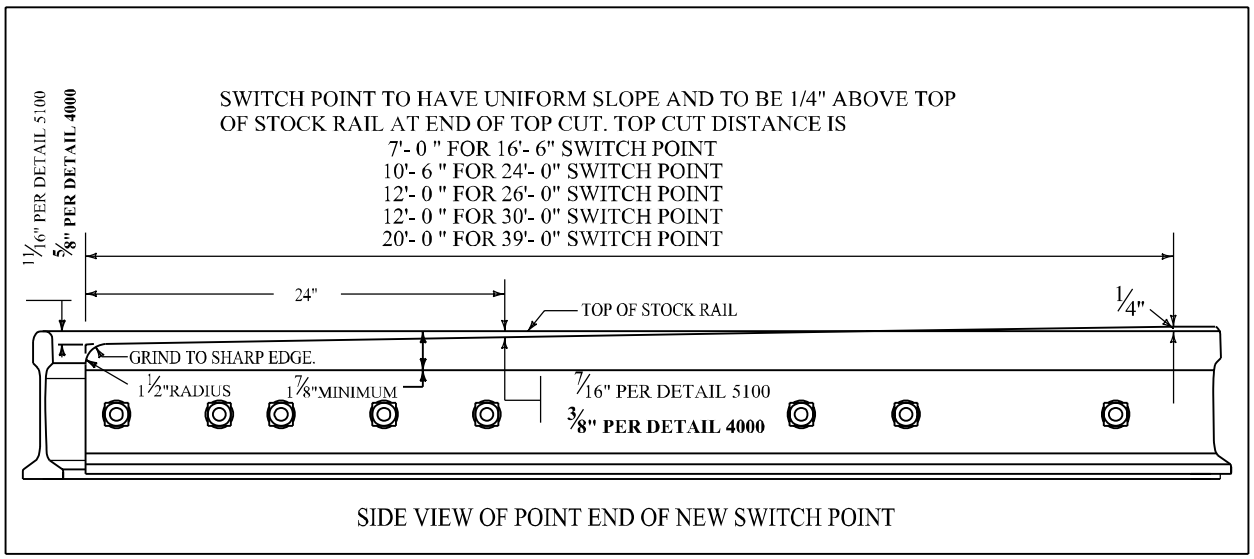
Photo F-1

6. Protect the point from cooling too rapidly.

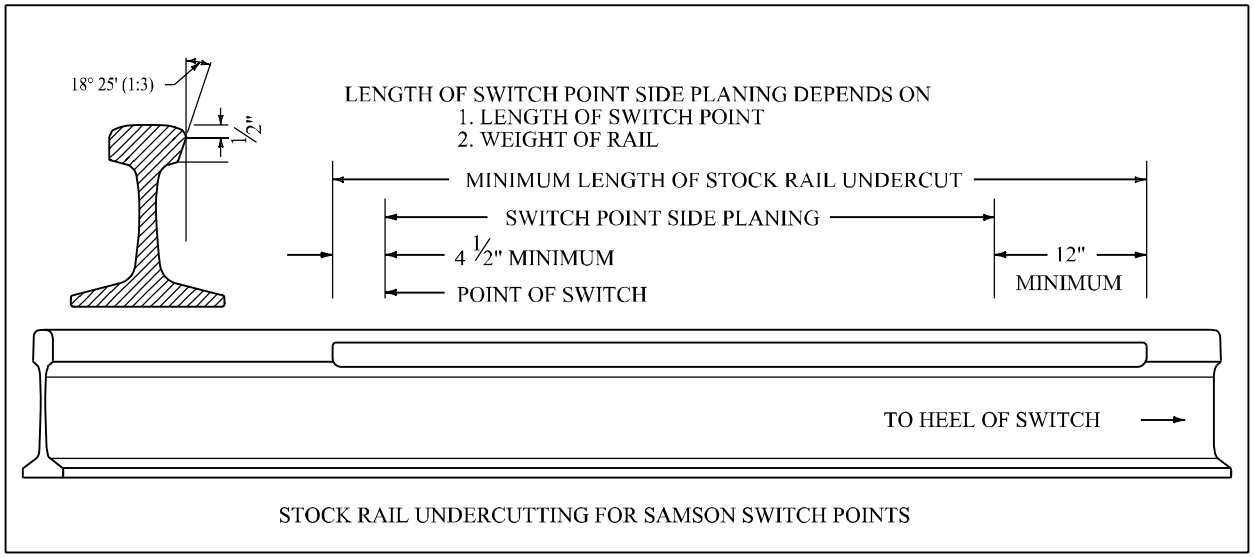
7. Traffic must not be allowed to use the switch until the switch point temperature is below 200°F.



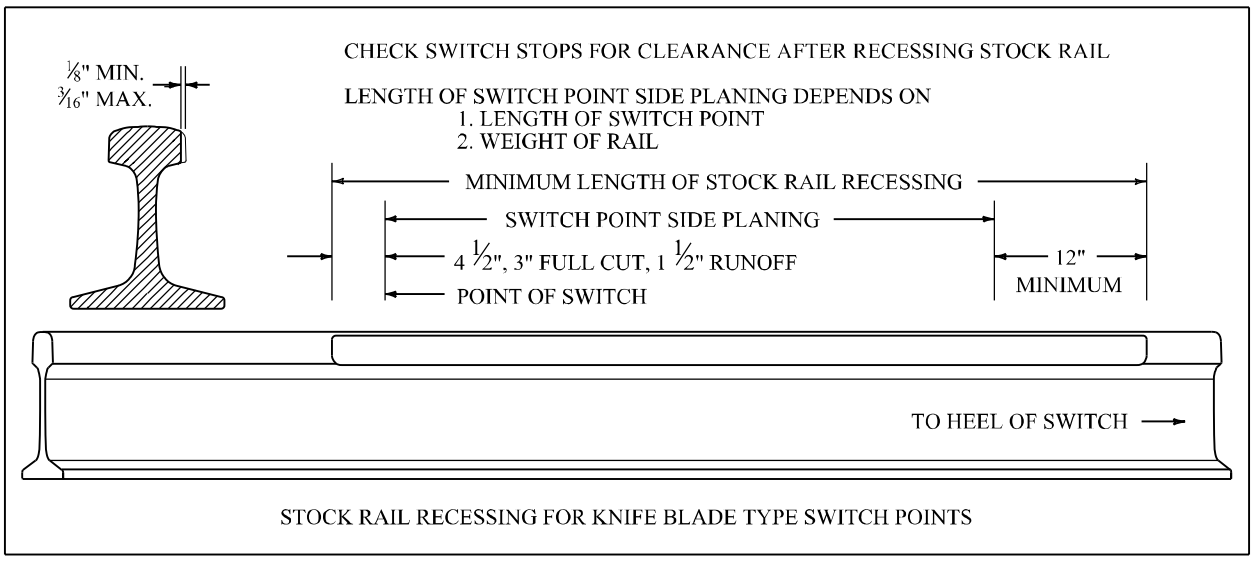
Sketch F-1



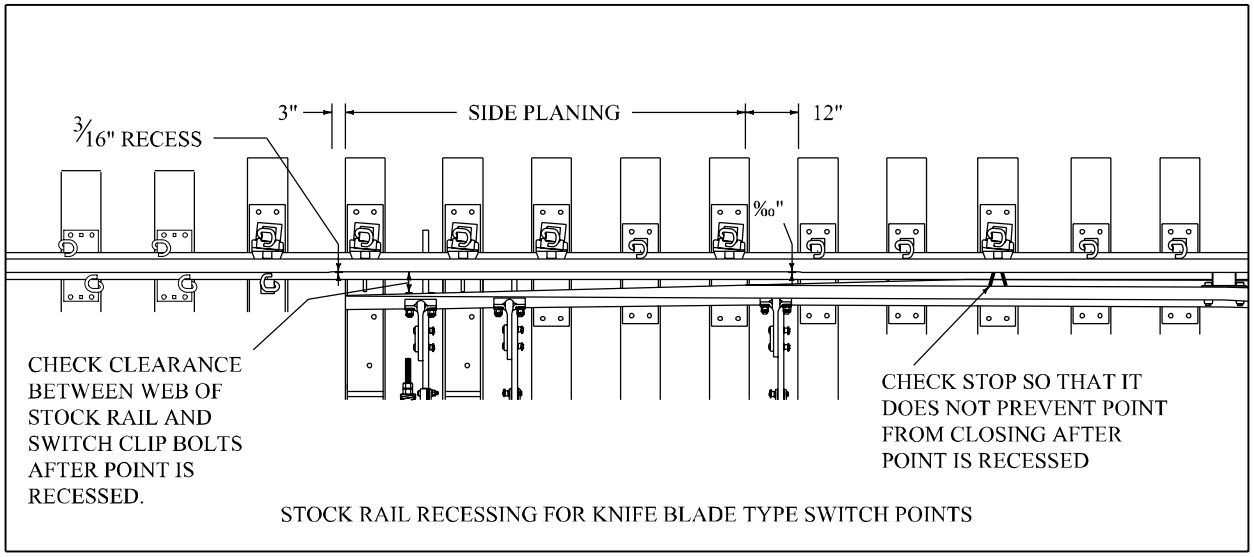
Sketch F-2



Sketch F-3



Sketch F-4



Sketch F-5

G. REPAIR AND MAINTENANCE GRINDING OF FROGS AND RAILROAD CROSSINGS:

TECHNICAL NOTES ABOUT MANGANESE CASTINGS

1. Manganese steel track components are comparatively soft (approximately 200 - 220 Brinell) when produced. Most items including frog castings are hardened (approximately 352 Brinell) before being placed in service. Other items are allowed to work harden.

2. Manganese steel work hardens by plastic flow of the metal grain structure under rolling wheel loads and impacts. This flow or deformation of the relatively soft metal results in a bead or ridge forming on the top edges of the frog points and wings usually on both sides of the flangeway and on the gage side of the flangeway in railroad crossings. The flow or deformation will slow as the hardness of the top surface increases by cold rolling under traffic.

3. Formation of this bead or ridge may narrow the flangeway opening. If this bead is allowed to form to the maximum, it can cause the frog to fail. The bead will become extremely hard. The wheel flanges will cause the bead to chip or spall, often very deeply into the casting. This is the reason all frogs, crossings, and other track components **must be ground to prevent premature cracking and welding.**

4. New manganese track components should be inspected frequently in the first few months after installation. **New manganese track components must have maintenance grinding**

performed weekly as needed for a period of one month. Newly repaired manganese components should be maintenance ground at least once per week as needed for a period of three weeks. When the bead or flow of metal starts to form, it should be removed by grinding. This grinding must be done several times until the top surface has work hardened to the maximum hardness and flowing has stopped. The time to reach maximum hardness depends on the tonnage passing over the track component.

5. Grinding should be confined to the top edges where overflow has occurred. No grinding should be done on the top surface, other than what is necessary to correct a mismatch or dress temporary wear ramp pads, as this will remove work hardened material.

6. A radius of 3/8" to 5/8" between the top and gage face should be ground on the wings and point. There should be no sharp edges. Sharp edges become hard and brittle under wheel loads and may spall, crack, or chip when contacted by the wheel flange.

7. Welding should not be done on practically new castings except to correct conditions that cannot be eliminated by grinding.

8. A thorough examination should be made of an older frog before a decision is made to weld the frog as **grinding can correct many problems**. Excessive heat can reduce the strength of manganese steel.

9. Slot grinding should be done at regular intervals to reduce chipping and spalling. The areas to be ground are those where the manganese casting is in rigid contact with wing and heel rails, the heel of the frog casting, and rail joints if the frog is not welded into track.

GENERAL

1. The manganese steel components of frogs and railroad crossings will be repaired through the use of the electric-arc welding process. Should the repair require more than thirty minutes, a wire feeder must be used. The rail components will be repaired using the techniques described in the appropriate rail repair section.

2. In the repair of manganese steel castings, it is of great importance to keep the heat build up caused by the welding process as low as possible. Manganese steel castings are heat treated at the foundry. Lack of attention to heat build-up will permanently destroy this heat treatment and will cause the casting to become brittle. The area of the casting being repaired must be kept less than **500°F** at all times.

3. Where compressed air is available, it is to be used to cool the area worked on manganese steel castings.

4. Water-cooling is also an acceptable option for cooling the area worked on manganese steel.

If water cooling techniques are employed, remove the carbon block if used, clean, peen, and then use a spray bottle (like a garden sprayer) or a bottle with a hole in its top to douse the weld with water until the water stops boiling on the weld. Use compressed air or a wire brush to remove excess water from the flangeway. The flangeway may be left damp, but the carbon block should never be applied in freestanding water. (Note: Only water (no additive) is to be used for the purpose of water-cooling. If an additive (windshield washer fluid, RV anti-freeze, etc.) is used in the water storage system to prevent freezing, this treated water CANNOT be used to control the heat build up in manganese steel.

5. When it becomes necessary to weld frogs there are certain practices that must be followed. These are:
    a. **Weld only on clean, sound, non-work-hardened metal (NOT THIS)**.

    b. Apply minimum heat to the base metal.
    c. Use welding procedures that produce the minimum thermal stress in the weld deposit.
    d. Use of a power blower is mandatory when welding or grinding manganese.
    e. Respirator use is mandatory if blower is broke or not available.
    f. Power blower

USE OF AIR CIRCULATER FAN

DO'S

a. Fan may be used by Thermite (field) Welding Team while make field welds to circulate air for cooling personnel in warm or hot temperatures.

b. Fan should be placed far enough from ongoing work as not to cause a tripping hazard, (suggested 10'), never in the foul of any track and should be placed on a level surface as not to turn over.

c. Fan must be plugged into a Ground Fault Circuit Interrupter (GFCI) receptacle or a portable GFCI must be used if power source doesn't have one provided.

d. Fan should be used in fair weather conditions.

e. When storing fan, it should be covered with a tarp, or some type of covering as to keep dry as much as possible. (Some teams have used grill covers to suffice for this).

f. Fan also may be used to blow smoke fumes away while welding on manganese frogs, or any type of weld repair.

DONT'S

a. Fan will not to be used in inclement weather conditions, such as rain, snow, sleet, etc.

b. Fan is not to be placed in a wet location or puddles, even if the weather conditions are dry, such as a mud location in track. Move to a dry area.

c. Fan will not be used if any portion of the grilling, cord or safety guard area is damaged or missing. Authorized repairs must be made or the fan replaced.

d. If an extension cord is used for powering the fan, it must be rated to match or exceed that of the fan.

e. If the fan is placed in track, the power cord is to either be run under rail in center of check not touching any metal portion of rail, rail anchor or tie plate. If it isn't run under the rail, it must have a rubber pad or some type insulator between power cord and rail. (A round pipe insulator works well for this application).

f. The fan must not blow directly on weld arc. Doing this will blow away the shielding gas which causes porosity holes.

6. There are usually three reasons that a frog must be welded.
    a. Cracks have developed to the point where a weld repair is necessary to make the frog safe and prevent further damage.
    b. The point needs to be built up because of wear or depression.
    c. Large sections have broken out, or deep sections are to be removed to correct spalling, chipping, or cracking.

7. Turnout and railroad crossing frogs must be rebuilt before the point is chipped, broken, or worn more than 5/8" down and 6" back, which is the FRA 10 MPH Slow Order Limit (FRA §213.137 (B)).

8. Turnout and railroad crossing frogs should be rebuilt when the tread surface has worn ¼" below the original surface, but must be rebuilt before the tread wear exceeds 3/8", which is the FRA 10 MPH Slow Order Limit (FRA §213.137 (C)).

9. Self-guarded frogs should be rebuilt when the raised guard has worn ¼" from the original contour, but must be rebuilt before the wear exceeds 3/8" (FRA §213.141 (A).

10. Conformal frogs with wrap rails and boltless conformal frogs must be repaired before the point is chipped, broken, or worn more than 5/8" down and 6" back, which is the FRA 10 MPH Slow Order Limit (FRA 213.137 (B). The notched straight edge gauge designed to determine the depth of wear or damage on conformal frogs must be used. The correct notched gauge for measurement is dependent on the type of conformal frog being inspected.

11. Approved welding rods and wires for manganese steel frog repairs are on page N-1.

12. The Signal Maintainer will be notified in advance whenever welding is to be performed in track circuit territory.

13. See *Section "A", Safety*, for instructions for electric arc welding in track circuit territory.

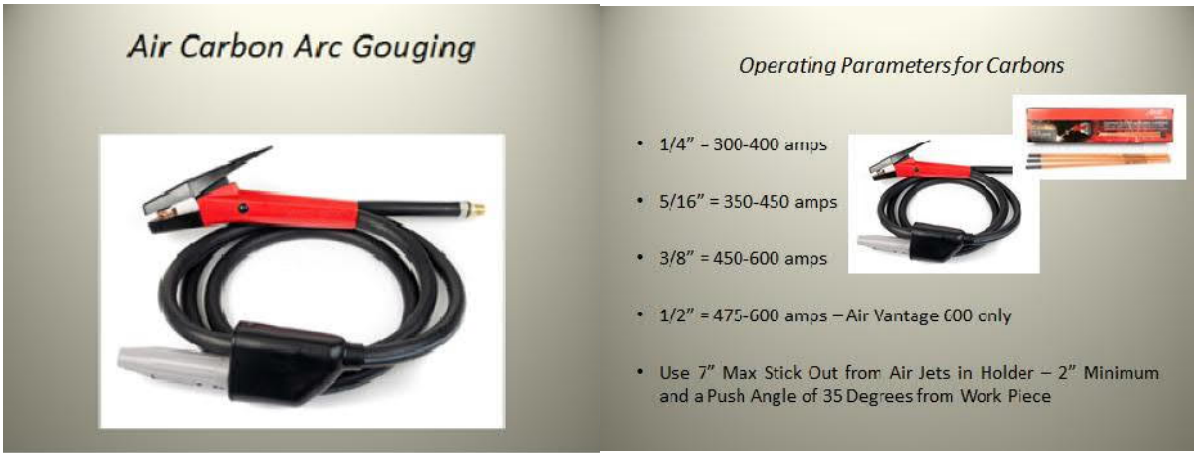
PRELIMINARY WORK

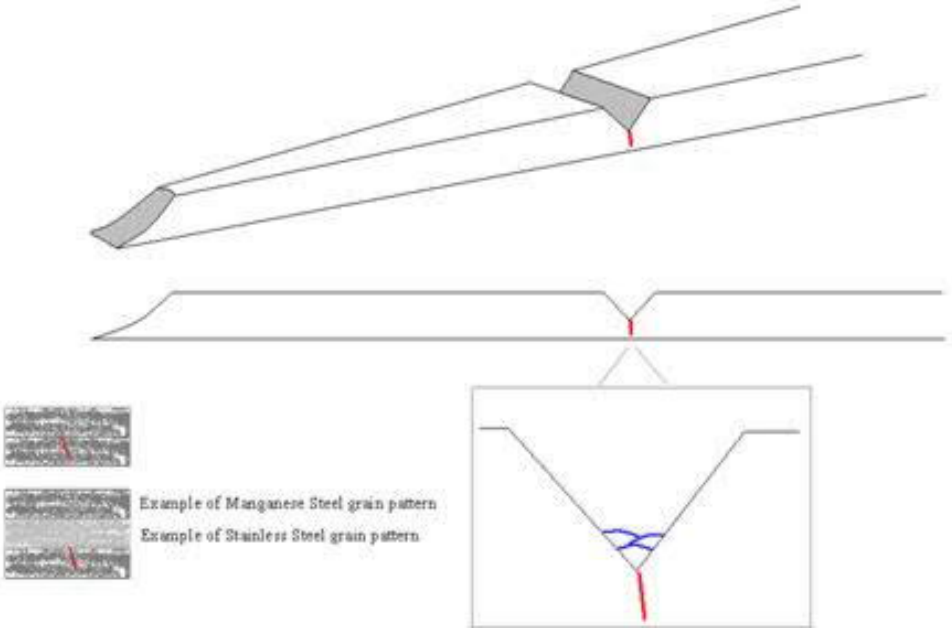
1. Prior to welding, frogs and railroad crossings must be inspected in the following areas and corrections made as required.

a. Good surface and crosslevel from ahead of the toe joint to past the heel joint. Defective ties should be replaced and tamped.
b. Measure guard check gage and guard face gage and correct, if necessary.
c. Check and tighten frog, guardrail, and joint bolts. Torque bolts in compliance with MWI 707 to equalize wear on bolts.

2. The running surface of the casting usually has areas that are not greatly worn. By using a 36" straight edge in these areas, low spots and the amount of build up can be determined. Lightly grind the entire running surface of the casting and inspect for cracks. More grinding will be required at high impact points which are at the frog point, the wings next to the point, and at the rail joints.

3. Manganese steel work hardens under impact. Arc gouge or grind out all loose, deteriorated, cracked, and work hardened material to clean parent metal. All cracks must be "veed" their full length and depth. Cracks will be sealed and a buffer pad of 2 layers of an approved stainless rod will be applied. Do not deposit any stainless closer than **3/4"** to a running surface. Care must be taken to ensure that all defective material is removed. **NEVER** use a torch to prepare manganese steel components. A grinding depth of 1/8" is usually sufficient but 3/16" may be required in high impact areas. Sharp edges along the flangeway are to be removed.


Air Carbon Arc Gouging
Operating Parameters for Carbons
• 1/4" – 300-400 amps
• 5/16" = 350-450 amps
• 3/8" = 450-600 amps
• 1/2" = 475-600 amps – Air Vantage 600 only
• Use 7" Max Stick Out from Air Jets in Holder – 2" Minimum and a Push Angle of 35 Degrees from Work Piece


Example of Manganese Steel grain pattern
Example of Stainless Steel grain pattern

4. If the Welder has been specifically trained in the use of air-arc metal removal or the use of a slice torch, it may be used. Air or water may be used to assist in cooling the manganese steel casting, following the manufacturer's recommendations.

The Welder must monitor the temperature of the casting during the repair by using an approved thermometer or a 500°F Tempilstik. To use the Tempilstik, mark the component approximately ½" below the surface on which the weld metal will be deposited. If the Tempilstik mark melts during the welding process, the welding must be stopped. Welding at another location on the component is advisable, while the original location is allowed to cool.

PROCEDURE FOR REPAIRING RAILBOUND MANGANESE FROGS AND RAILROAD CROSSINGS

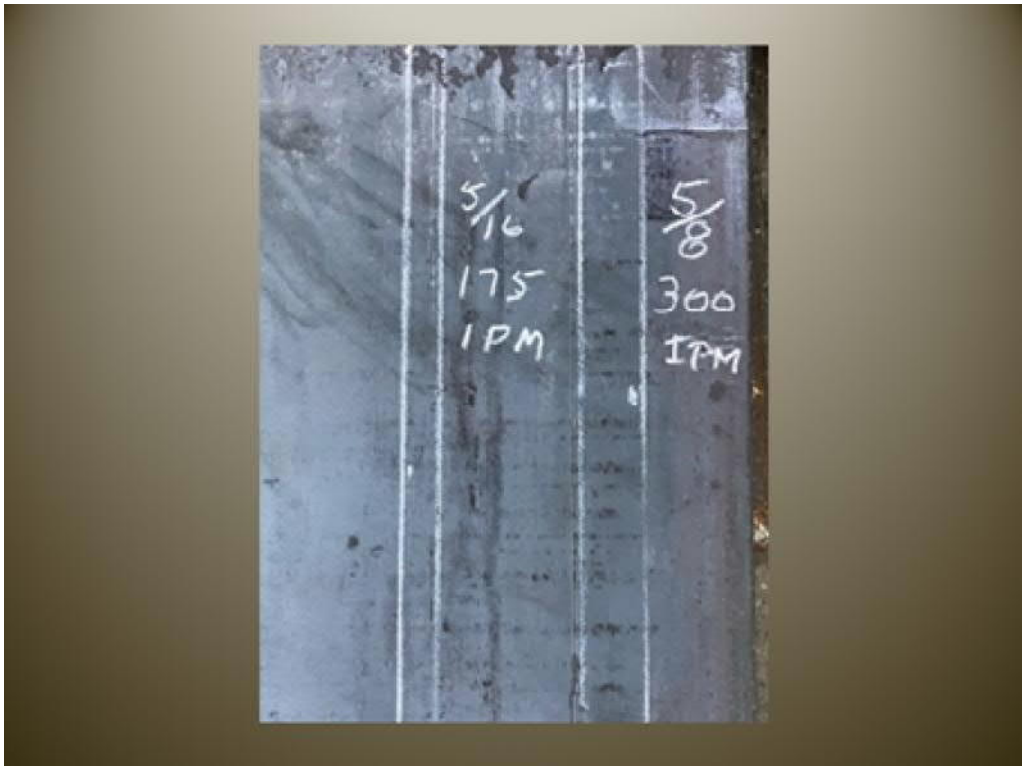
1. Be sure that the ground connection is securely attached to the component.

2. Use an approved wire or 3/16" welding rod for the electric-arc process. The type electrode to be used depends on the depth of the metal that must be laid down.

3. Use a standard flangeway gauge (See Sketch G-3) to check the flangeway opening and riser slope as welding progresses.

4. **Never** preheat manganese steel. If below 32° F, take the chill out of the casting.

5. Proper voltage or amperage is required by the work being done and the size and type of wire or rod being applied will be used. Make the weld at such a rate that the bead will not be wider than 5/8" nor higher than 3/16".



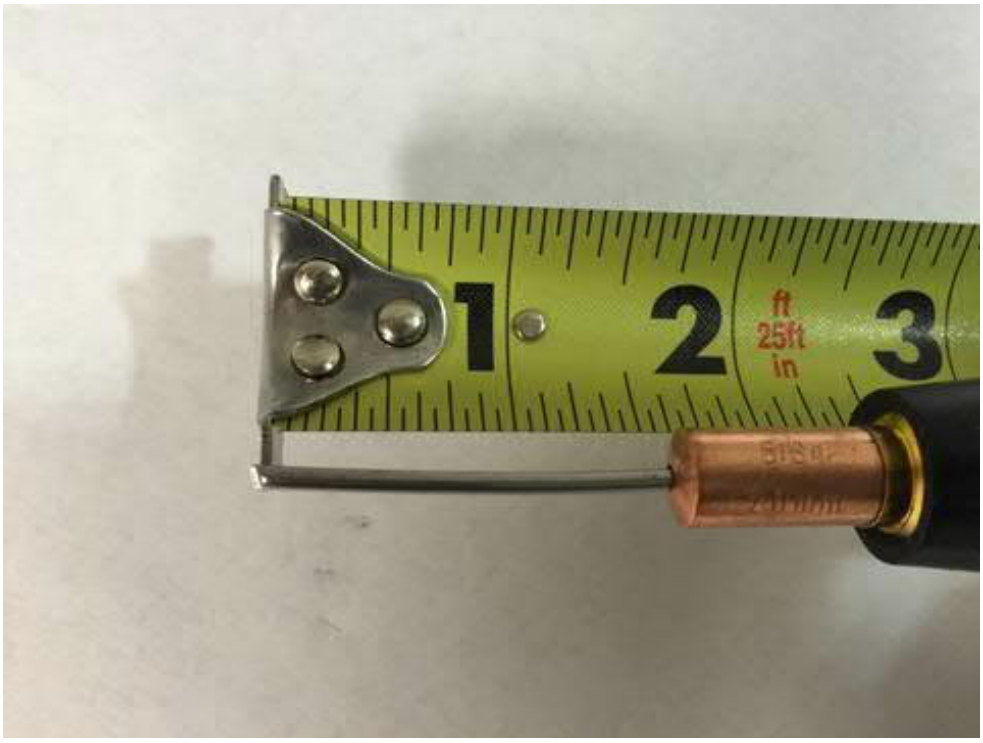
6. **Skip weld whenever possible.**

Wire Preparation

- Verify wire size and place on feeder
- Use cold feed or gun trigger to slowly feed wire through the feed roll and gun mechanism
- Remove tip from gun to feed wire beyond the end of the gun tube. Slide tip over wire and tighten and establish 1 ¼" – 1 ½" stick out
- Begin welding and read wire feed meter to get 28 volts. This may require minor adjustment to the fine control on the welding machine

Welding On Variable Thicknesses

- Use Wire Feed Speed adjustment to avoid heat buildup in small base metal parts
- The lower the wire feed speed the lower the amperage
- The higher the wire feed speed the higher the amperage
- *Min* WFS 175 IPM – *Max* WFS 300 IPM (Frog Mang)
- The shorter the stick out the higher the amperage
- The longer the stick out the lower the amperage
- Maintain same travel speed (5/16" stringer bead)
- *Min* ESO 1 ¼" – *Max* ESO 1 ½"



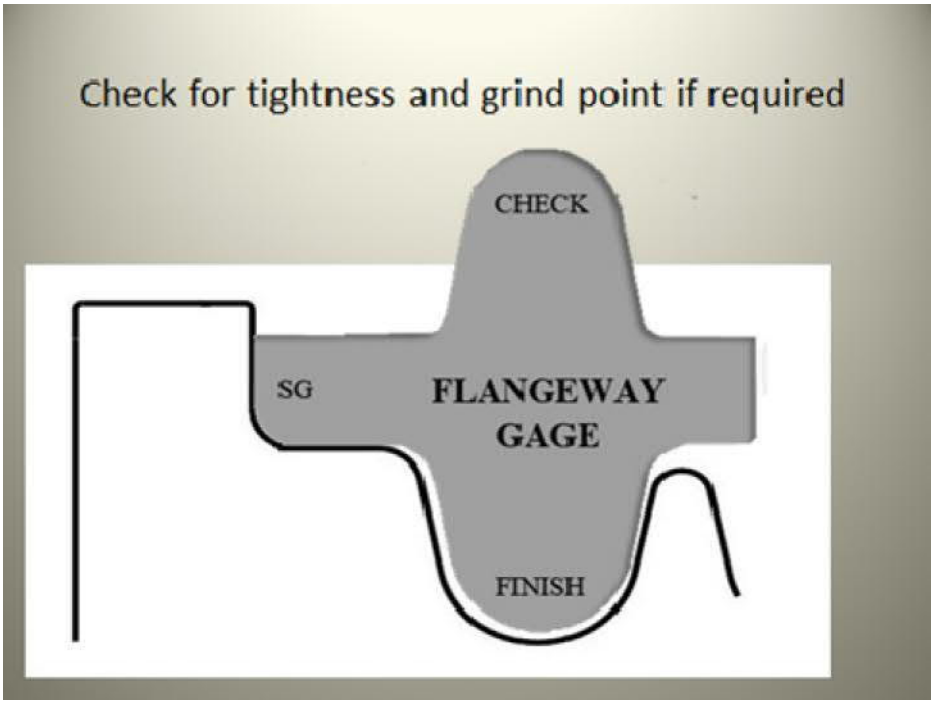
7. Beads should not start or stop at the edge of the casting.

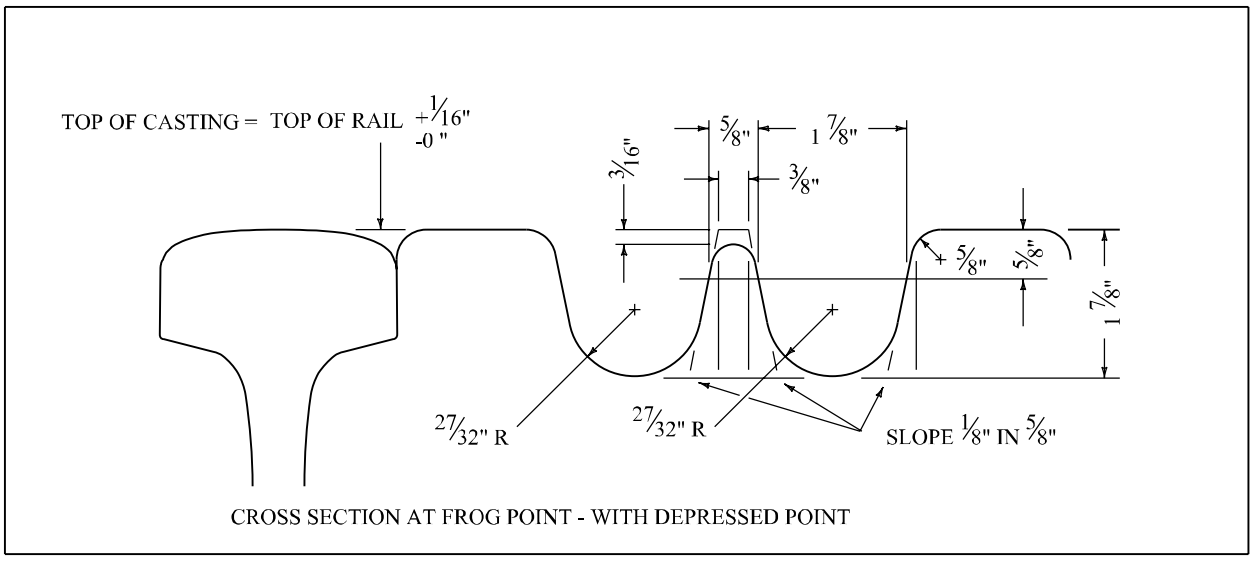
8. Every bead must be cleaned and peened to relieve stresses before depositing the next bead. NOTE: Weld beads making up the stainless buffer pad should NOT be peened.

9. The final deposits should be built up high enough, so that when the grinding is completed, there will be no welding marks or seams visible and the finished surface will be smooth. In the wheel transition area of the frog, **the point and the wing rails must be finished to the same level, even if the repair is not completed at this time**. Plans must be made to return and complete the repair.

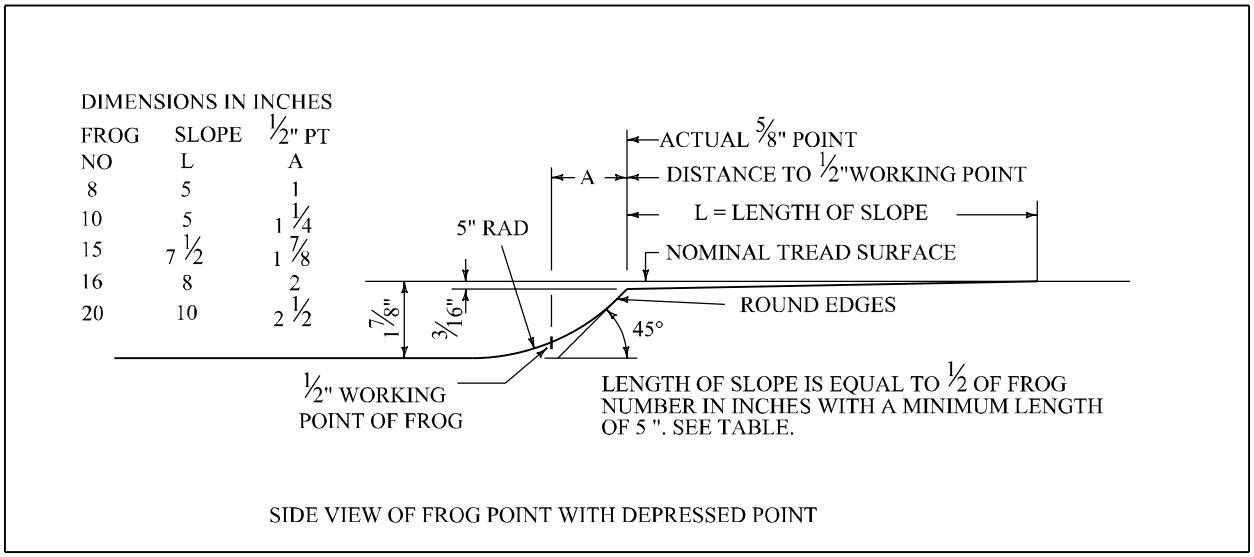
10. The built-up casting should be carefully ground and contoured. Special attention must be given to restoring a smooth and even running surface and to restoring the corner radii. Do not leave sharp corners. Use the flangeway gauge and 36" straight edge often during grinding to check openings, flat running surface (no waves) and radii.

11. After grinding, the welder will check the casting using a 36" straightedge and frog flangeway gauge. The surface tolerance is 0" low and 0.030" high. The top of the frog point will be low at the point and taper up to zero, as shown on Sketches G-1 and G-2. The flangeway will conform with the flangeway gauge, as shown on Sketch G-3.

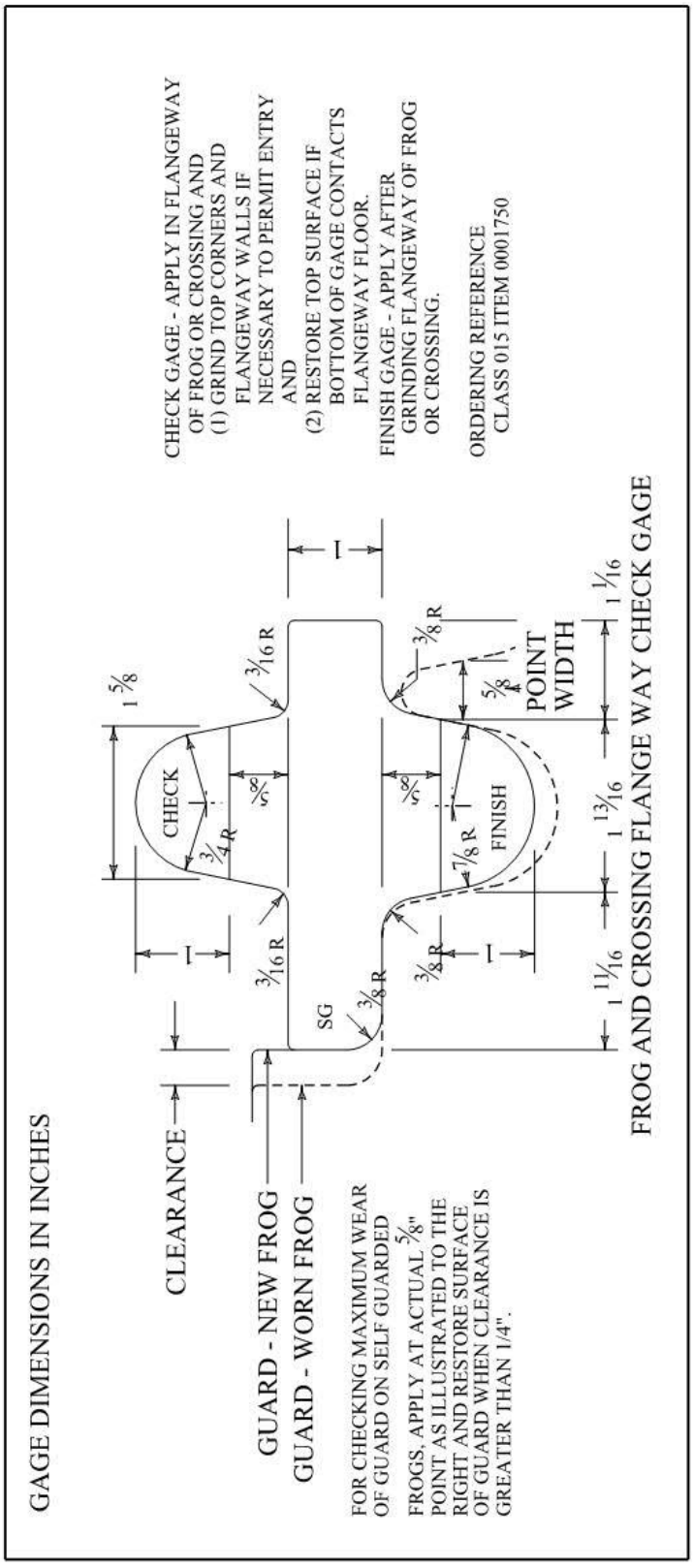




Sketch G-1



Sketch G-2



Sketch G-3

12. The junction between the castings and rail components will be slotted 1/8” wide and ¼” deep to prevent chipping and spalling of the metal.

13. Measure the guard check gage and the guard face gage after grinding is completed to be sure it has not been changed (See Sketches G-45 and G-56).
14. After each welding repair to a frog is completed, a short weld bead or "hash mark" will be placed on the top of the heel end of the wing rail. These marks will indicate the number of repairs each frog has required. This is not needed anymore due to DTW Reporting System.

15. For OWLS crossings, ensure excessive metal flow is removed on both the manganese casting and on the main line continuous running rail. Only remove metal flow and do not remove parent metal. Grooving on the main line continuous running rail is to be expected.

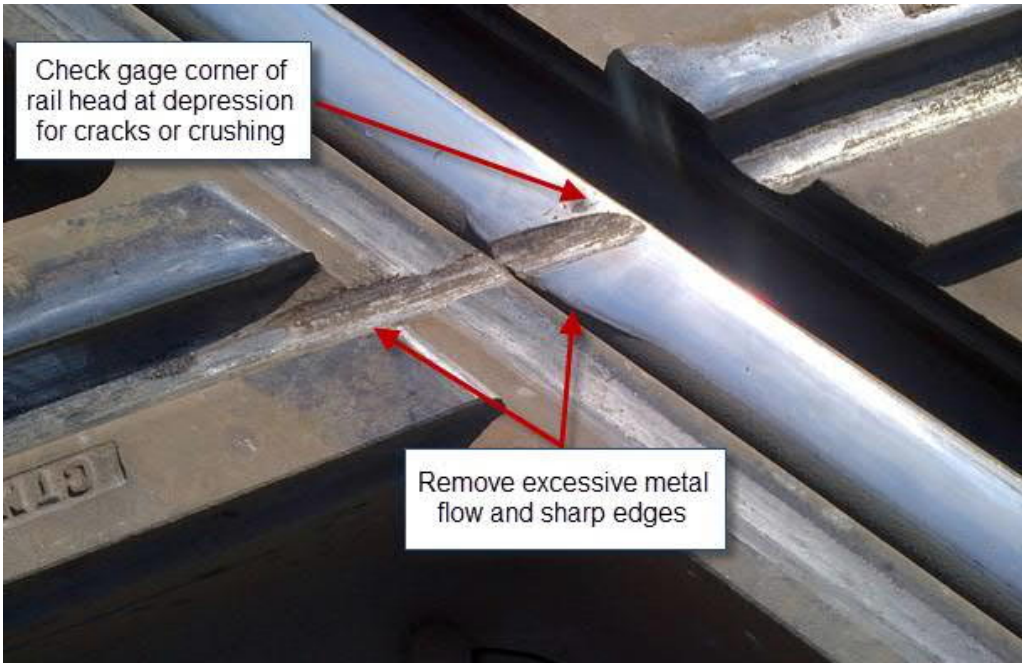
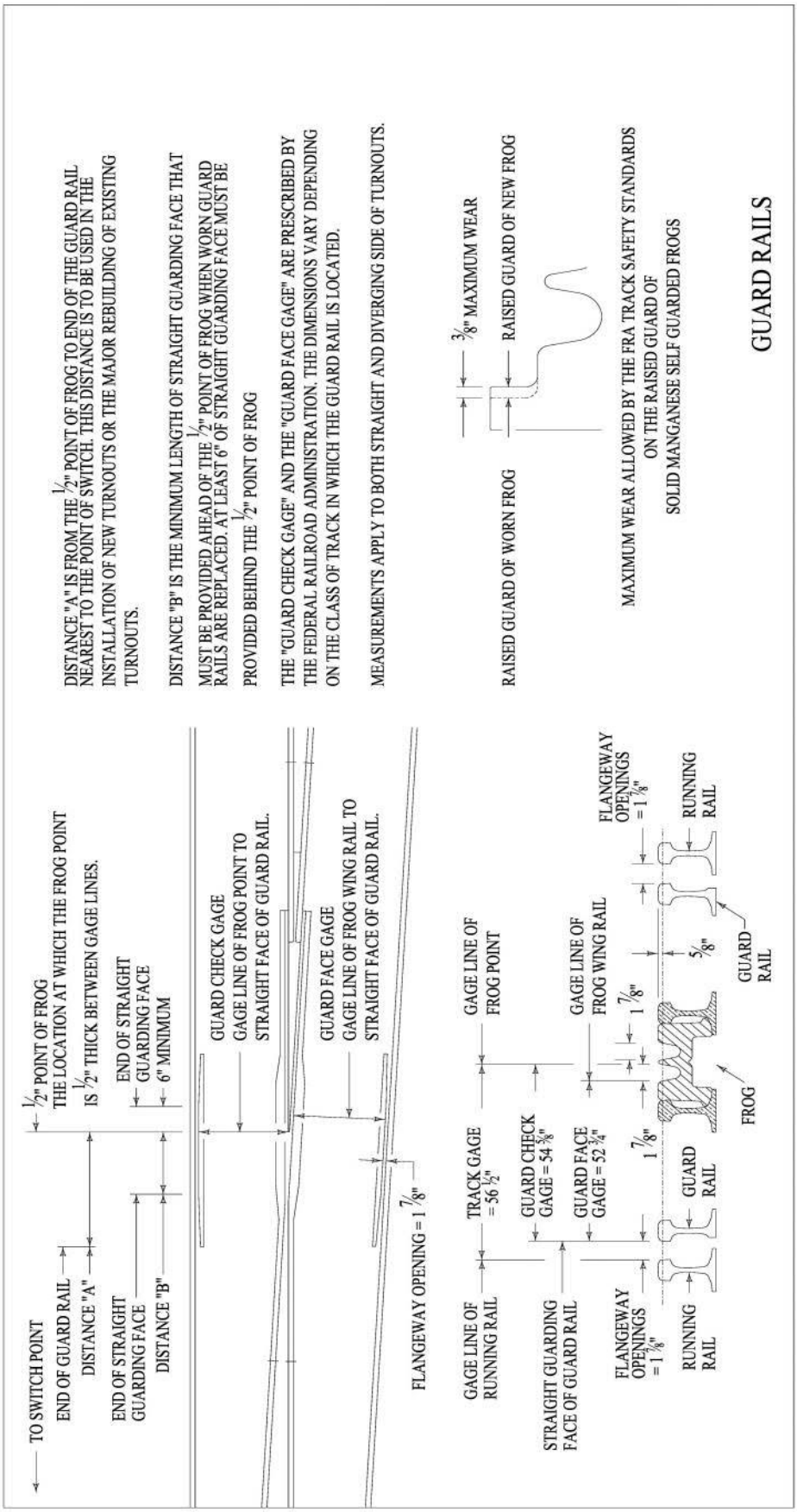
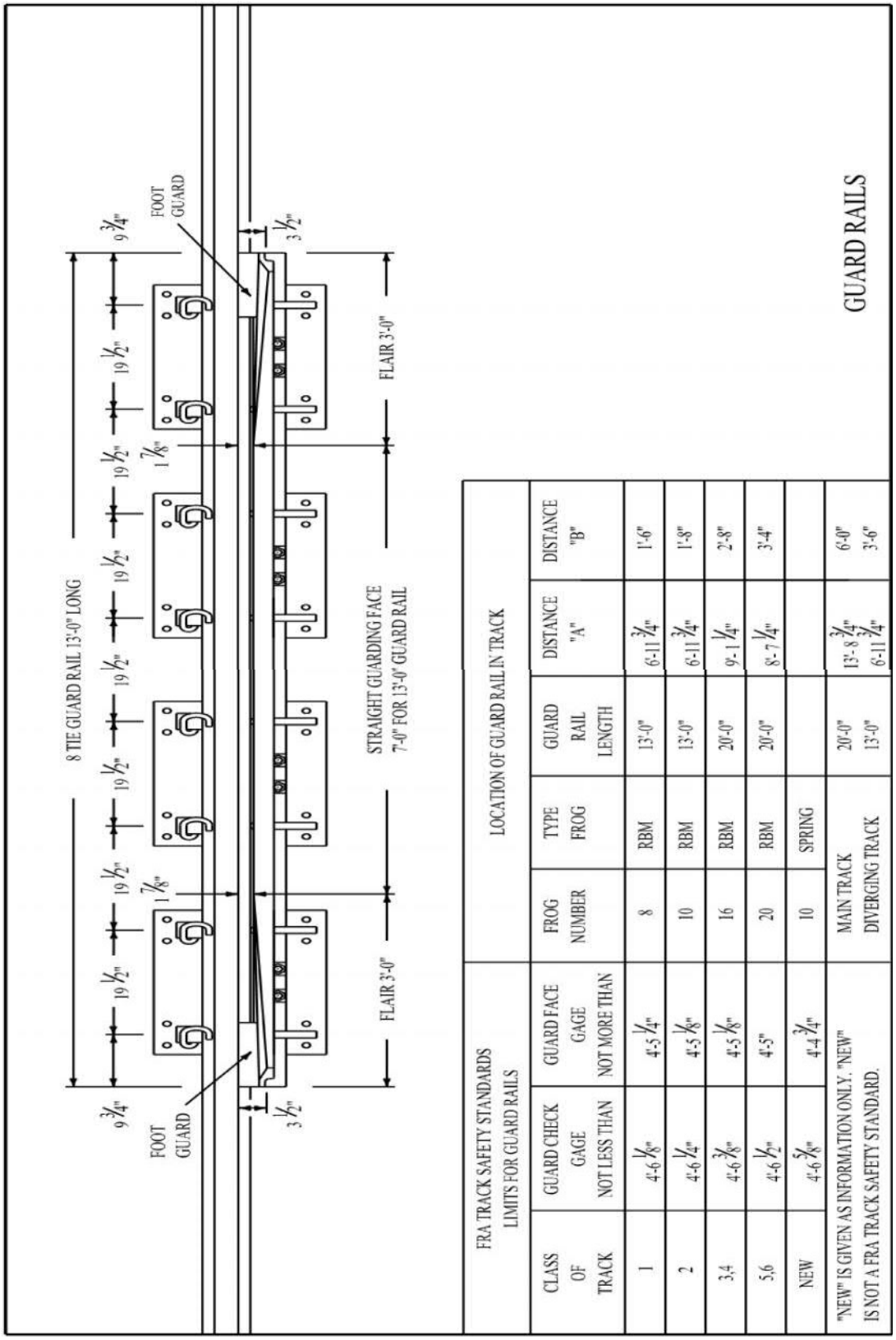


Photo G-1


GUARD RAILS
DISTANCE "A" IS FROM THE ½" POINT OF FROG TO END OF THE GUARD RAIL NEAREST TO THE POINT OF SWITCH. THIS DISTANCE IS TO BE USED IN THE INSTALLATION OF NEW TURNOUTS OR THE MAJOR REBUILDING OF EXISTING TURNOUTS.
DISTANCE "B" IS THE MINIMUM LENGTH OF STRAIGHT GUARDING FACE THAT MUST BE PROVIDED AHEAD OF THE ½" POINT OF FROG WHEN WORN GUARD RAILS ARE REPLACED. AT LEAST 6" OF STRAIGHT GUARDING FACE MUST BE PROVIDED BEHIND THE ½" POINT OF FROG
THE "GUARD CHECK GAGE" AND THE "GUARD FACE GAGE" ARE PRESCRIBED BY THE FEDERAL RAILROAD ADMINISTRATION. THE DIMENSIONS VARY DEPENDING ON THE CLASS OF TRACK IN WHICH THE GUARD RAIL IS LOCATED.
MEASUREMENTS APPLY TO BOTH STRAIGHT AND DIVERGING SIDE OF TURNOUTS.
⅜" MAXIMUM WEAR
RAISED GUARD OF NEW FROG
RAISED GUARD OF WORN FROG
MAXIMUM WEAR ALLOWED BY THE FRA TRACK SAFETY STANDARDS ON THE RAISED GUARD OF SOLID MANGANESE SELF GUARDED FROGS
TO SWITCH POINT
½" POINT OF FROG
THE LOCATION AT WHICH THE FROG POINT IS ½" THICK BETWEEN GAGE LINES.
END OF GUARD RAIL
DISTANCE "A"
END OF STRAIGHT GUARDING FACE
DISTANCE "B"
6" MINIMUM
GUARD CHECK GAGE
GAGE LINE OF FROG POINT TO STRAIGHT FACE OF GUARD RAIL.
GUARD FACE GAGE
GAGE LINE OF FROG WING RAIL TO STRAIGHT FACE OF GUARD RAIL.
FLANGEWAY OPENING = 1 ⅞"
GAGE LINE OF RUNNING RAIL
TRACK GAGE = 56 ½"
GAGE LINE OF FROG POINT
STRAIGHT GUARDING FACE OF GUARD RAIL
GUARD CHECK GAGE = 54 ⅜"
GUARD FACE GAGE = 52 ¾"
GAGE LINE OF FROG WING RAIL
FLANGEWAY OPENINGS = 1 ⅞"
1 ⅞"
1 ⅞"
5/8"
FLANGEWAY OPENINGS = 1 ⅞"
RUNNING RAIL
GUARD RAIL
FROG
GUARD RAIL
RUNNING RAIL

Sketch G-4



FRA TRACK SAFETY STANDARDS LIMITS FOR GUARD RAILS			LOCATION OF GUARD RAIL IN TRACK				
CLASS OF TRACK	GUARD CHECK GAGE NOT LESS THAN	GUARD FACE GAGE NOT MORE THAN	FROG NUMBER	TYPE FROG	GUARD RAIL LENGTH	DISTANCE "A"	DISTANCE "B"
1	4'-6 ⅛"	4'-5 ¼"	8	RBM	13'-0"	6'-11 ¾"	1'-6"
2	4'-6 ¼"	4'-5 ⅜"	10	RBM	13'-0"	6'-11 ¾"	1'-8"
3,4	4'-6 ⅜"	4'-5 ⅜"	16	RBM	20'-0"	9'- 1 ¼"	2'-8"
5,6	4'-6 ½"	4'-5"	20	RBM	20'-0"	8'- 7 ¼"	3'-4"
NEW	4'-6 ⅝"	4'-4 ¾"	10	SPRING			
"NEW" IS GIVEN AS INFORMATION ONLY. "NEW" IS NOT A FRA TRACK SAFETY STANDARD.			MAIN TRACK		20'-0"	13'- 8 ¾"	6'-0"
			DIVERGING TRACK		13'-0"	6'-11 ¾"	3'-6"

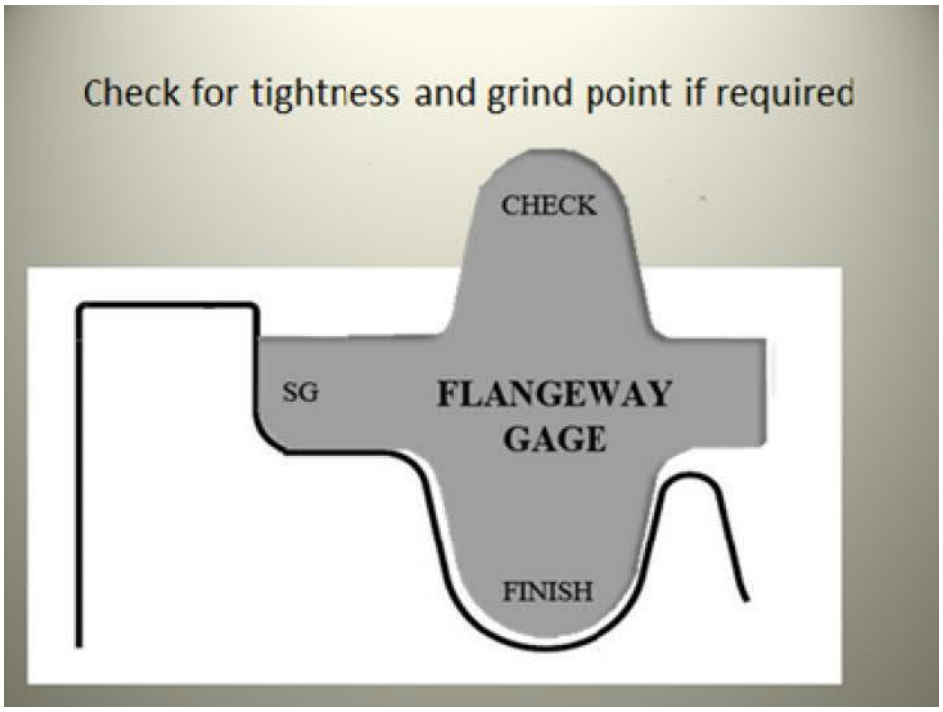
Sketch G-5

PROCEDURE FOR REPAIRING SELF-GUARDED MANGANESE STEEL FROGS

1. The procedures specified for railbound manganese steel frogs are to be used for self guarded frogs.

2. Additional requirements for self-guarded frogs:

   a. The guards on self-guarded frogs must be welded and ground to contour prior to welding the point and wings of the frog.
   b. Check the amount of wear on the raised guard by placing the gauge in the flangeway at the actual point (5/8" Point). It may necessary to remove the flow from the flangeway to permit entry of the gauge. If the clearance between the "SG" end of the gauge is more than ¼", the guarding face should be repaired. It must be repaired before the clearance exceeds 3/8".
   c. To repair the guarding face of a frog under traffic, first place a ¼" bead at the top of the guard to ensure that the frog point is protected. Then begin at the bottom and build toward the top. After all welds have been made and ground, use the gauge to check the work.
   d. Check the point, wings and flangeway of the frog by placing the gauge, "check" side down, into the flangeway. If the gauge contacts the flangeway floor, the running surface of the frog must be built up and ground to a true surface using the same repair techniques employed on other manganese steel frogs and railroad crossings.
   e. Build up the point if required.
   f. After the point, wings and flangeway repairs are completed recheck the guard by using the gauge. If the clearance between the gauge and the guard is too tight, further grinding should be done on the point, not the guard, to provide the correct clearance.



PROCEDURE FOR REPAIRING SPRING FROGS

1. Inspect frog for rail flow, broken bolts, proper clearance between horns and housing, welds or bolts securing housing to plates, spring tension for wing rail, chipping or other damage to point and other frog parts. See MWI 609 Inspections and Maintenance of Spring Frogs.

2. Rail ends on frogs will be repaired using the appropriate techniques for repairing fully heat-treated rail or head hardened rail described in this manual. Any additional welding repairs on spring frogs will not be made until the welding manager is contacted.

PROCEDURE FOR REPAIRING BOLTED RAIL FROGS AND RAILROAD CROSSINGS

General

1. Rail end batter in fully heat treated rails, head hardened rails and rails in contact with manganese steel castings will be repaired through the use of the electric-arc welding process.

2. Rail ends, that are battered, chipped or spalled, should be repaired to prevent further damage to the rail ends and accelerated deterioration of the other track components.

3. Rail end repairs should be made when the batter reaches the limits as listed below:
   1/8 inch (0.125") where freight train speed exceeds 60 MPH
   1/4 inch (0.250") where freight train speed exceeds 40 MPH
   3/8 inch (0.375") where freight train speed exceeds 10 MPH
   1/2 inch (0.500") where freight train speed is 10 MPH or on excepted track.

4. Batter is the distance, measured in thousandths of an inch, between an approved 36" straightedge and the top of rail 1/2 inch in from the end of the rail as shown in Sketch D-1.

5. Slot grinding to prevent chipping due to overflow will performed on rail ends and the area between parallel rails.

Preliminary Work

Prior to welding, frogs and railroad crossings must be inspected in the following areas and corrections made as required.

1. Good surface and cross level from ahead of the toe joint to past the heel joint. Defective ties should be replaced and tamped.

2. Measure guard check gage and guard face gage and correct, if necessary.

PROCEDURE FOR REPAIRING BOLTED RAIL FROGS AND RAILROAD CROSSINGS

1. Be sure that the ground connection is securely attached to the component. Use of a magnetic ground clamp is recommended.

2. Approved welding rods and wire for welding the rail ends of frogs are listed on Page N-2.

3. Use a flangeway gauge to check the flangeway opening as welding progresses (See Sketch G-3).

4. Use an approved 36" straightedge to mark the limits of the repair. The repair limits should be marked at an angle across the top of rail so that the length of the repair on the gage side will be approximately one inch (1") longer than on the field side.

5. Rail ends to be repaired must be clean, free from dirt, dust, oil, grease or other foreign substance. Grind out all damaged metal down to sound and clean parent metal. The removal must not be accomplished through the use of a torch.

6. Before welding, preheat the ground railhead to approximately 800°F for a distance of 8" beyond the weld area in each rail requiring repair. Carefully examine it for cracks. Cracks will appear as dark hair lines in the heated area. If cracks are present, further grinding is required.

7. Welding must begin immediately after preheating and the 800°F preheat maintained in the area surrounding the repair.

8. The welding should proceed as beads across the railhead. Each bead must be peened while the deposit is hot to relieve welding stresses. The weld should be extended beyond the rail end and the excess metal removed by slotting after the weld is completed.

9. Enough weld material should be deposited so that the unground surface will be higher than the rail and that grinding will eliminate the visible welding marks and seams.

10. With fully heat treated and head hardened rails, post-heat the welded area to approximately 800°F immediately after the welding operations. After post-heating, it is most important that the rail cool slowly to 200°F. It may be necessary to protect the weld area with a welding blanket to obtain the desired slow cooling and against rain, snow, etc.

11. It is very important that preheating and post-heating be diligently performed to obtain a quality repair weld.

12. Use the surface grinding attachment to grind the weld area to a smooth surface and true rail contour.

13. After the welds are made and allowed to cool, an inspection must be made to determine the straightness of the rail. Use an approved 36" straightedge. Surface tolerance is -0.000 inch/ +0.030 inch

PROCEDURE FOR REPAIRING CONFORMAL FROGS

Conformal frogs have been in use on Owner's Railroad since 2008. The conformal frog design protects the frog point and permits longer life before the first weld repair is required as compared to older standard RBM flat frogs. To ensure the correct methodology of inspecting and repairing of conformal frogs is used, the following procedure is adopted.

The point tread is contoured at a 1:20 ratio of slope (3 degrees) as well as the wing tread or riser portion of the casting to meet the contour of new wheels on the trucks. It is normal for a wear pattern to form in a conformal frog on the wing tread portion. See photos G-2 and G-3.

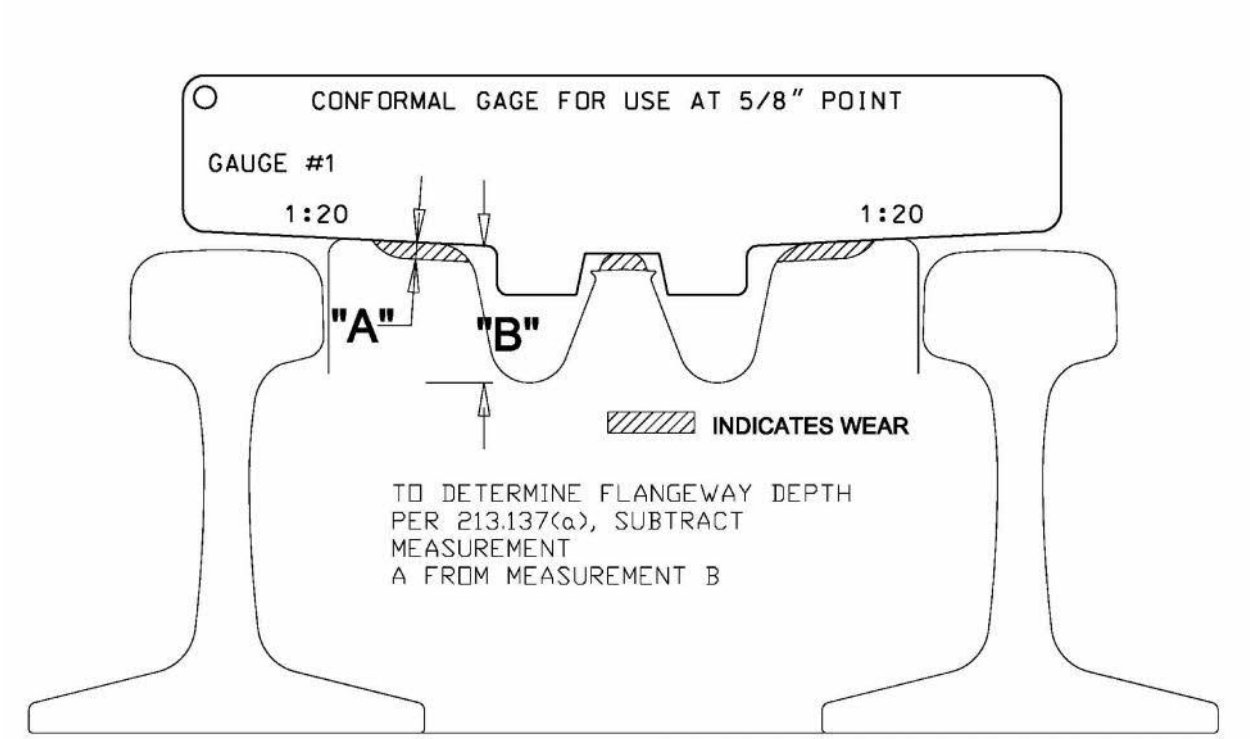
This section addresses the maintenance and repair of conformal frogs with wrap rails (RBM) and boltless frogs. The weld repair of a boltless conformal frog is the same as for the conformal frogs with wrap rails. The gauge set for checking wear can be used for both the conformal frog with wrap rails (RBM) and boltless.

Photo G-2

Photo G-3

After the frog has been in service for a period of 60 days, the "humped" up metal left on the wing tread portion of the frog should be removed by grinding from the point of where the second gauge (shown later) is placed on the frog (where the point is 1 9/16" spread) to a height level with a straight edge. The humped up metal is caused by excess metal flow. The location of the second gauge is dependent on the frog size. See Table 1 in this section for the proper location of the second gauge. This will help determine true wear on the frog. A welding manager should be contacted to help ensure this is done correctly.

During routine inspections, place the conformal frog gauge #01 along the top of the casting. The outer edge of the casting does not have tread wear and can be used to support the conformal frog gauge. See Sketch G-6 below on the following page (NEED TO UPDATE). If the tread wear exceeds 3/8" below wrap rail height, the wing tread must be repaired or slow order to 10 mph.

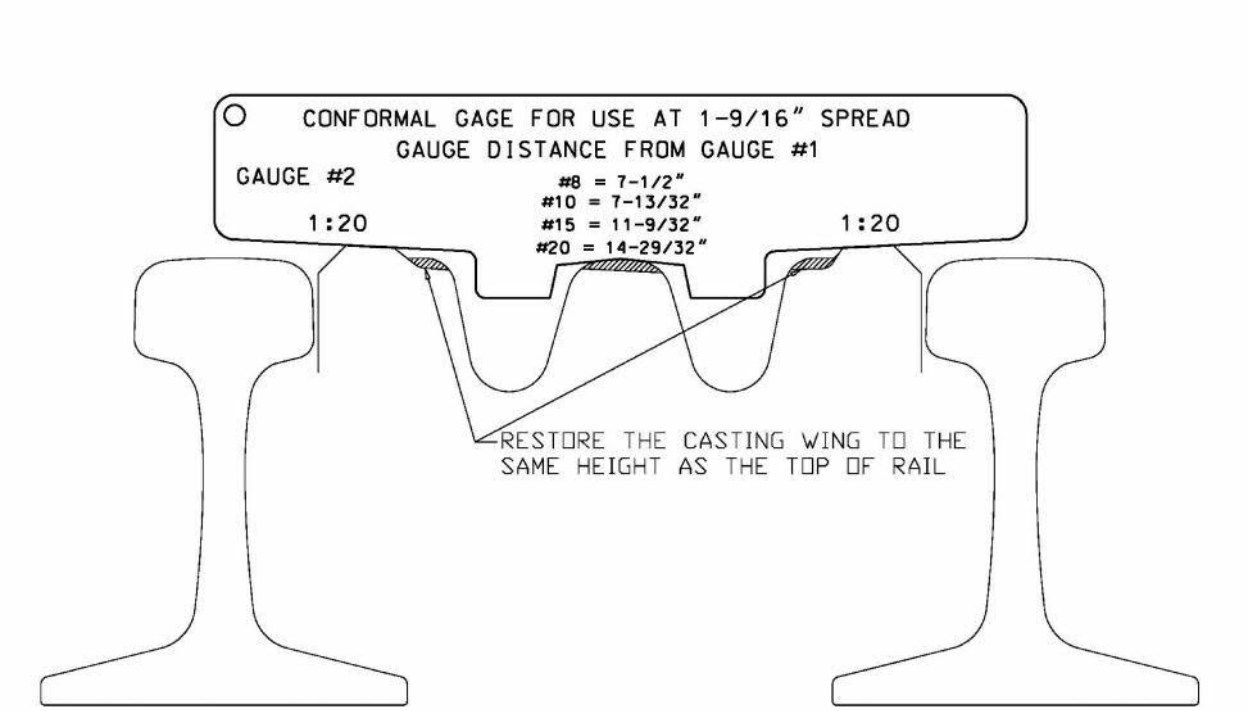


CONFORMAL GAUGE FOR CHECKING TREAD WEAR AND FLANGEWAY DEPTH AT POINT

Sketch G-6

The wing tread portion of the casting must be repaired when the wear exceeds 3/8" below the wrap rails top surface when using the conformal frog gauge #02.

If repairs are required on the wing tread portion of the casting, the repair area should be brought up to even with undamaged portions of adjacent tread or even with the height of the wrap rails after finish grinding is complete. See Sketch G-7 below on the next page. The repair must be checked using a conformal frog gauge #02 for both frogs with wrap rails and for boltless frogs and taper gauge.



CONFORMAL GAUGE FOR WELD REPAIR OF THE WING AND POINT AT 1 9/16" SPREAD

Sketch G-7

Note: The height of the wing tread in the original casting on a conformal frog is 3/16" greater than the height of the top surface of the wrap rails. When repairing the wing tread, the 3/16" measurement should not be included in the repair. Check the height of the repair by placing a conformal frog gauge across the casting and using a taper gauge to ensure the repaired area is the same height as the wrap rails. Table 1 below gives the proper distance to place the #02 conformal frog gauge from the 5/8" frog point (actual point) for frogs with wrap rails. No weld repair will be made beyond the location of the second gauge on the wing tread.

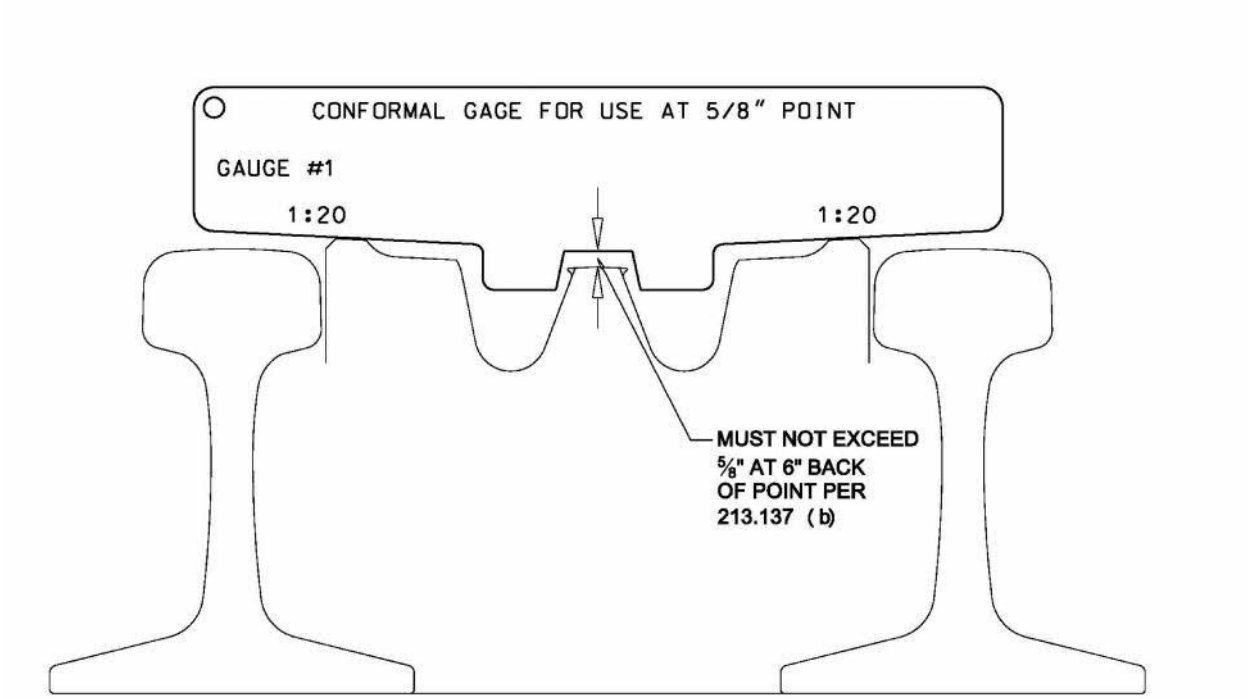
Frog No.	Distance from #01 gauge
8	7 – ½"
10	7 - 13/32"
15	11 – 9/32"
20	14 - 29/32"

Table 1 – For Conformal frogs with wrap rails and Boltless Conformal frogs

To check the frog point, use gauge #01 for both style of frogs. If the frog point is worn, broken, or chipped down more than 5/8" and back 6 inches, the frog point must be repaired or slow order

to 10 mph. The frog point area is one-half the frog number. For example, for a No. 20 turnout, the point area extends 10" back from the actual point. See Sketch G-8. Photo G-4 provides an example of the boltless conformal frog with gauges on a #20 frog.

Photo G-4



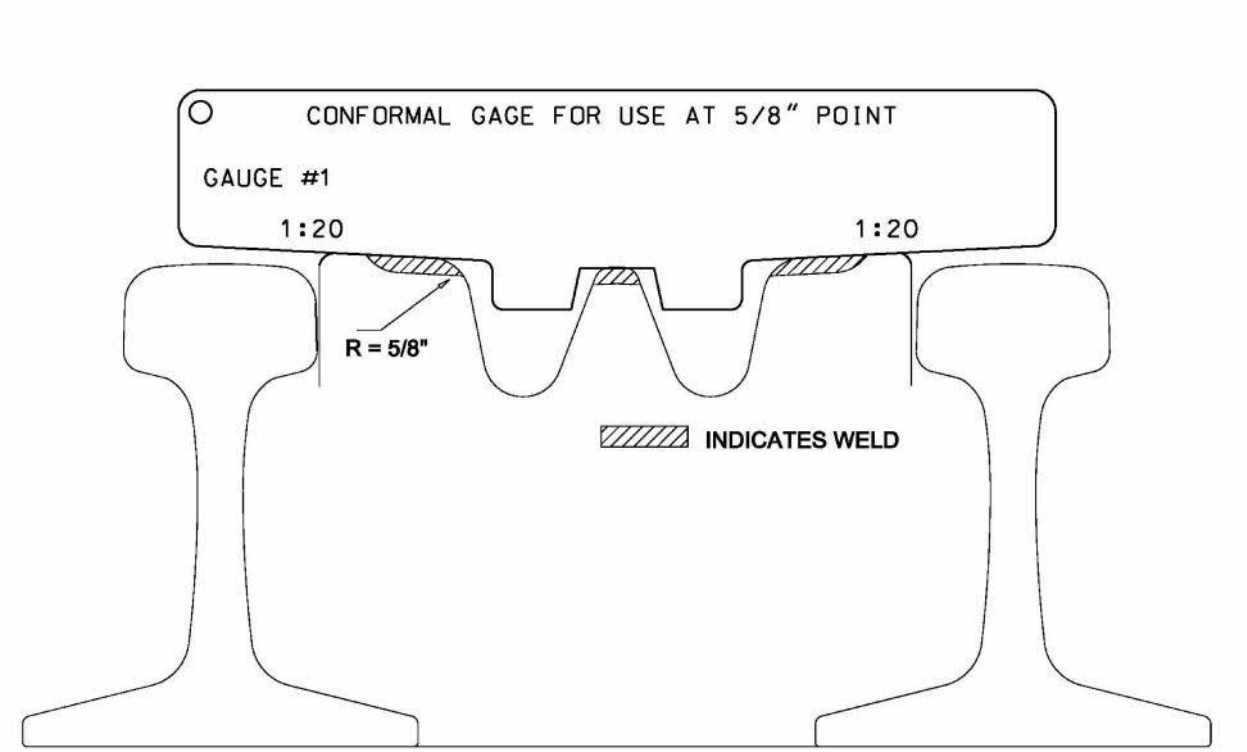
GAUGE TO CHECK 5/8" POINT WEAR ON CONFORMAL FROGS

Sketch G-8

Maintenance grinding of the overflow should be performed when needed.

When repairs are required on the tread area of the point, the area of the point should be brought up to a height that is level with the existing point after finish grinding, with the repaired area being brought up high enough to ensure no welding seams exist after grinding is complete. The repair must be checked using a 36" straight edge.

New manganese track components must have maintenance grinding performed weekly as needed for a period of one month. Newly repaired manganese components should be maintenance ground at least once per week as needed for a period of three weeks.



CONFORMAL GAUGE FOR WELD REPAIR OF WING AND POINT.

Sketch G-9

Proper grinding for the point repair should be contoured to the 1:20 slope (3 degrees) matching the existing contour left on the point. See Sketch G-9. The existing casting includes the 1:20 slope which may or may not be present. Finish grinding may include the bevel; however, where the weld repair area meets the original casting, the contour should be blended in to allow for a smooth transition from the repair area to the original casting. Figure 4 shows how the finished weld should appear at the 5/8" point.

Note: The point of the conformal frog DOES NOT contain a slope as a traditional RBM flat frog. When repair welding to the wrap rail level, a point slope should be made so the point is below the wing rail tread.

PROCEDURE FOR REPAIRING FLANGE BEARING FROGS AND FLANGE BEARING RAILROAD CROSSINGS

Photo G-5

All sharp edges and over flow should be lightly ground (radius). Do not cause bluing. For self-guarded welding, refer to self-guarded frog procedures.

Photo G-6

Flange tread can be lightly ground. Weld only broken or chipped-out areas. Flangeway repair shall be welded to existing wear patterns. When welding, a 36" straight edge is to be used from heel to toe to check the straightness of the flangeway.

Photo G-7

Always check work when complete

H. CUTTING RAIL

GENERAL

1. The FRA *Track Safety Standards* have two subparts that specifically address torch cut rails. In general, the FRA states: "Except as a temporary repair in emergency situations, no rail having a torch cut end shall be used in Classes 3 through 5 track" and above track. "When a rail end is torch cut, train speed over that rail end shall not exceed the maximum allowable for Class 2."

2. All rail ends must be cut square and straight.

3. Cutting rail on timber structures or open deck bridges is not permitted without specific approval of the Manager-Bridges or their designated representative. If rail is to be cut on a structure, a fire prevention and response plan must be developed and implemented.

4. All rail ends that will be used for thermite welding will be saw cut. The only exception is a mechanical failure of the saw during a cut and then an oxy propane torch may be used to complete that cut. No other welds will be made until an operational saw is available. Rail ends torch cut for thermite welding must be welded into the track within one (1) hour. This includes cutting rail to make field weld closures when laying rail or plugging out defects.

5. If rail is to be cut with a torch, the Welder must be sure that the rail is not alloy rail. Torch cut rail ends must be square and straight.

6. All torch cut rail ends will be protected by a 10 MPH Temporary Speed Restriction until the thermite weld is made, or the end has been sawed and standard joint bars installed.

7. To remove torch cut ends on standard or alloy rails for thermite welding or installing standard joint bars, a minimum of 3/8 inches of rail will be removed by making a saw cut. If the torch cut is not square to the rail end, the saw cut is to be made at the point that will make the rail end square and the piece cut off 3/8 inch thick at its thinnest point. The thickness of the saw blade may be considered to be part of the 3/8 inch minimum to be removed. Visually inspect the rail end for defects after the cut has been made. If more than one (1) hour has elapsed since the torch cut was made, then a minimum of 6 inches of rail will be removed by a saw cut.

ALLOY RAIL

1. Alloy rail will be saw cut only. If it becomes necessary to torch cut an alloy rail, the torch cut rail end will be removed before the track is returned to service.

2. At the present time there are only three types of alloy rail on this railroad. These are "Chromalloy" manufactured by Colorado Fuel and Iron (CFI), "Wear Resistant" manufactured by Wheeling-Pittsburgh (WP) and "Super Rail" manufactured by Nippon

Steel. In the field, the alloy rail may be identified in the following manner:

a. CFI "Chromalloy" Rail - letters "CRO" will be included in the brand near the rail section identification.

b. WP "Wear Resistant" Rail - letters "WWR" will be included in the heat identification.

CUTTING RAIL UNDER COMPRESSION

The following steps should be taken to safely, and properly relieve rail that is in compression.

1. Select a location to cut rail with torch in center of crib, not less than 10' from any existing weld in same rail. Select location on both rails with a minimum of a four tie stagger. Both rails will be cut when adjusting tight track.

2. Make a paint mark 2' on field side of rail on each end of location where cut will be made, (overall 4' distance) this will be measured again after rail is adjusted to determine amount of rail removed.

3. Remove ballast out of check where cut will be made to accommodate saw when used to remove torched rail ends.

4. Remove anchors for 10 ties on each side of area to be cut. (This will keep ties from shifting around when rail starts to come in).

5. Use torch to make a straight, complete cut through the rail in the center of the crib. (Use torch cutting guide if available) Start cut from base and cut upward in web area toward ball of rail, switch to opposite side of rail and cut remaining base section, once this is done, cut across the top of ball directly above previous cut to ensure straightness. (Using this process will keep you from having to remove slag from base area to be cut if you were to cut the ball first).

6. Move torch over 1 ½" and start at base of rail and cut within 1" of web area and cut across to previous cut. Move to opposite side of rail and start cut 1 ½" from previous cut and cut within 1" of web and cut across to previous cut through rail. Remove the base cuts with hammer and track punch. (Use of face shield is mandatory)

7. Use torch and start in previous complete cut 2" above base in web of rail and cut across 1 ½" and cut up web area to bottom of ball of rail. Cut ball of rail directly above cut and ensure straightness. Remove ball and web of cut rail with hammer and track punch. (Use of face shield is mandatory)

8. At this time the only area left is the web-base area, now the torch will be used to slowly, safely cut through the center of the remaining rail in the area. Use torch to continue as many passes needed until rail is relieved. If rail runs back tight together follow steps 6

and 7 again, but take caution to only remove in ½" increments at this time.

9. Once rail has quit running, the rail saw should be used to remove a minimum of 3/8" of rail off the torch cut portion of rail, (The saw blade width should be used in the measurement). Both rail ends are to be saw cut with the second rail gap cut a total of 1". (Use of saw at this point will cut down on amount of heat in rail to be considered after adjustment is made to make the field weld).

10. Remainder of anchors will be removed for 200 ties each side of the cut rail. (Anchor removal will start at the cut and work outward from cut to remove the chance of rail bunching between end of 200 ties and cut).

11. The tie plates should be struck with sledge hammer to allow the rail to move, never strike the rail.

12. As the rail comes together, the rail saw should be used to remove rail, not to exceed a 1" gap at any time due to not knowing how far the rail will run and this will allow for a weld to be made when the rail stops running.

13. Steps 1 through 12 are to be followed for the opposite rail to be adjusted.

14. When rail has stopped running, the anchors are to be replaced starting at the end of the 200 ties and work toward the area of rail that was cut, this will allow for any remaining movement of rail. This will be done on both sides of the cut rail. The same procedure will be followed for the opposite rail.

15. After all anchors are replaced a field weld should be made, if for unknown reason a weld can't be made, drill rail and apply joint bars.

16. Fill crib areas back in with ballast.

17. Replace any spikes that were removed to make field welds.

18. Re-measure rail reference marks to determine amount of rail removed from each rail.

19. Write weld information in web of rail per Welding Manual.

20. Clean work area.

21. Fill out track disturbance record online.

MWI 801-09
Welding Manual
9/29/17

I. THERMITE WELDING

GENERAL

1. Only qualified welders will make field welds.

2. **Welds require a high degree of compliance with procedures and attention to detail,** therefore; specific equipment is required. Some required equipment includes a **digital Owner approved stopwatch** and a taper gauge that must be used during the welding process. Stopwatch must not be worn loosely around the neck and is not to hang freely nor catch on any equipment or interfere with the use of a torch.

3. **Torch must be equipped with working in-line pressure gages at torch handle.**

4. Thermite welding equipment and supplies must be kept dry at all times. The molds, portions, etc. must be kept in the original containers until ready to use. Thermite welding materials must be used within three years from the date of manufacture. Weld kits must be rotated (use up oldest, non-expired stock first) to prevent expiration of the kits. This date is stamped on each box. Store only the supplies needed for one day's work on the truck. If the situation requires large quantities of supplies, they may be stored on the truck after ensuring that the materials can be kept dry and damage free.

USE OF AIR CIRCULATOR FAN

DO'S

a. Fan may be used by Thermite (field) Welding Team while make field welds to circulate air for cooling personnel in warm or hot temperatures.

b. Fan should be placed far enough from ongoing work as not to cause a tripping hazard, (suggested 10'), never in the foul of any track and should be placed on a level surface as not to turn over.

c. Fan must be plugged into a GFCI receptacle or a portable GFCI must be used if power source doesn't have one provided.

d. Fan should be used in fair weather conditions.

e. When storing fan, it should be covered with a tarp, or some type of covering as to keep dry as much as possible. (Some teams have used grill covers to suffice for this).

f. Fan also may be used to blow smoke fumes away while welding on manganese frogs, or any type of weld repair.

g. Inspect power cord and plug before each use.

DONT'S

a. Fan will not to be used in inclement weather conditions, such as rain, snow, sleet, etc.

b. Fan is not to be placed in a wet location like a puddle, even if the weather conditions are dry, such as a mud location in track. Move to a dry area.

c. Fan will not be used if any portion of the grilling, cord or safety guard area is damaged or missing. Authorized repairs must be made or the fan replaced.

d. If an extension cord is used for powering the fan, it must be rated to match or exceed that of the fan.

e. If the fan is placed in track, the power cord is to either be run under rail in center of check not touching any metal portion of rail, rail anchor or tie plate. If it isn't run under the rail, it must have a rubber pad or some type insulator between power cord and rail. (A round pipe insulator works well for this application).

1. Making thermite welds in rainy weather should be avoided wherever possible. If this is not possible:

   a. All precautions must be taken to ensure that the weld is protected from the rain, including the use of umbrellas. Thermite welds must not be made in blowing rain.
   b. All precautions must be taken to ensure that the weld is protected from the large temperature drop that rainfall can cause. The rail must be positively anchored against movement.

2. Unless in an emergency, thermite welds should not be made if the gauge of track is filled with snow. If the weld must be made:

   a. Clear snow around the weld area for a minimum 10' radius. When not practical due to embankment constrains, snow must be cleared to the edge of the ballast section.
   b. Use a metal safety pan as described in item 18 of this section.
   c. A hydraulic puller must be used for all closure welds. The puller must not be released until the weld has cooled below 700°F.
   d. Just prior to igniting the charge, ensure that everyone is clear of the weld area red zone by at 30' and remain at this distance until the reaction and pour is complete.

3. Thermite welds, especially non-closure welds, can be made successfully at most temperatures provided the proper procedures are followed. The rails must be positively anchored against movement. For closure welds when the rail temperature is less than Desired Rail Neutral Temperature, a rail puller must be used, and a track disturbance record must be made indicating the amount of rail removed during the closure weld.

4. Thermite welds will not be made closer than ten feet (10') from any existing field weld or any closer than three feet (3') from any existing plant weld in the same rail.
   a. When installing an Insulated Glued Joint (IJ), thermite welds can not be made closer than

18" from the insulated joint bar.

5. Thermite welds will not be made over a tie. Rail should be cut so that the weld will be made between ties. This will eliminate the need to move cross ties.

6. A waste disposal area must be prepared prior to demolding the weld. This area must be free of any moisture, standing water, snow, ice, and/or frozen ballast. A clear walking path to this area must be maintained. All of the hot demolding debris must be placed in this prepared waste disposal area prior to welders departing the weld area.

7. Ensure that area around where weld is to be made, as well as walking paths for slag basin disposal, are kept clear of obstructions and hazards such as equipment, hydraulic lines, oxygen/propane lines, hand tools, jumper wires, etc. Walking areas should be kept clear at all times during the welding process.

8. When laying rail out of face, thermite welds will be made no closer than the height of the rail from the near edge of a bolt hole. When installing a maintenance plug, the distance from the end of the rail to the near edge of the bolt hole may be less than the height of the rail but it cannot be less than 4".

   Exception for yard tracks: the distance from the end of the rail to the near edge of the bolt hole may not be less than 1 1/2". Any rail cuts, closer than 6" from the edge of a bolt hole, must be made with a saw to eliminate the heat affected zone that would be caused by a torch cut.

9. Thermite welds will <u>not</u> be made opposite any weld (in same crib) in the other rail. A Thermite weld should be staggered four (4) ties from any weld in the opposite rail, but must not be made any closer than one (1) tie stagger from any weld in the opposite rail (except when designed in special trackwork).

10. When installing a plug rail, the minimum plug length will be twelve (12) feet in tangent track and sixteen (16) feet in curved track. **Exception:** Plant welds made by either the electric flash or the oxy-acetylene method and marked by a rail defect detector car as having a transverse defect may be repaired by cutting out 1" of rail on both sides of the center of the weld (total of 2") and making a thermite weld. These may also be repaired with the Electric Flash Butt Welding process, see section M. This may be done only if the weld is not excessively battered and the proper welding gap is obtained without adversely affecting the adjustment temperature of the rail.

11. All thermite welds must be ground before the heat leaves the weld. Do not re-introduce heat into the sides of the weld where it will be ground.

12. An ultrasonic test device will be used to test thermite welds as shown below:

    a. The Manager–Welding, will randomly test thermite welds on their territory to ensure the weld quality. Additional random tests may be made by individuals from the Rail Testing group.

b. Thermite Welds made in FRA Class 6 and above tracks – The *FRA Track Safety Standards,* §213.341 (d), identifies the requirement to test these welds. The welds will be tested not more than two (2) days after the weld is made. If the welds are not tested within this time period, a temporary speed restriction of 30 MPH will be placed.
c. If the thermite weld does not test satisfactorily, it must be removed from the track and replaced by an appropriate length plug or removed with a wide gap weld.
d. The ultrasonic test device may also be used during the qualification of a Welder.

13. All thermite welds will be identified with the following paint stick markings on the web of the rail:

    a. Specific Mile Post Designation must be on rail.
    b. Date of weld (MM/DD/YY).
    c. Thermite weld batch/serial numbers will be recorded in Division Track Works (DTW).
    d. Team number.
    e. Weld Number, by Team, for the year.
    f. Rail temperature (°F).
    g. Additional information may be required, such as **TC** for torch cut rail, **P** if rail puller is used, and on track class 6 and above the **date the weld is tested** and the **testers initials**.

14. The welder will submit a Welding Report on the Engineering Gateway in DTW at the completion of each work day. A Track Disturbance Report must also be completed for every thermite weld made in the track structure. Welds made Out Of Track do not require a Track Disturbance Report.

15. Molten steel and slag can explode upon contact with snow, ice, standing water, frozen ballast or soil, and wet ballast or soil. When the ballast or soil under a weld is wet, a metal safety pan containing at least three inches of dry sand should be placed directly under the weld. This will allow any leakage to fall in dry sand. The bridge safety pan will also provide some protection against fire for timber bridge members, and against heat damage to steel beams. The pans may be reviewed in Sketches A-1 and A-2; the pans may be ordered using the following stock control numbers:

    Standard Track Safety Pan
    Bridge Safety Pan

16. During the time the weld is reacting or is being ground, personnel and equipment must be located at a safe distance from the weld (minimum 20' unless snow on track, then 30'). In particular, vehicles shall be located far enough away from the work to ensure that they cannot be showered by the sparks.

17. No thermite welding on timber structures or open deck bridges is permitted without specific approval of the Manager - Bridge or his designated representative. The following minimum safety instructions must have been implemented:
    a. A fire prevention and response plan must be developed and implemented.
    b. An adequate source of pressurized water must be available and accessible.
    c. The entire area, where the weld will be made, will be wetted before commencing work.

Any area, which may be showered with sparks, must be kept wet and protected.

d. A metal safety pan will be used under the weld.
e. After the weld is completed, the bridge ties will be wetted again. The work area should be inspected again several hours after the work is completed.
f. Care must be taken to ensure that the rail and weld do not contact water until the weld has cooled.
g. These are bare minimum requirements. Good judgment must be exercised to ensure that the structure is properly protected.

20. When making a weld in concrete tie track, the tie pads and insulators must be removed for one or more ties on each side of the weld before the weld is made. This will prevent scorching and deformation of these items. They must be replaced before allowing a train to pass after the weld has been made.

21. Heating rail by using rail heaters or cellulose/rope will not be used to make field welds.

22. Maintenance of Way jumper wires may only be used where appropriate.

23. Temperature and weather must be considered when making a thermite weld. Conditions that increase the cooling rate of the weld must be mitigated so that the weld does not cool too rapidly. See the chart below: Weld Cooling Cover (Blanket)

Rail Temperature	*Weather Conditions*	
	Clear	*Wind, light rain, or snow*
40°F or greater	• Air Cool • Weld Cooling Cover is not required	• Apply Weld Cooling Cover immediately after shearing. • Leave cover in place until weld is cooled below 800°F (about 35 minutes).
Between 40°F and 0°F	• Prior to installation of molds, preheat railhead and base to 100°F (hand hot) for a distance of 3 feet on both sides of the weld gap. • Complete weld and unmold normally. • Apply Weld Cooling Cover immediately after shearing. • Leave cover in place until weld is cooled below 800°F (about 35 minutes).	
0°F and less	• Welding is not recommended	

24. Check the pressures at the torch by installing test gauges between the torch end check valves and the torch at the beginning of each week, or anytime there is a change in regulators, hoses, flash back arrestors, check valves, or hose reel using the following procedure.

a. Install the test gauges between the torch end check valves and the torch.
b. Set the regulators at the tanks to the proper Propane and Oxygen pressure.
c. Light the torch and adjust the propane valve so that the blue flame tips are of even length and 7/8" long.
d. Check the oxygen and propane gas pressures at the test gauges at the torch.

e. Adjust regulators at the tanks, if necessary, to get the proper Propane and Oxygen pressures at the test gauge.
f. Record the regulator settings for use in preheating the rail ends. The test gauges should be left in-place to ensure that proper delivery point pressures are maintained throughout the entire preheating process. Care must be taken to protect the test gauges from damage.

25. There are two (2) approved thermite weld manufacturers on Owner's Railroad. The two (2) approved manufacturers are Orgo-Thermit and Railtech-Boutet. Each manufacturer's process uses different equipment and procedures. A section detailing each of the welding processes follows.

WHEN WELDING ON A BRIDGE USING A HYDRAULIC RAIL PULLER TO MAKE WELDS ON THE OUTSIDE RAIL WHERE NO WALKWAY EXISTS

If the employee is working on the outside of the hydraulic rail puller the bridge must be equipped with a walkway and railings of sufficient height, width, and strength to prevent a fall and no closer than 6' from an opening in the deck or walkway greater than 1' X 1'. **Do not** use the hydraulic rail puller to perform a thermite weld if **no** walkway with railings is installed adjacent to the rail needing repairs.

WHEN REPAIRING STRIPPED JOINTS WHERE NO WALKWAY EXISTS

When fixing stripped joints, bolts on the gage side can be tightened with a track wrench, then the rail puller removed and the field side bolts can be tightened with an impact wrench following all fall protection guidelines.

ALL CASES

All other FALL PROTECTION guidelines must be adhered to which means the required written Fall Retrieval Rescue Plan must be used. Refer to M 074 for further guidance.

1. Team will have a written Retrieval Plan which includes a list of equipment necessary for the retrieval.

2. Employees will have a coworker that is responsible for knowing their safety partner's location at all times.

3. During the operation of the hydraulic rail puller, each end of the hydraulic rail puller is in the line of movement. This means the hydraulic rail puller can move in either direction along the rail while in operation. Fifteen feet on each end of the rail puller is a red zone

4. In all cases when using a hydraulic rail puller, employees must not stand inside hydraulic rail puller area.

5. When installing the hydraulic rail puller to the rail, ensure the operator controls are within the gage side of the rail.

6. The rail where the jaws of the hydraulic rail puller touch or clamp **must be ground** and all lettering, dirt, or grease removed prior to making a pull with the hydraulic rail puller.

HYDRAULIC RAIL PULLER PROCEDURES FOR GEISMAR MODEL TH-120-STP

Before operating puller, be in compliance with Owner's Operating Rules and procedures.

1. Read and understand operating instructions and maintenance manual supplied with rail puller. If not available, ask welding manager for a copy.

2. Locate joint or defective weld to be removed.

3. **Before starting, surface the joint or defective weld by tamping necessary ties. This should be done if using the puller or not.**

4. Before tear down or saw cuts are made, check for marks on rail if plug was put in during cold weather, and then pull according to winter track buckling procedures. If not, place reference marks each side of joint on rail, six to seven ties away from joint. This should be done on the field side with paint stick to watch and measure movement of rail, **just like the winter track buckling procedures. Do not add rail.**

5. Take off joint bars and or make saw cuts to achieve proper gap for weld. **Check rail laying charts to see how much rail is to be removed to reach the neutral rail temp**. Obtain proper gap for weld (1") for regular or (2 ¾") for wide gap weld.

6. If Rail moves widening the gap, the resulting gap **must not** be used for the weld. One inch (1") or (2 ¾") for wide gap must be cut out of the rail, plus pulling the gap that is needed to reach the proper Neutral Rail Temperature. **DO NOT ADD RAIL**.

7. Remove tie plates at joint and place alignment plates or jacks under rail. Remove anchors where puller is to set on rail and knock down any high spikes. **Alignment plates are mandatory when puller is used during the thermite weld process**. The use of wedges is **not allowed**.

8. Pre align rail to proper crown and gage with alignment plates. To insure puller will set level on rail and not slip, check web of rail for dirt, grease or obstructions. The rail must be ground ensuring all lettering is removed and all rust and grease must be burned off with torch and the web of the rail ground where puller jaws will make contact. (Roughly 3 feet to the open end and 4 feet to the intensifier end from the rail ends of the joint.)

9. Set puller on rail. Make sure puller is centered to get maximum working area, using centering arrow on beam.

10. Ensure the area to be gripped is clean and dry and any rust or mill scale and raised lettering has been ground flat.

11. Follow operating instructions for clamping and pulling rail. (OPERATING MANUAL)

12. Remove hoisting cable from the lifting beam. **NEVER OPERATE PULLER WITH CABLE ATTACHED.**

13. Connect puller to hydraulic power source set to 5gpm. Turn directional valve to the retract position and draw the jaws up to the web of the rail. Once all four jaws make contact with the rail, return the directional valve to the lock position.

14. Pull the four pins holding the lifting beam to the puller and pick up the lifting beam with the supplied handles and set in the gauge of the track out of the way.

EVERYONE MUST STAY CLEAR OF THE PULLER RED ZONE DURING PULL AND WHILE UNDER LOAD. THE RED ZONE IS DEFINED AS 15' FROM THE ENDS OF THE TOOL ALONG THE RAIL WHERE IT COULD POSSIBLY SLIP.

15. Begin pull by turning the directional valve to the retract position to get the proper gap (1" or 2¾" for wide gap). **DO NOT ADD RAIL.**

16. If proper gap cannot be achieved when puller is at maximum operating pressure of 120 tons, puller must be unclamped by using instructions in line 20 – 21 and 22 and anchors must be removed.

17. When proper gap is achieved, return directional valve to the center lock position, turn locking valve on control panel clockwise locking pressures in puller to hold in place. Shut the hydraulic power source off, and with the locking valve turned to the closed position, move the directional valve back and forth to relieve pressure at the hose connection. Disconnect hydraulic lines to use grinding tools and shear while the weld is cooling to 700°F.

18. Check rail alignment and adjust if needed.

19. Rail Alignment Plates must be used when using puller.

IMPORTANT:

DO NOT STRIKE ANY PART OF PULLER OR TRACK STRUCTURE WHILE PULLER IS UNDER LOAD. DO NOT REMOVE OR APPLY ANY RAIL ANCHORS WHILE THE PULLER IS UNDER LOAD. NO SAW CUTS ALLOWED WHILE PULLER IS ON RAIL. WHEN USING PULLER AROUND SWITCHES, CAUTION SHOULD BE USED TO KEEP FROM MISALIGNING. A 200-FOOT DISTANCE OR OUT OF SOLID ANCHORS, IS A GOOD RULE TO FOLLOW. Note: Puller may be used in a switch area to hold the rail or bring it back to original position (*Do Not Add Rail); however, it is not recommended to remove extra rail around the switch area.

20. Begin making weld by using MWI 801 Thermite welding procedures. (ORG. or BOUTET Wide Gap).

21. **Rail puller cannot be removed until weld has cooled to 700°F or below.** At the end of the finish grinding, a temperature of 700°F is generally reached. Temperature of weld MUST be checked using an infrared temperature gun or a 700F Tempilstik prior to removing puller.

BEFORE REMOVING PULLER

22. Remove rail puller by hooking hydraulic lines to puller. **(DO NOT START UNIT OR PTO).** Open lock valve by turning it counter clockwise. With Locking valve open slowly turn the directional valve to the extend position to release the pressure on the puller.

23. Once the pressure is released off the puller and the gauge reads zero tons, pick up lifting beam with handles and place it back in the cradles and install the four pins.

24. Turn power source on and turn directional valve to the extend position until the jaws on both ends have opened and are clear of the head of the rail.

25. Hydraulics can now be turned off. Do NOT remove hoses yet. **MOVE DIRECTIONAL VALVE BACK AND FORTH TO RELIEVE TRAPPED PRESSURE.** Check pressure gauge to make sure it is on zero and then remove hoses.

26. Hook up lifting cable from crane, lining up cable to get a straight lift. Make sure tagline is connected. Now puller can be lifted off the rail. If more work is to be done, move puller to the clear and put on ground or load in truck.

27. Remove alignment plates, and put tie plates on using proper tool. **Never put fingers under plates.** Spike and apply all anchors and dress work area in compliance with Owner's standards.

28. All field welds must be marked with a Paint Marker. If puller was used, web of rail must be marked – PULL WELD or PW.

29. Move to the next weld and follow instructions again.

HYDRAULIC RAIL PULLER PROCEDURES FOR SIMPLEX RP 120

1. Read and understand operating instructions and maintenance manual supplied with puller. If not available, ask welding supervisor for copy. It is recommended to apply graphite lube on SIMPLEX PULLER only, weekly to all moving parts.

2. Locate joint or defective weld to be removed.

3. **Before starting, surface the joint or defective weld by tamping necessary ties. This should be done if using the puller or not**.

4. Before tear down or saw cuts are made, check for marks on rail if plug was put in during cold weather, then pull according to winter track buckling procedures. If not, place reference marks each side of joint on rail, two feet each side of joint. This should be done on the field side with paint stick to watch and measure movement of rail, just like the winter track buckling procedures. DO NOT ADD RAIL.

5. Take off joint bars and or make saw cuts to achieve proper gap for weld. **Check rail laying chart to see how much rail is to be removed to reach the neutral rail temp. Obtain proper gap for weld (1″) for regular or (2 ¾″ wide gap weld).**

6. If Rail jumps open, this gap **must not** be used to make the weld. You must still cut (1”) or (2¾” for wide gap) out of the rail. Plus pulling the gap that is needed to reach the proper rail temp. DO NOT ADD RAIL.

7. Remove tie plates at joint and place alignment plates or jacks under rail. **Alignment plates are mandatory when puller is used during thermite weld process**. Remove anchors where puller is to set on rail and knock down any high spikes. The use of wedges is **not allowed**.

8. Pre align rail to proper crown and gauge with alignment plates. To insure puller will set level on rail and not slip, check web of rail for dirt, grease or obstructions.

9. Set puller on rail. Make sure puller is centered to get maximum working area, using centering arrow on beam. Run pull cylinders ahead 2" before clamping to the rail.

10. The rail must be ground ensuring all lettering is removed and all rust and grease must be burnt off with torch and the web of the rail ground where puller jaws will make contact. (Roughly 3' to the open end and 4' to the intensifier end from the rail end of the joint.)

11. Follow operating instructions for clamping and pulling rail. (OPERATING MANUAL)

12. Remove lifting cable on crane and move it out of work area. **NEVER OPERATE PULLER WITH CABLE ATTACHED**.

13. Connect puller to hydraulic power source, setting to 5gpm. On puller control panel, extend lifting beam to clamp puller to rail. DO NOT STAND OVER BEAM WHEN IT IS BEING MOVED. If beam does not move, the speed control knob must be turned clockwise to send more hydraulic pressure to beam. Now you can remove beam locking pin and retract beam until it is fully contracted. DO NOT STAND OVER BEAM WHEN IT IS BEING MOVED. If beam does not move, the speed control knob must be turned clockwise to send more hydraulic pressure to beam. Lift beam up out of working area and use the lock pin to lock in place (THIS IS THE ONLY TIME THIS PIN IS TO BE REMOVED). This is to provide enough work area to make field welds.

14. Now you can start your pull by using pull lever in the pull mode to get the proper gap (1" or 2 ¾" for wide gap). You can turn speed control knob to speed up (clockwise) or slow down (counter clockwise) the speed of the pull. DO NOT ADD RAIL.

15. If proper gap cannot be achieved when puller is at maximum operating pressure 120 tons, puller must be unclamped by using instructions in line 20 – 22 and anchors must be removed.

16. When proper gap is achieved, turn lock valve on control panel clockwise locking pressures in puller to hold in place and turn speed control knob counter clockwise completely.

17. Disconnect hydraulic lines to use grinding tools and shear while the weld is cooling to 700°F.

18. Check rail alignment and adjust if needed.

19. Rail Alignment Plates **must** be used when using puller. Pandrol and concrete must be pre-aligned with jacks and crowned .020 higher before puller is placed on rail. More clips must be removed.

IMPORTANT:
DO NOT STRIKE ANY PART OF PULLER OR TRACK STRUCTURE WHILE PULLER IS UNDER LOAD. DO NOT REMOVE OR APPLY ANY RAIL ANCHORS WHILE THE PULLER IS UNDER LOAD. WHEN USING PULLER AROUND

SWITCHES, CAUTION SHOULD BE USED TO KEEP FROM MISALIGNING. A 200-FOOT DISTANCE OR OUT OF SOLID ANCHORS, IS A GOOD RULE TO A FOLLOW. NO SAW CUTS ALLOWED WHILE PULLER IS ON RAIL. Note: Puller may be used in a switch area to hold the rail or bring it back to original position (*Do Not Add Rail); however, it is not recommended to remove extra rail around the switch area.

20. Begin making weld by using MWI 801 Thermite welding procedures. (ORGO-THERMIT or BOUTET Wide Gap).

21. **Rail puller cannot be removed until weld has cooled to 700°F or below.** At the end of the finish grinding, a temperature of 700°F is generally reached. Temperature of weld MUST be checked using an infrared temperature gun or a 700F Tempilstik prior to removing puller.

BEFORE REMOVING PULLER

22. Remove rail puller by hooking hydraulic lines to puller. **(DO NOT START UNIT OR PTO).** Open lock valve by turning it counter clockwise. Move both valve handles to left and right to dump pressure in puller back to tank. The gauge should read 0. Start power source for hydraulics.

23. Pull pin and lower lifting beam to rail, making sure guide on bottom of beam is on rail to guide into place. Extend beam slowly until lock pin can be replaced. Replace pin when holes line up. If beam does not move then use speed control knob to help.

24. **REMOVING PULLER After beam lock pin is replaced, retract lifting beam and extend pull cylinders at the same time**, turning speed control knob all the way open, clockwise until puller is completely open. You must visually look to verify puller is open and will clear railhead. Return speed control valve to full counter clockwise position.

25. Hydraulics can now be turned off. **MOVE BOTH BEAM CONTROL HANDLE AND PULL CONTROL HANDLE BACK AND FORTH TO RELEVE ANY TRAPPED PRESSURE IN SYSTEM.** Check pressure gauge to make sure it is on zero and then remove hoses.

26. Hook up lifting cable from crane, lining up cable to get a straight lift. Make sure tagline is connected, if it was removed. Now puller can be lifted off the rail. If more work is to be done, move puller to the clear and put on ground or load in truck.

27. Remove alignment plates, and put tie plates on using proper tool. **Never put fingers under plates. Spike and apply all anchors and dress work area in compliance with Owner and FRA standards.**

28. All field welds must be marked with proper name plate provided, or Paint Marker. If puller was used, web of rail must be marked – PULL WELD or PW.

29. Move to next weld and use instructions again. If using other model numbers or other manufacturers' brand of puller, refer to the manufacturer's written instructions.

THERMITE WELDING PROCEDURES

1" Gap, Orgo-Thermit Weld with Degradable Crucible

1. PREPARATION OF RAIL ENDS AND GAP

a. Prior to removing bars or cutting rail tighten rail anchors at least 40' in either direction of weld location.

b. The rail is to be saw cut. The Welder must have a rail saw in operating condition prior to making a weld.

c. Examine the rail ends to see if they have rail end damage (chips, nicks, and surface deformation) or were previously repaired by welding to remove rail end batter. Do not make a field weld to a rail that has rail end damage or was previously welded unless the rail end is cropped to remove all the damaged area or welded-on material. Also completely remove signal bond wires, if present, by grinding.

d. In an emergency, such as the mechanical failure of the rail saw during the cut, the rail may be torch cut. If a torch is used, **care** must be used to ensure a straight cut. All slag must be removed from the face of a torch cut rail. The weld must be made within one (1) hour of the torch cut. Also, the Welder will mark "TC" on the rail if a torch cut rail is welded into track.

e. Clean the rails for a distance of 4" to 6" from each end with a burner and wire brush until the area is free of grease, rust, mill scale, paint and other foreign matter.

2. ALIGNMENT OF THE RAILS

a. There are four parameters to be considered in aligning the rails for welding: gap, horizontal alignment, vertical alignment, and twist. The strongest weld is produced when the same section has no mismatch in the elevation of the rail bases, the webs are not twisted in relationship to each other, and any rail head mismatch is removed by grinding after the weld is made.

b. With some worn rails, it may not be possible to have the rail bases at the same elevation without having to perform considerable grinding on the rail heads to obtain a smooth transition between rails. In these instances, a limited amount of rail base mismatch is permitted. As the amount of rail base mismatch increases, it becomes harder to align the webs of rail with a straightedge to eliminate twist. As the rail base mismatch increases, the strength of the weld decreases.

c. Remove or loosen rail fastening from two or three ties (or whatever is necessary) on each side of the weld location.

d. To position rail ends to be welded, use:

1. Alignment plates if available, or
2. Use a mechanical or hydraulic jack under the center of the two rail ends, and lift them slightly. Place the four wedges under each side of the tie plate on both ties to nearly the desired height. Then remove the jack. A few light hits with a dead blow hammer should be all that is required to reach the desired crown and alignment. **No welds will be made with a hydraulic jack without supporting the crown with wedges.**

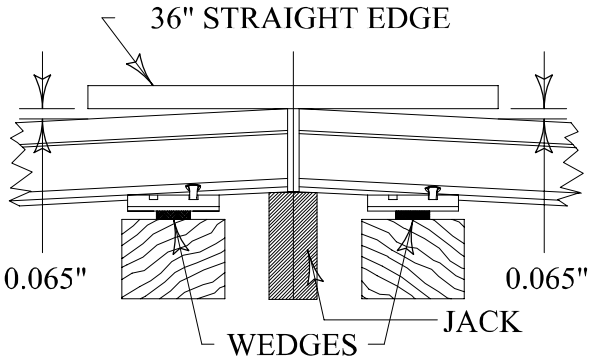
e. **Ensure that the correct gap is obtained**. The correct gap for all rail sections is 1" to 1- 3/16". The gap will be measured on both sides of the head and base (4 measurements) to confirm the proper gap has been established.

f. If the gap between rail ends is too small, the ends may be cut to give the proper gap.

g. All rails should be eye aligned 40' from where the weld is being made.

h. Then use a 36" steel straightedge at the rail ends. The horizontal alignment along the web must be perfect with the straightedge. Check the web from the rail base to the rail head to insure that the two rails are not twisted in relationship to each other.

i. The vertical alignment should have a 1/8" crown at the joint. Using a 36" straightedge, there will be 0.065" between the straightedge and the rail at each end. See Sketch I-1.



LIFT OF RAIL ENDS EXAGGERATED

Sketch I-1

j. If necessary, use gage rods (Ball Ratchet Gage Rod, Base Ratchet Gage Rod) one on each side of the joint, to hold the alignment. Additional gage rods may be required in curved track. Use of a "Canting Tool" is very helpful in removing twist from the rail.

k. When welding top worn rail to new rail, it may be necessary to have the bases of the two rails mismatched. Transition Rails have been developed to address this problem (See MWI 507). If transition rails are not used, it is preferable that the base mismatch does not exceed 1/8" but up to 1/4" is permitted. If the rail height difference is greater than 1/4", the weld will be made with the running surfaces of the rails mismatched and no more than a 1/4" base mismatch. The molds will have to be filed to fit. After the weld is

completed, the higher rail will be ground off to match the lower rail.

l. When making compromise welds, the rails will be aligned in a manner similar to that used for worn rail to new rail. Visually check the alignment of the webs to insure that the two rails are not canted in relationship to each other. Railhead mismatch should be corrected by grinding rather than by a major alteration of the molds.

m. If it is necessary to make a compromise weld from rail sections 122# and heavier to rail sections 100# and lighter, a 112# or 115# intermediate rail will be inserted between the heavier and lighter rail sections. Transition rails should be used in main tracks. See MWI 507 for details.

n. When welding in a plug, joint bars should be installed on the end which will be field welded last, in order to hold the plug in true alignment while the first weld is being installed. When placing the plug in track, it should be of proper length to provide 1-inch gaps at each end for welding.

o. Secure the rails. When the desired rail gap has been established, clamp the rails to secure the position so that sudden temperature changes or sudden jolts will not disturb the gap opening. Mark the rails and tie plates on either side of the gap so any longitudinal rail movement can be detected during welding.

3. INSTALLATION OF THE MOLDS

a. Before installation, check the molds for damage. The pouring channels and risers must be clear. Verify that the molds are the correct size for the rails being welded. Some molds may be used for more than one rail section, such as 132 # on 131# rail and 115# on 112# rail. Place each mold in the mold shoe. The sides of the mold shoe must fit the mold tightly. If they do not, adjust the shoes by straightening the angle to 90°.

NOTE: The shoes are designed with structures at the top of the walls, which are used to support and position the single-use crucible above the molds.

b. Apply one mold half on the rail, central to the gap, checking for fit. Match the other mold half to it. If the two halves do not fit tightly together due to a rail mismatch, one or both molds may have to be filed for proper fit. It is preferable that this filing does not exceed 1/8" but up to 1/4" is permitted. File the outer edges only where necessary. Wherever the outer edge is filed, the collar in the same area is also to be filed.

c. Apply one mold half in the mold shoe centrally on the gap and slightly tighten the swivel arm screw of the clamping device while lifting the mold shoe upwards. Match the other mold half to it and slightly tighten the other swivel arm while lifting the mold shoe upwards. Tap both shoes under the bottom and tighten each swivel arm screw firmly with one hand. Recheck to ensure both molds are flush and fitting tightly together.

d. Cover the mold top with plexiglas or cardboard before starting luting to keep the inside of the mold clean.

e. When welding in curves, the top of the diverting plug is to be filed so that it fits horizontally into the mold. This will achieve a more even flow of the thermite steel into the mold halves.

f. Before luting, pack any gaps between the molds and rails with toilet paper flush with the outside of the mold. Tear a piece of paper to the width of the rail heads, fold into a "Z" shape, and slide along the top of the rail under the mold. A vertical tab will prevent luting sand from falling on the rail head.

g. Ready-to-use luting material is available in 10 pound plastic bags from Orgo-Thermit, Inc. and is shipped with each kit.

h. Fill the luting grooves surrounding the rail and under the rail base with luting sand and pack it firmly into place to prevent leakage of the molten metal when the mold is filled. Take care when luting under the rail base, to make sure the luting sand is placed on the correct side of the luting grove. After luting is completed, check the molds for foreign material, and re-cover.

NOTE: Preheating must begin within 10 minutes after molds have been luted. In the event that preheating does not commence within this time, the existing molds may be used, but new luting sand must be applied.

i. Place three-quarter (3/4) inch of dry sand in the slag basin and fit the slag basin to the lugs on the sides of the mold shoes. Place the rail head protecting sheet on the rail heads next to the mold shoes. Carefully place additional luting sand on the rail head between the mold shoes and the rail head protecting sheets.

j. When making welds in turnouts, the Left Handed Hinged Shoe can be used to prevent the slag basin from coming in contact with adjacent rails. This will replace the Turnout Kit was previously used.

4. PREHEATING

a. Ensure that the preheating burner has been tested as detailed in Section I--Thermite Welding, General, paragraph 22.

b. Set the propane and oxygen regulators to deliver the proper pressures to the burner.

c. Place the burner saddle assembly on the universal clamp, turn the saddle adjustment knobs to center the burner head over the rail gap, and remove the burner saddle assembly. Open the oxygen valve completely and open the propane valve 1/4 turn. Adjust the oxygen and propane regulators to the proper pressures. Light the burner with a flint type lighter. Adjust the torch propane valve so that the blue flame tips are of even length at 7/8" long. Check the burner for clogged holes, and clean if necessary.

d. SKV-Extended (5-minute) data using SKV 5 minute preheating burner. A Digital

stopwatch **must** be used to ensure proper preheating times.

Propane:	14 PSI
Oxygen:	65 PSI
Burner Hgt:	1 3/8"

Victor or Harris 6 minute preheat burners are also authorized for preheating the SKV process. Use these pressure settings for Victor or Smith Preheaters:

Propane:	15 PSI
Oxygen:	65 PSI
Burner Hgt:	1 3/8"

e. Pressures are measured at the burner when using 3/8" inside diameter hoses with flash-back arrestors behind the burner bodies. Burner height is measured from the top of the lower rail if the rail ends are mismatched in height.

f. Briefly preheat both slag basins to ensure that they are dry. Position the preheating burner on the universal clamp and adjust the knobs so that the flame is directed down the center of the rail gap. Ensure that the burner saddle is contacting the height adjustment ring. Verify that the burner tip does not touch the sand mold. Tighten the burner saddle clamp.

g. During preheating, ensure that the preheating burner is in the center of the one (1-1/16") gap in the rail. Make certain that it is also aligned in the center across the head.

h. Recheck the gauge pressures, and adjust if necessary. On a windless day the burner flame should rise about 18" from the outside risers. The diverting plug should be dried before placing it in the mold. Wave the diverting plug with the fire tong over the riser flame for approximately 1 to 2 minutes.

CAUTION: Do not hold the diverting plug in the flame until it turns white. The plug will become brittle.

i. At the end of the 6 minute minimum preheating time for rail sections greater than 122#, the rail ends should show good orange/yellow color in the web and the base. Rail sections smaller than 122#, 5 minute minimum preheating time is required. If the rail ends do not show good orange/yellow color, continue to preheat until the color is obtained. When making a compromise weld, the base of the heavier rail section must have an orange/yellow color.

j. It is recommended to use a temperature gun to help the welder acknowledge the achievement of 450 degrees at 2 1/2" from the rail end.

k. Upon completion of preheating, remove the universal clamp and burner saddle assembly and insert the diverting plug into the mold, making sure it seats properly

NOTE: The welding charge must be ignited within 15 seconds after the preheating burner has been removed.

5. CRUCIBLE PREPARATION AND CHARGING

a. These procedures may be accomplished while the rail ends are being preheated.

b. The crucible is a Degradable Crucible (a beta set process crucible), which is equipped with a self-tapping device. A refractory cap is supplied with each crucible.

c. Remove the lid on the crucible. Gently remove the crucible cap, which is shipped upside-down inside the crucible. Inspect both the cap and crucible for damage.

CAUTION: If there are signs of damage, do not use the crucible.

d. Turn the crucible upside-down and dump out any loose liner material. Inspect the tap hole area to ensure that the refractory discs (white color discs) are in place and nothing is covering them.

e. Place the crucible on a level, clean and dry surface. Place the crucible on cardboard at a dry location near the working area. Pour in the portion, level the surface and install the cap.

CAUTION: Use only the portions designed for the single-use crucible. They are packed in orange bags. Never mix components from different kits.

6. REACTION AND POUR

a. The welder will clear all individuals from the welding area prior to igniting the welding portion. All track equipment working in the area will be stopped if vibrations can be felt in the rail being welded or roadbed until the weld has been poured and solidified.

b. Place the charged crucible on top of the mold shoes. Ensure that it is properly seated.

c. The welder, using a gloved hand, will insert a lit igniter through the top of the crucible cap until it contacts the center of the welding portion. As soon as the igniter is inserted, the Welder will move away from the crucible to a safe position (approximately 20 ft, 30 feet if snow on track) while the reaction takes place.

d. The tapping time, which is the time from when the portion ignites until the time the portion begins to flow, will be timed for each weld. The normal tapping time is from 23 to 28 seconds. If the tapping time is less than 15 seconds or more than 35 seconds, the weld is to be considered defective and immediately removed from track.

CAUTION: If the crucible's secondary tap does not tap within 1 minute, remain at a safe distance for 20 minutes. The heat from the reaction will slowly transfer through the refractory material. The crucible walls will become red hot.

7. REMOVING THE MOLDS

a. Note that a full face shield, long sleeves and welding gloves are required during the tear down process. This includes shearing of the weld.

b. Stand clear of the assembly for 5 minutes after the pour.

c. After 5 minutes have passed, remove the crucible and the slag basins from the mold shoes. Set the crucible aside in a safe location. Carry the slag basins level staying on the level portion of the track. Do not step over the rail while carrying a hot slag basin. Take the slag basin fifteen to twenty feet (eight to ten ties) away from the weld. Place the slag basin on level ballast between the ties. Note that this area must be level and dry. Do not flip over the slag basin at this time; allow time for the slag to cool in the basin.

d. After removing the crucible and slag basins, remove the universal clamp and mold shoes.

e. Score the mold on both sides about 1 1/2" above the rail head. Hold a shovel against the score mark on one side of the mold and carefully push the head of the mold from the opposite side until the mold is partially broken. If molten metal leaks out, return the mold to its original position and wait 15 to 30 seconds. Repeat until no leakage occurs; then push the mold head onto the shovel.

f. While the weld is still at red heat, use the power shears to remove the excess metal from the sides and top of the rail head. The power shears must be a type of "Safety Shear", one having a metal shroud completely covering all the hydraulic hoses which will prevent accidental damage to the hydraulic lines from hot material or from being struck by any tool. The safety shear shroud also helps prevent a "flare up" if a hose or fitting should fail during the shearing process. Shears with exposed flexible hydraulic lines will not be used. Operate the shears at a slow and consistent speed. Careful operation of the shears will decrease the likelihood of "hot tears". Leave enough of the weld to permit proper grinding. If power shears are not available, a sledge hammer and hot cut chisel, or a propane torch may be used.

   NOTE: When cutting away the excess metal from the top and sides of the ball, the chisel must be turned at an angle to the perpendicular, and not vertical to the ground.

g. Base risers may be bent out slightly to make room for rough grinding. The angle between the riser and the rail head should be approximately 45° degrees. Care must be taken during bending to ensure that a hot tear is not created in the top of the base of the rail.

h. The wedges may be removed after the weld cools to 700°F. Use a mechanical or hydraulic jack to remove wedges to relive pressure in a switch area.

i. After cooling for 20 minutes, the slag basin may be moved to the selected waste area and emptied. The preferred method for handling the debris produced during the welding

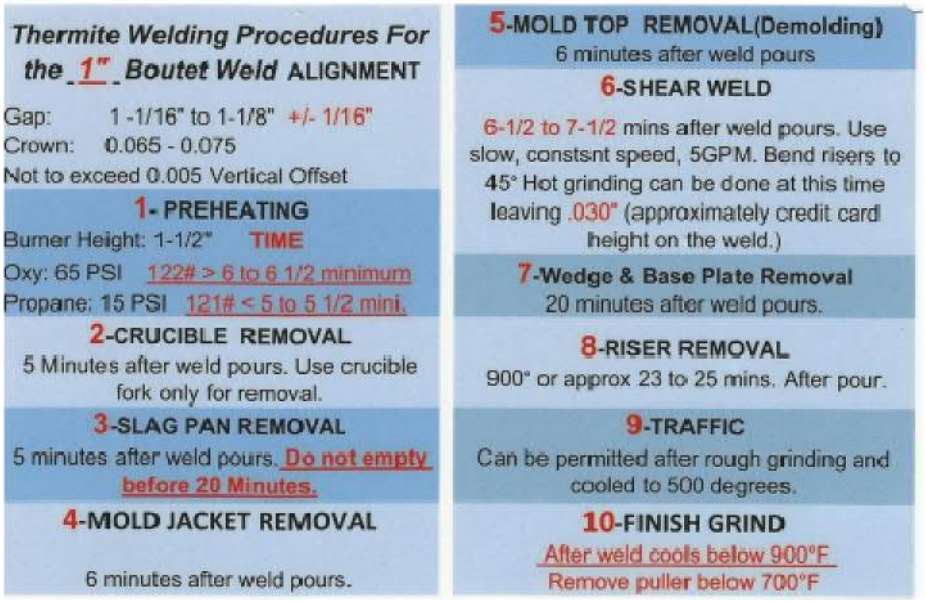
process is to place it in the used crucible "can" and move it to a normal trash disposal container. If this is not possible, bury the hot debris in a shallow hole. Make sure that the hole is dry. If the ground is wet, let the debris cool before burying. Be careful of underground facilities on the right-of-way, such as signal cables, fiber optic cables, etc.

CAUTION: Do NOT throw debris into water or snow.

j. The site should be left in a neat and orderly condition. All released track materials will be taken to the local material storage site.

THERMITE WELDING PROCEDURES

1" Gap, Railtech Boutet Weld with CJ Crucible (One-Shot):



1. PREPARATION OF RAIL ENDS

a. The rail is to be saw cut. The Welder must have a rail saw in operating condition prior to making a weld and it must be used.

b. Examine the rail ends to see if they have rail end damage (chips, nicks, bolt hole cracks and surface deformation) or were previously repaired by welding to remove rail end batter. Do not make a field weld to a rail that has rail end damage or was previously welded unless the rail end is cropped to remove all the damaged area or welded-on material. Also completely remove signal bond wires, if present, **by grinding.** To relieve tension on the rail with a torch, refer to Section H (Cutting Rail) on page H-2.

c. Only in an emergency, such as the mechanical failure of the rail saw during the cut, may the rail be torch cut. If a torch is used, care must be used to ensure a straight cut. All slag must be removed from the face of a torch cut rail. The weld must be made within one (1) hour of the torch cut. Also, "TC" will be marked on the rail.

d. Flame clean the rails for a distance of 4" to 6" from each end with the preheater and wire brush until area is free of grease, rust, mill scale, paint and other foreign matter.

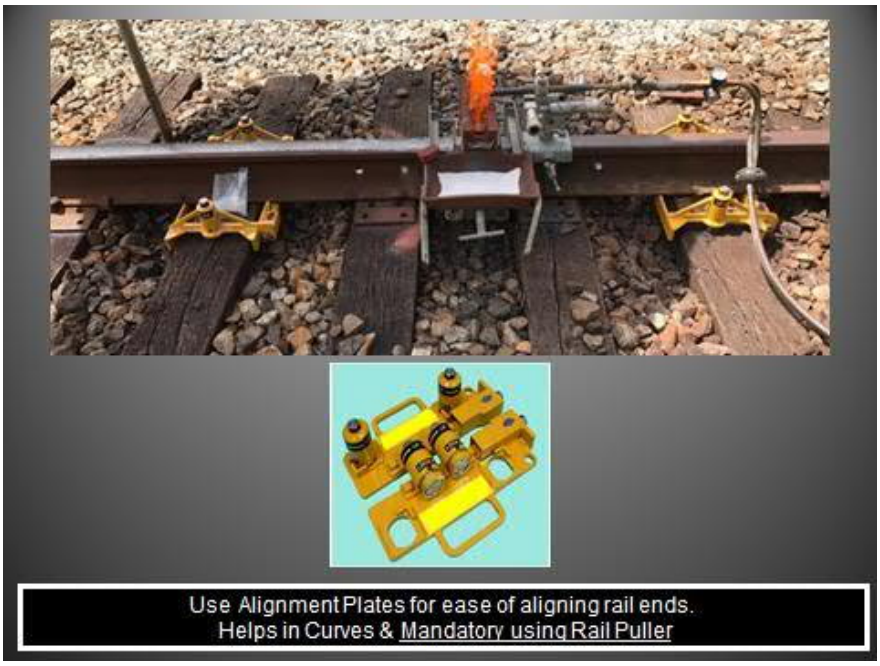
2. ALIGNMENT OF THE RAILS

a. There are four parameters to be considered in aligning the rails for welding: gap, horizontal alignment, vertical alignment and twist. The strongest weld is produced when the same section has no mismatch in the elevation of the rail bases, the webs are not twisted in relationship to each other, and any rail head mismatch is removed by grinding after the weld is made.

b. With some worn rails, it may not be possible to have the rail bases at the same elevation without having to perform considerable grinding on the rail heads to obtain a smooth transition between rails. In these instances, a limited amount of rail base mismatch is

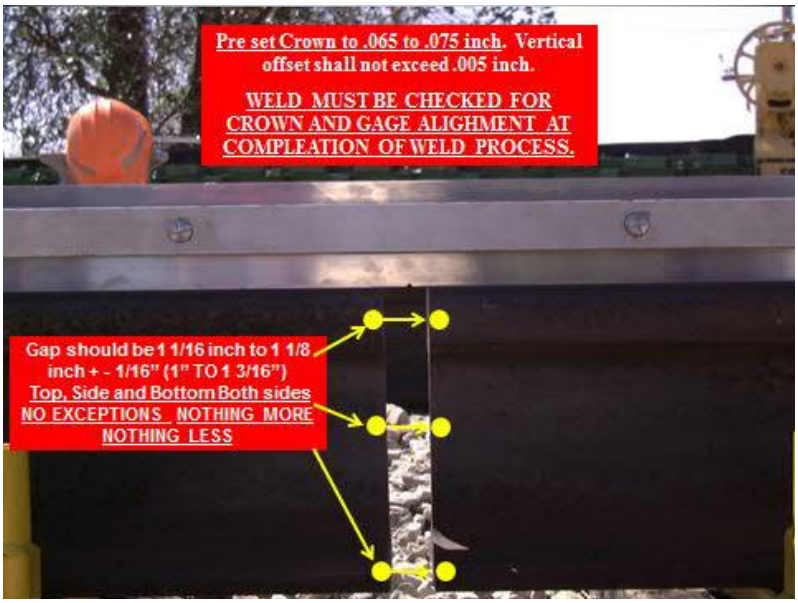
permitted. As the amount of rail base mismatch increases, it becomes harder to align the webs of rail with a straightedge to eliminate twist. As the rail base mismatch increases, the strength of the weld decreases.

c. Remove or loosen rail fastening from two or three ties (or whatever is necessary) on each side of the weld location.



d. To position rail ends to be welded, use:

1. alignment plates if available, or
2. use a mechanical or hydraulic jack under the center of the two rail ends, and lift them slightly. Place the four wedges under each side of the tie plate on both ties to nearly the desired height. Then remove the jack. A few light hits with a dead blow hammer should be all that is required to reach the desired crown and alignment. Replacement ends for dead blow hammer. A dead blow sledgehammer may also be used to achieve desired crown. Replacement ends for dead blow sledgehammer. No welds will be made with a hydraulic jack without supporting the crown with wedges.



e. **Ensure that the correct gap is obtained**. The correct gap for all rail sections is 1" to 1-3/16". The gap will be measured on both sides of the head and base (4 measurements) to confirm the proper gap has been established. Saw must be maintained to specifications to cut within the parameters of accepted tolerances or it MUST be removed from service.

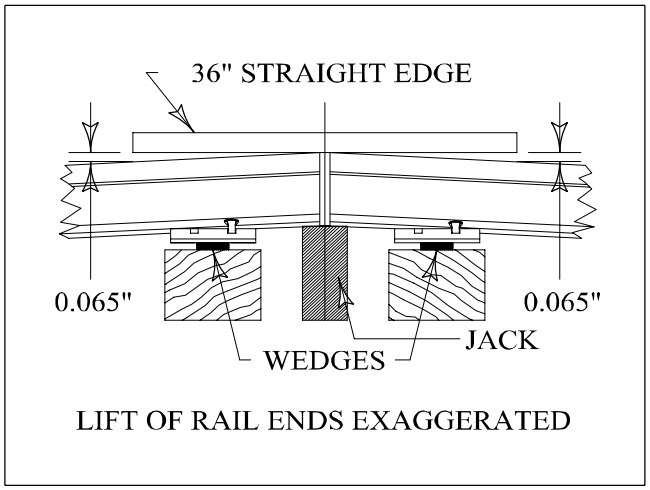
f. If the gap between rail ends is too small, the ends may be cut to give the proper gap.

g. All rails should be eye aligned 40 feet from where the weld is being made.

h. Then use a 36" steel straightedge at the rail ends. The horizontal alignment along the web must be perfect with the straightedge. Check the web from the rail base to the rail head to insure that the two rails are not twisted in relationship to each other.

i. The vertical alignment should have a 1/8" crown at the joint. Using a 36" straightedge, there will be 0.065" between the straightedge and the rail at each end. See Sketch I-2 below.

j. If necessary, use gage rods (Ball Ratchet Gage Rod, Base Ratchet Gage Rod), one on each side of the joint, to hold the alignment. Additional gage rods may be required in curved track. Use of a "Canting Tool" is very helpful in removing twist from the rail.



Sketch I-2

k. When welding top worn rail to new rail, it may be necessary to have the bases of the two rails mismatched. Transition Rails have been developed to address this problem (See MWI 507). If transition rails are not used, it is preferable that the base mismatch does not exceed 1/8" but up to 1/4" is permitted. If the rail height difference is greater than 1/4", the weld will be made with the running surfaces of the rails mismatched and no more than a 1/4" base mismatch. The molds will have to be filed to fit. After the weld is completed, the higher rail will be ~~ground~~ blended ~~off~~ to match the lower rail.

l. When making compromise welds, the rails will be aligned in a manner similar to that used for worn rail to new rail. Visually check the alignment of the webs to insure that the two rails are not twisted or canted in relationship to each other. Rail head mismatch should be corrected by grinding rather than by a major alteration of the molds.

m. If it is necessary to make a compromise weld from rail sections 122# and heavier to rail sections 100# and lighter, a 112# or a 115# intermediate rail will be inserted between the heavier and lighter rail sections. Transition rails should be used in the main track. See MWI 507 for details.

n. When welding in a plug, joint bars should be installed on the end which will be field welded last in order to hold the plug in true alignment while the first weld is being installed. When placing the plug in track it should be of the proper length to provide 1" gaps at each end for welding.

o. Secure the rails. When the desired rail gap has been established, clamp the rails to secure the position so that sudden temperature changes or sudden jolts will not disturb the gap opening. Mark the rails and tie plates on either side of the gap so any longitudinal rail movement can be detected during welding.

p. For the best quality product, no batter on either rail end is preferred. However, if batter is present, only one rail end may contain batter not to exceed 1/8" (approximately 0.125") and grinding must be complete per Owner's standards on rail run off. *See Section I

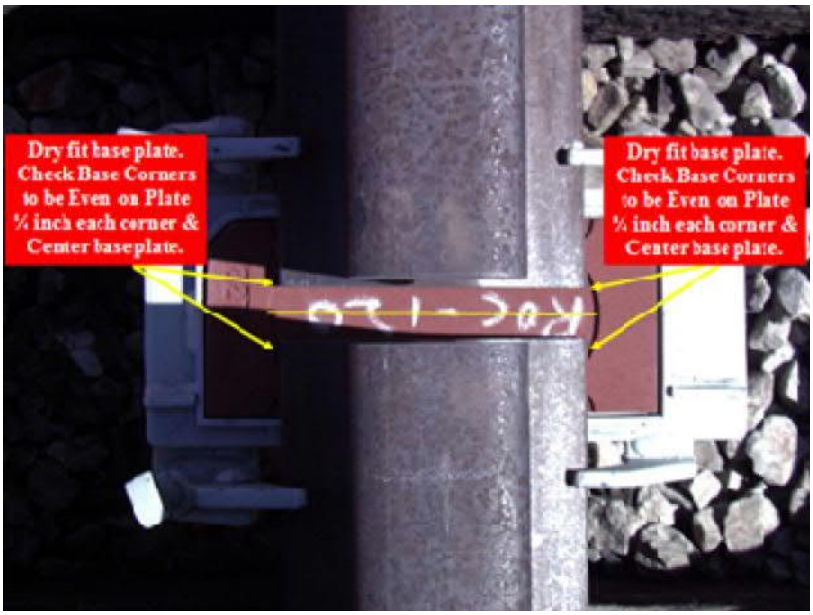
Finish Grinding of Thermite Welds, Part 2 Section E.

3. INSTALLATION OF THE MOLDS

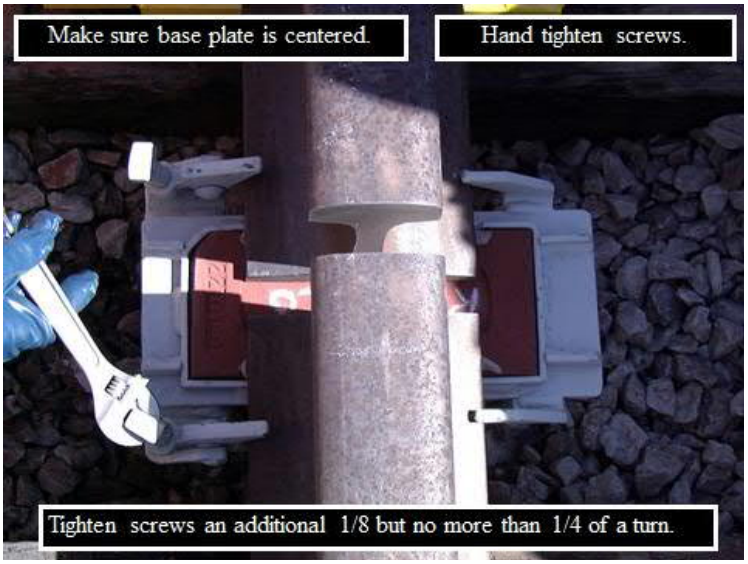
a. Before installation, check the molds and base briquette for damage. The pouring channels and risers must be clear. Verify that the molds and base briquette are the correct size for the rails being welded. Place each mold in a mold jacket and the base briquette in the base plate. Plan placement of the mold such that the pour side of the mold is in the gage of the track on tangent track or to the low side of a curve on curved track; this will place the slag basin on the same side as the pour.

b. Test fit the molds to the rail. The molds must be centered over the rail end gap with equal amount of rail exposed in the mold cavity. **Vertical mold mismatch should not exceed 1/8".** Grind off any rail flow that will prevent the molds from fitting tightly against the rail.

c. Test the base briquette fit and alignment on the base of rail before applying the refractory paste. Apply a bead of refractory paste (the diameter of a pencil) in the recess on the base briquette. Do not allow any paste in the middle depression of the base briquette.



d. Install the base plate to the base of rail. Make sure that equal amounts of rail are exposed in the depression of the base briquette. Ensure that the thumbscrews are on the field side. Hand tighten the thumbscrews, and then give ¼ turn with a wrench. Recheck the crown after installing the base plate.3



e. Place one mold half on the rail. Center it in relation to the gap and the base plate. The pouring spout and mold clamp handle should be on the gage side on tangent track or on the low side of curved track. Put the second mold half in place. Center it in relation to the gap and the base plate. Re-adjust the mold halves, if necessary, to achieve a perfect fit.

f. Final adjustment and control is achieved by positioning the mold clamp. Be careful not to break the molds by over-tightening the mold clamp. After clamping cover the mold top with Plexiglas or cardboard before starting luting to keep the inside of the mold clean.

CAUTION: Over-tightening of the base plate or the mold clamp may cause cracking of the molds or base briquette, which could lead to leakage of

molten steel and personal injury.

g. The luting process is designed to form a seal between the rail and the molds to prevent leakage of the molten metal when the mold is filled. Poorly aligned rail and/or molds make this process more difficult and increase the chance of leakage.

h. Evenly apply by hand a thin layer of the pre-mixed luting sand to seal the gap between the rail and the mold; follow this thin layer by another to fill completely around the entire profile of the rail, including the bottom of the rail base. After luting the molds, place the slag basin on the mold clamp under the pour spout of the pour mold jacket. Apply a small amount of the luting sand on the lip of the pour spout and place three-quarter (3/4) inch of dry sand in the slag basin. After luting is completed, check the molds for foreign material, and re-cover.

i. Do NOT let completed molds sit idle longer than 10 minutes before beginning preheating. In the event that preheating does not commence within this time, the existing molds may be used, but new luting sand must be applied.

CAUTION: If moisture is present under the weld, place a container of dry sand on the ballast under the weld to catch any leakage. Molten steel and slag can cause serious explosions upon coming into contact with snow, ice, standing water and/or frozen ballast/soil.

4. PREHEATING

a. The preheating operation has a major influence on the quality of the finished weld. It must remove the residual moisture from the molds and bring the rail ends to the proper temperature range.

b. Always check the Oxygen and Propane before beginning each preheat. Ensure that there is enough of each to complete the weld procedure and that the pressures are proper.

c. Ensure that the preheating burner has been tested as detailed in Thermite Welding, General, paragraph 22.

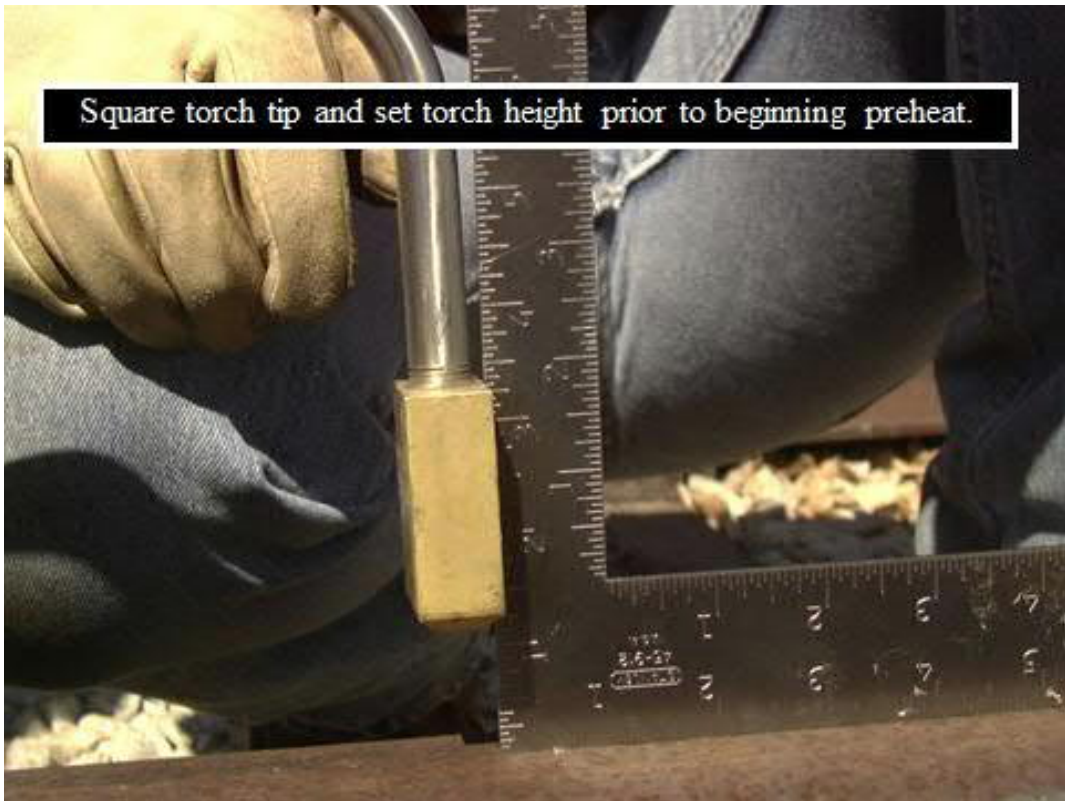
d. Set the propane and oxygen regulators to deliver the proper pressures to the burner.
***Two Stage Regulators are Mandatory for the Thermite preheating process**

e. The proper preheat working pressures are:

Smith, Victor or Hessa Equipment	
Propane:	15 PSI
Oxygen:	65 PSI
Burner Hgt.:	1 1/2" for 1" Weld

Pressures are measured at the burner when using Grade T 3/8" inside diameter hoses with reverse flow check valves behind burner body. Burner height is measured from the top of the lower rail if the rail ends are mismatched in height.

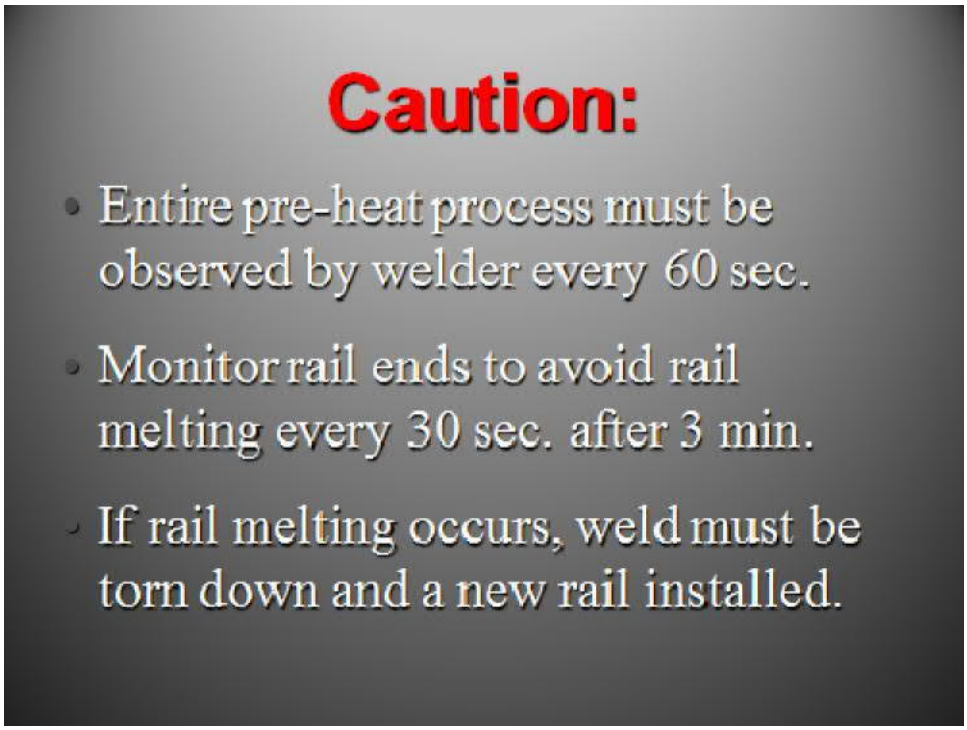
f. Position the preheating burner stand on the rail. Attach the unlit burner and align it so that the burner is centered in the gap in the rail. Make certain that it is also aligned in the center across the head and the burner tip is 1 1/2" above the head of the rail. Remove the burner from the stand. Light the burner, replace it on the stand and adjust the flame.



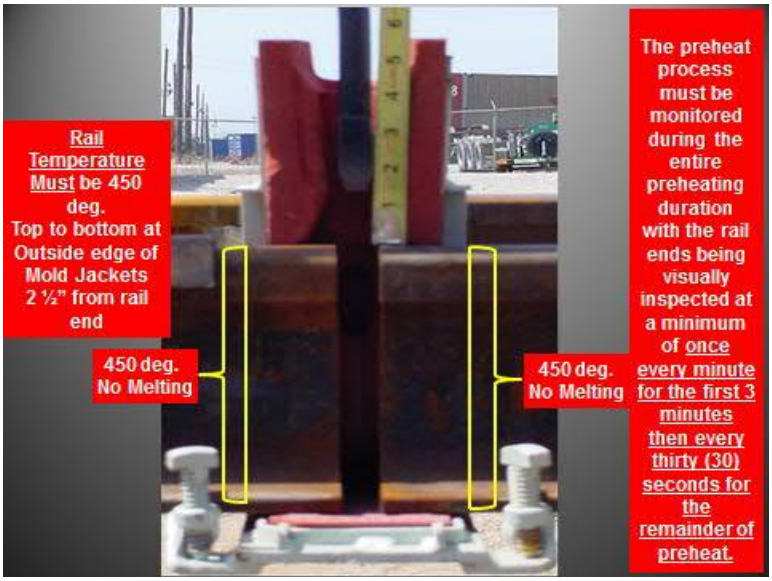
g. Preheating time starts after the flame has been adjusted and the burner alignment has been "fine-tuned". A digital stopwatch **must** be used to measure the preheat time. The proper preheat times are:

Rail Size	***Duration***
122 # rail and above	6 minutes **minimum**
below 122# rail	5 minutes **minimum**

h. On a windless day the burner flame should rise about 18" from the outside risers. The diverting plug should be dried before placing it in the mold. Place the diverting plug on the edge of the mold next to the riser flame for approximately 1 to 2 minutes. Do not block the flame from the riser hole with the diverter brick.



i. The preheat process must be monitored during the entire preheating duration with the rail ends being visually inspected at a minimum of **once every minute for the first 3 minutes then every 30 m for the remainder of preheat**.



j. At the end of the preheating time, the rail ends should show good orange/yellow color in the web and the base. If the rail ends do not show good orange/yellow color, continue to preheat until the color is obtained. When making a compromise weld, the base of the heavier rail section must have an orange/yellow color.

k. Upon completion of preheating, remove the burner and burner stand. Insert the diverting plug into the mold, making sure it seats properly.

NOTE: The welding charge must be ignited within 15 seconds after the preheating burner has been removed.

l. If the rail ends melt during the preheating process, the welding process shall cease. If repaired within 1 hour, cut no closer than 3/8" from the damaged (melted) rail ends. If repaired after 1 hour, cut no closer than 6" from the damaged (melted) rail ends to install a plug rail.

5. CJ CRUCIBLE

a. The CJ Crucible (One-shot) is made from a refractory compound combined with a resin. The CJ Welding Charge must be used with the CJ Crucible, ie. only use the welding charge shipped in the field welding kit.

CAUTION: **Never use a welding charge that has lost material or has a hole in the bag. Never mix two welding charges or add anything to the charge.**

b. Preparing the crucible for use may be done before or during the preheat process. Inspect the crucible for cracks or other damage. Clean out any loose sand. Open and pour the welding charge into the crucible. Place the crucible on cardboard at a dry location near the working area. Get an igniter ready. Place the CJ fork near the crucible. Ensure that the slag basins contain 3/4" of dry sand.

6. REACTION AND POUR

a. The welder will clear all individuals from the welding area prior to igniting the welding portion. All track equipment working in the area will be stopped if vibrations can be felt in the rail being welded or roadbed until the weld has been poured and solidified.

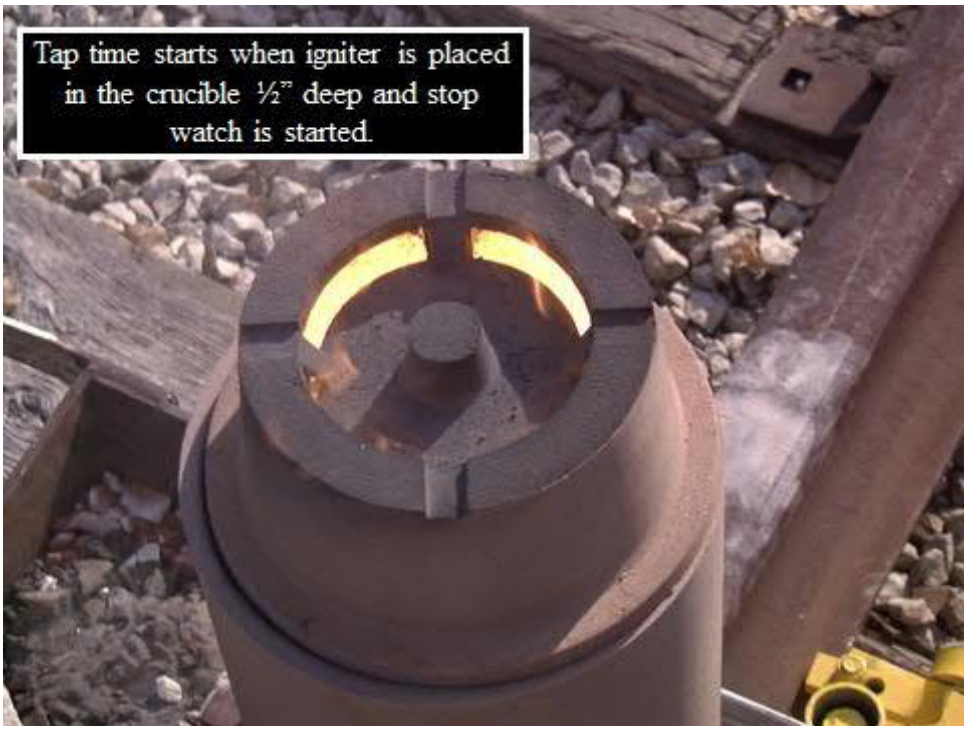
b. As soon as the preheating is complete and the diverter plug is in place, place the crucible on top of the molds. Ensure that it is centered by using the two large outside riser holes as a reference.

c. The welder, using a gloved hand, will insert a lit igniter into the center of the welding charge to a depth of 1/2". Gently place the cover on the crucible, and move to a safe position.

CAUTION: During the reaction and pouring of the weld material, all personnel must move away from the crucible and remain a minimum of 20' (30' if snow on track) away while the reaction takes place. Do not return to the weld until you are certain that all molten material is contained.

d. The tapping time, which is the time from when the lit ignitor is placed into the shot portion until the time the portion begins to exit the crucible, will be timed for each weld. The normal tapping time is from 23 to 28 seconds. If the tapping time is less than 15 seconds or more than 35 seconds, the weld is to be considered defective and immediately removed from track. The CJ Crucible is designed with a by-pass feature. In the event that the molten material does not discharge within the normal tapping time, the bypass will pour into the large riser hole at approximately 90 seconds after ignition. If the by-pass tap does not function remain a safe distance away for 20 minutes.

e. When the crucible taps, the molten material will flow into the molds and the excess material and slag will flow into the slag basin. After the flow of molten material has stopped, start the solidification time. Do not place dry sand on top of molds and slag basins until 5 minutes have passed from the pour.



7. REMOVING THE MOLDS

a. Note that a full face shield, long sleeves and welding gloves are required during the tear down process. This includes shearing of the weld.

b. Following the pour, and after 5 minutes have elapsed, sprinkle dry sand on top of the molds and slag basin and remove the slag basin. Carry the slag basin level staying on the level part of the track. Do not step over a rail while carrying the hot slag basin. Take the slag basin fifteen to twenty feet (eight to ten ties) away from the weld. Place the slag basin on level ballast between the ties. Note that this area must be level and dry. Do not flip over the slag basin at this time; allow time for the slag to cool in the basin.

c. After removing the slag basin, the CJ Crucible may be gently removed from the weld using the CJ Crucible Fork. The crucible will be lifted straight up and leveled. Pause momentarily to ensure that all molten material has drained into the mold. Carry the crucible level and set it down level in the "waste disposal" area.

CAUTION: Hot metal or slag coming in contact with moisture can cause an explosion.

d. When 6 minutes after the finish of the pour has past, score the mold on both sides 1 1/2" above railhead. Hold a shovel against the score mark on one side of mold and carefully push the head of the mold from the opposite side until mold is partially broken a demolding tool **must** be used if available. If molten metal leaks out, return the mold to its original position and wait 15 to 30 seconds. Repeat until no leakage occurs. Then push the mold head onto the shovel or remove with the demolder over with the handle up

and carry the excess weld head to the waste disposal area already predetermined at the welding site.

e. While the weld is still at red heat, use the power shears to remove the excess metal from the sides and top of the railhead. The power shears must be a type of "Safety Shear", one having a metal shroud completely covering all the hydraulic hoses which will prevent accidental damage to the hydraulic lines from hot material or from being struck by any tool. The safety shear shroud also helps prevent a "flare up" if a hose or fitting should fail during the shearing process. Shears with exposed flexible hydraulic lines will not be used. Operate the shears at a slow and consistent speed. Careful operation of the shears will decrease the likelihood of "hot tears". Leave enough of the weld to permit proper grinding. If power shears are not available or in case of a weld shear failure, excess top railhead material may be removed by torch and excess railhead side material may be removed by hot cut chisel.

NOTE: When cutting away the excess metal from the sides of the railhead, the hot cut chisel must be turned at an angle to the perpendicular, and not vertical to the ground. Refer to page A-13 – Hand Tools.

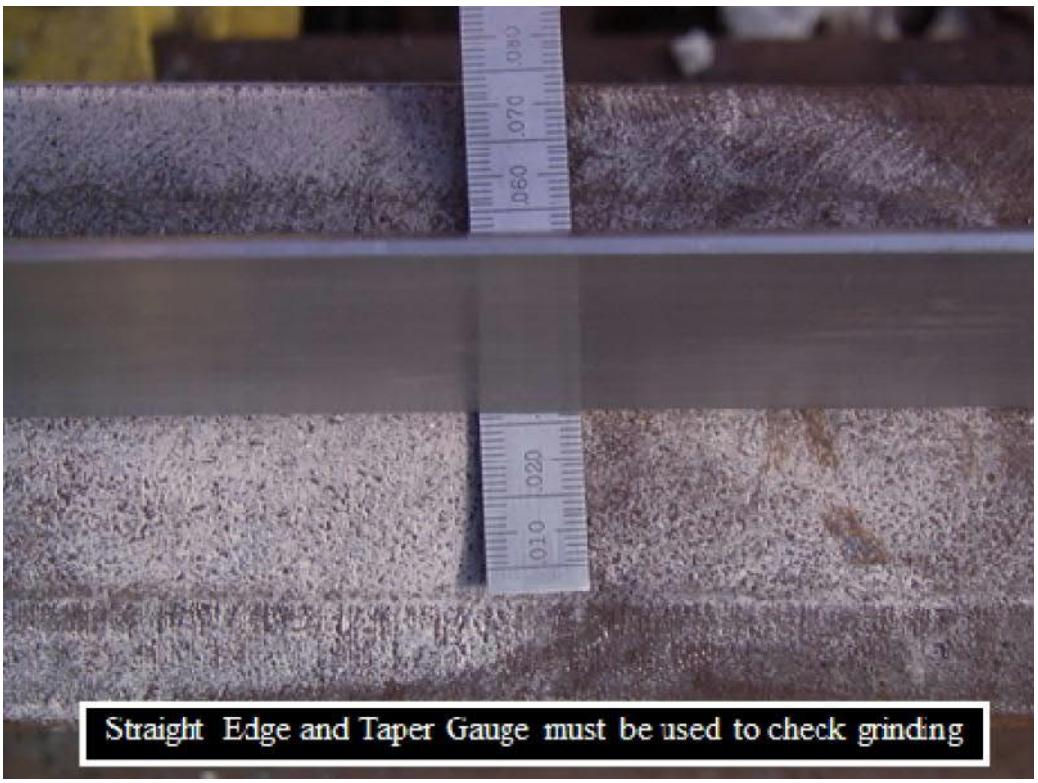
f. Base risers may be bent out slightly to make room for rough grinding. The angle between the riser and the rail head should not exceed 45°. Care must be taken during bending to ensure that a hot tear is not created in the top of the base of the rail and not to remove the risers.

g. The wedges and weld base plate may be removed after 20 minutes. Use a mechanical or hydraulic jack to remove wedges to relieve pressure in a switch area.

h. After cooling for 20 minutes, the slag basin may be moved to the selected waste area and emptied. Bury the hot debris in a shallow hole, making sure there is no water in the hole. If the ground is wet or covered in snow, let the debris cool before burying. Be careful of

underground facilities on the right-of-way, such as signal cables, fiber optic cables, etc.
CAUTION: Do NOT throw debris into water or snow.

i. The site should be left in a neat and orderly condition. All released track materials will be taken to the local material storage site.



THERMITE WELDING PROCEDURES

2 3/4" Wide Gap Weld using Boutet CJ Crucible (One-Shot)

1. GENERAL

Thermite Welding Procedures For the 2-3/4" WG Boutet Weld

ALIGNMENT
Gap: 2 3/4" +/- 1/16"
Crown: 0.085 - 0.095
Not to exceed 0.005 Vertical Offset

1- PREHEATING
Burner Hight 2 3/8" **TIME**
Oxy: 60 PSI **6-1/2 Minimum**
Propane: 15 PSI

2-CRUCIBLE REMOVAL
6 Minutes after weld pours. Use crucible fork only for removal.

3-SLAG PAN REMOVAL
6 minutes after weld pours. Do not empty before 20 minutes.

4-MOLD JACKET REMOVAL
10 minutes after weld pours.

5 - MOLD TOP REMOVAL (Demolding)
10 1/2 minutes after weld pours.

6-SHEAR WELD
11 1/2 minutes after weld pours. Use slow, constant speed, 5 GPM. Bend risers to 45°. Hot grinding can be done at this time leaving .030" (approximately credit card height on the weld.)

7-Wedge & Base Plate Removal
20 minutes after weld pours.

8-RISER REMOVAL
900° or approx. 23 to 25 mins. After pour.

9-TRAFFIC
Can be permitted after rough grinding and cooled to 500 degrees.

10-FINISH GRIND
After weld cools below 900° F
Remove puller below 700° F

Wide Gap Thermite Welds have been approved to be used in the field to replace defective electric flash butt plant welds, oxygen-acetylene plant welds, thermite welds and in-track welder welds. Wide Gap Welds may also be used when changing out a frog that is field welded in track with a frog of the same size, to eliminate installation of additional rails on each leg of the frog.

2. PREPARATION OF RAIL ENDS

a. Locate the defective plant/field weld. The area of the defective weld, that contains the defect, will be indicated by a vertical line on the field side head of the rail. Mark the "cut marks" on the rail head, ensuring that the existing weld and the defect area is completely removed. Also place "reference marks" on the field side of the rail head. The "reference marks" will be 24" apart and centered on the "cut marks".

b. Wide gap welds will not be made on a tie. The weld should be no closer than 4" to the edge of a tie. If tie re-spacing is required, it should be done before the rail is cut.

c. Prior to saw cutting the rail, ensure that all anchors 40' to either side of the cut are installed and tight. The rail is to be saw cut. The Welder must have a rail saw in operating condition prior to making a weld and it must be used.

d. Examine the rail ends to see if they have rail end damage (chips, nicks, and surface deformation) or were previously repaired by welding to remove rail end batter. Do not make a field weld to a rail that has rail end damage or was previously welded unless the rail end is cropped to remove all the damaged area or welded-on material. If signal bond wires are present, remove them by grinding.

e. Flame clean the rails for a distance of 4" to 6" from each end with the preheater and wire brush until area is free of grease, rust, mill scale, paint and other foreign matter.

3. ALIGNMENT OF THE RAILS

a. There are four parameters to be considered in aligning the rails for welding: horizontal alignment, vertical alignment, twist and gap width. The strongest weld is produced when there is no mismatch in the elevation of the rail bases, the webs are not twisted in relationship to each other, and any rail head mismatch is removed by grinding after the weld is made.

b. With some worn rails, it may not be possible to have the rail bases at the same elevation without having to perform considerable grinding on the rail heads to obtain a smooth transition between rails. In these instances, a maximum of 1/8" rail base mismatch is permitted. As the amount of rail base mismatch increases, the strength of the weld decreases.

c. Remove or loosen rail fastening from two or three ties (or whatever is necessary) on each

side of the weld location.

d. To position rail ends to be welded, use:

1. alignment plates if available, or
2. use a mechanical or hydraulic jack under the center of the two rail ends, and lift them slightly. Place the four wedges under each side of the tie plate on both ties to nearly the desired height. Then remove the jack. A few light hits with a dead blow hammer should be all that is required to reach the desired crown and alignment. **No welds will be made with a hydraulic jack without supporting the crown with wedges.**

e. **Ensure that the correct gap is obtained**. The correct gap for all rail sections is 2 3/4" with a tolerance of 1/16" (2 3/4" to 2 13/16" permitted). The gap will be measured on both sides of the head and web in the base fillet area to confirm the proper gap has been established. This gap must be maintained throughout the welding process. Use a rail puller when the rail temperature is less than Desired Rail Neutral Temperature.

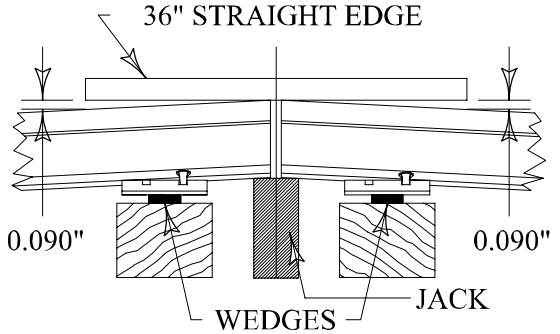
f. If the gap between rail ends is too small, the ends may be trimmed with a saw to give the proper gap.

g. All rails should be eye aligned 40' from where the weld is being made.

h. Then use a 36" steel straightedge at the rail ends. The horizontal alignment along the gage side of the web must be perfect with the straightedge. Check the web from the rail base to the rail head to insure that the two rails are not twisted in relationship to each other.

i. The vertical alignment must be crowned at the joint. Determine the crown by placing a 36" straightedge on the rail, so that it is centered on the gap. Then measure between the straightedge and the rail at each end. This measurement will be 0.090 (+/- 0.005). See Sketch I-3 below.

j. When welding top worn rail to new rail, it may be necessary to have the bases of the two rails mismatched. The base mismatch must not exceed 1/8". (If the rail height difference is greater than 1/8", do not use a wide gap weld.) The molds will have to be filed to fit. After the weld is completed, the higher rail will be ground off to match the lower rail. A wide gap weld is not designed to be used in place of a compromise weld. Therefore, use the existing compromise welds where appropriate.



LIFT OF RAIL ENDS EXAGGERATED

Sketch I-3

k. If necessary, use gage rods (Ball Ratchet Gage Rod, Base Ratchet Gage Rod), one on each side of the joint, to hold the alignment. Additional gage rods may be required in curved track. Use of a "Canting Tool" is very helpful in removing twist from the rail.

l. Secure the rails. When the desired rail gap has been established, tighten or add rail anchors to secure the rail position so that sudden temperature changes or sudden jolts will not disturb the gap opening. The "reference marks" will be checked to ensure that no rail is added to the track. The rails and tie plates on either side of the gap should also be marked so any longitudinal rail movement can be detected during welding. If the temperature is less than Desired Rail Neutral Temperature a hydraulic rail puller must be used to hold the rail from any movement during the solidification of the weld.

4. INSTALLATION OF THE MOLDS

a. Before installation, check the molds and base briquette for damage. The pouring channels and risers must be clear. Verify that the molds and base briquette are the correct size for the rails being welded. Place each mold in a mold jacket and the base briquette in the base plate. Plan placement of the mold such that the pour side of the mold is in the gage of the track on tangent track or to the low side of a curve on curved track; this will place the slag basin on the same side as the pour.

b. Test fit the molds to the rail. The molds must be centered over the rail end gap with equal amount of rail exposed in the mold cavity. Vertical mold mismatch should not exceed 1/8". Grind off any rail flow that will prevent the molds from fitting tightly against the rail.

c. Test the base briquette fit and alignment on the base of rail before applying the refractory paste. Apply a bead of refractory paste (the diameter of a pencil) in the recess on the base briquette. Do not allow any paste in the middle depression of the base briquette.

d. Install the base plate to the base of rail. Make sure that equal amounts of rail are exposed in the depression of the base briquette. Ensure that the thumb screws are on the field side. Hand tighten the thumbscrews, and then give ¼ turn with a wrench. Recheck the crown after installing the base plate.

e. Place one mold half on the rail. Center it in relation to the gap and the base plate. The pouring spout and mold clamp handle should be on the gage side on tangent track or on the low side of curved track. Put the second mold half in place. Center it in relation to the gap and the base plate. Re-adjust the mold halves, if necessary, to achieve a perfect fit.

f. Final adjustment and control is achieved by positioning the mold clamp. Be careful not to break the molds by over-tightening the mold clamp. After clamping, cover the mold top with Plexiglas or cardboard before starting luting to keep the inside of the mold clean.

CAUTION: Over-tightening of the base plate or the mold clamp may cause cracking of the base briquette or molds, which could lead to leakage of molten steel and personal injury.

g. The luting process is designed to form a seal between the rail and the molds to prevent leakage of the molten metal when the mold is filled. Poorly aligned rail and/or molds make this process more difficult and increases the chance of leakage. Only luting paste will be applied on the base briquette.

h. Evenly apply by hand the pre-mixed luting sand around the entire profile of the rail, including the bottom of the rail base. After luting the molds, place the slag basin on the mold clamp under the pour spout of the pour mold jacket. Apply a small amount of the luting sand on the lip of the pour spout and place three quarter (3/4) inch of dry sand in the slag basin. After luting is completed, check the molds for foreign material, and re-cover.

i. Do NOT let packed molds sit idle longer than 10 minutes before beginning preheating. In

the event that preheating does not commence within this time, the existing molds may be used, but new luting sand must be applied.

CAUTION: If moisture is present under the weld, use a safety pan with dry sand between the ties to catch any leakage. Molten steel and slag can cause serious explosions upon coming into contact with snow, ice, standing water and/or frozen ballast/soil.

5. PREHEATING

a. The preheating operation has a major influence on the quality of the finished weld. It must remove the residual moisture from the molds and bring the rail ends and the molds to the proper temperature range.

b. Always check the Oxygen and Propane before beginning each preheat. Ensure that there is enough of each to complete the weld procedure and that the pressures are proper.

c. Ensure that the preheating burner has been tested as detailed in Thermite Welding, General, paragraph 22.

d. Set the propane and oxygen regulators to deliver the proper pressures to the burner.

e. The proper preheating equipment and working pressures are:

Preheating Equipment

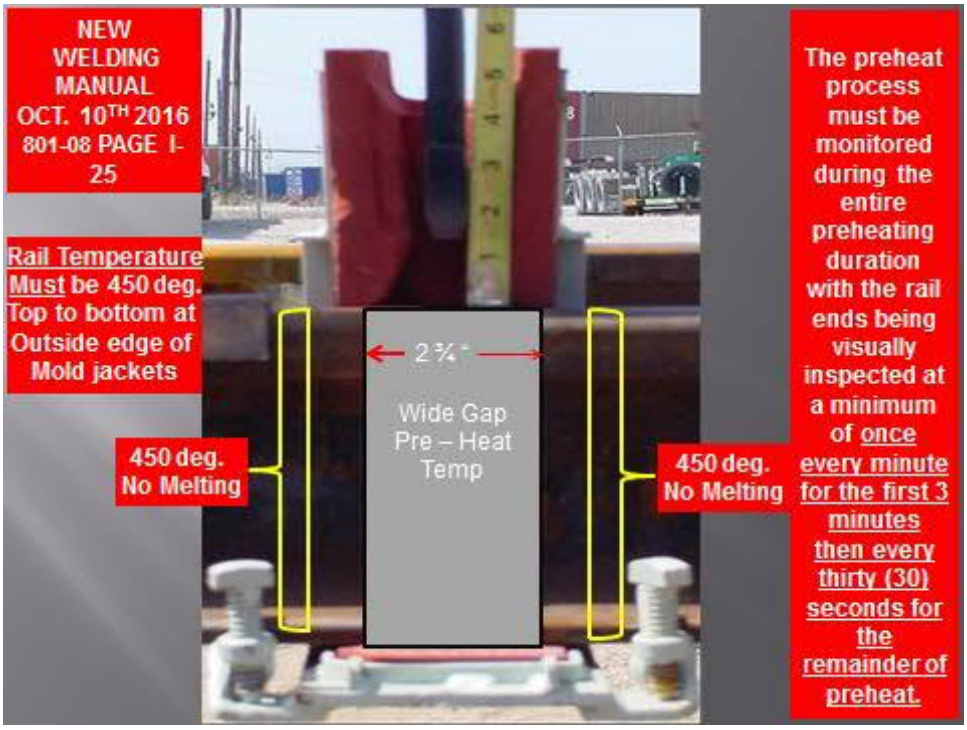
Torch Body		
Manufacturer	Victor	Harris
Model	HD310C	43-2
Preheating Burner 22 Orifice		
Manufacturer	Victor	Harris
Model	TWN-5	QC2SCT7777

Preheating Operating Pressures at the Torch Handle

Propane: 15 PSI
Oxygen: 60 PSI
Inline pressure gauges

Preheating Time

All rail sections: 6 1/2 minutes a digital stopwatch MUST be used to ensure proper time requirements are followed.
Inline Pressure Gauges **must** be used when making Wide Gap Welds.
Pressures are measured at the burner when using 3/8" inside diameter hoses with reverse flow check valves behind burner body. Burner height is measured from the top of the lower rail if the rail ends are mismatched in height.



f. Position the preheating burner stand on the rail. Attach the unlit burner and align it so that the burner is centered in the gap between the rail ends. Make certain that it is also aligned in the center across the head and the burner tip is **2 3/8"** above the head of the rail. Remove the burner from the stand. Light the burner, replace it on the stand and adjust the flame. On a windless day, the burner flame should rise about 12" to 14" from the outside risers.

g. Preheating time starts after the flame has been adjusted to a slight crackle and the burner alignment has been "fine-tuned". A stopwatch is the easiest and most accurate way to measure the preheat time. The proper preheat time is 6 1/2 minutes for all rail sections.

h. The diverting plug must be dried before placing it in the mold. This is accomplished by placing the diverting plug on the end of the mold next to the riser flame for approximately 1 to 2 minutes. Do not block the flame from the riser hole with the diverter plug.

i. At the end of preheating time, remove the burner and burner stand. Insert the diverting plug into the mold, making sure it seats properly.

NOTE: The welding charge must be ignited within 15 seconds after the preheating burner has been removed.

6. CJ CRUCIBLE

a. The CJ Crucible (One-shot) is made from a refractory compound combined with a resin. The CJ Welding Charge must be used with the CJ Crucible, ie. only use the welding charge shipped in the field welding kit.

CAUTION: Never use a welding charge that has lost material or has a hole in the bag. Never mix two welding charges or add anything to the charge.

b. Preparing the crucible for use may be done before or during the preheat process. Inspect the crucible for cracks or other damage. Clean out any loose sand. Open and pour the welding charge into the crucible. Place the crucible on cardboard at a dry location near the working area. Get an igniter ready. Place the CJ fork near the crucible. Ensure that the slag basin contains 1" of dry sand.

7. REACTION AND POUR

a. The welder will clear all individuals from the welding area prior to igniting the welding portion. All track equipment working in the area or vehicular traffic (if adjacent to a road crossing) will be stopped if vibrations can be felt in the rail being welded or roadbed until the weld has been poured and solidified.

b. As soon as the preheating is complete and the diverting plug is in place, place the crucible on top of the molds. Ensure that crucible is perpendicular and flush with side molds as rise holes are not visible as a reference on wide gap welds.

c. The welder, using a gloved hand, will insert a lit igniter into the center of the welding charge to a depth of 1". He will gently place the cover on the crucible, and move to a safe position.

CAUTION: During the reaction and pouring of the weld material, all personnel must move away from the crucible and remain a minimum of 20' (30' if snow on track) away while the reaction takes place. Do not return to the weld until you are certain that all molten material is contained.

d. The tapping time, which is the time from when the igniter is inserted until the time the portion begins to flow, will be timed for each weld. The normal tapping time is from 23 to 28 seconds. If the tapping time is less than 15 seconds or more than 35 seconds, the weld is to be considered defective and immediately removed from track. The CJ Crucible is designed with a by-pass feature. In the event that the molten material does not discharge within the normal tapping time, the bypass will pour into the large riser hole at approximately 90 seconds after ignition.

e. When the crucible taps, the molten material will flow into the molds and the excess material and slag will flow into the slag basin. After the flow of molten material has stopped, start the solidification time. Do not place dry sand on top of molds and slag basins until 6 minutes have passed from the pour.

8. REMOVING THE MOLDS

a. Note that a full face shield, long sleeves and welding gloves are required during the tear down process. This includes shearing of the weld

b. Following the pour and after 6 minutes have passed, sprinkle dry sand on top of molds and slag basin. Now the CJ Crucible may be gently removed from the weld using the CJ Crucible Fork. The crucible will be lifted straight up and leveled. Pause momentarily to ensure that all molten material has drained into the mold. Carry the crucible level and set it down level in the "waste disposal area". Remove the slag basin. Carry the slag basin level staying on the level area of the track. Take the slag basin fifteen to twenty feet (eight to ten ties) away from the weld. Place the slag basin on level ballast between the ties. Note that this area must be level and dry. Do not flip over the slag basin at this time; allow time for the slag to cool in the basin.

CAUTION: The "waste disposal location" should be selected before removing the slag basin. It must be dry, and out of the way. **Hot metal or slag coming in contact with moisture can cause an explosion.**

c. After 10 minutes, remove the mold jackets.

d. After 10 1/2 minutes, remove the mold top using the Boutet de-molding tool.

e. After 11 1/2 minutes, use the power shears and shear the weld through the molds. The power shears must be a type of "Safety Shear", one having a metal shroud completely covering all the hydraulic hoses which will prevent accidental damage to the hydraulic lines from hot material or from being struck by any tool. The safety shear shroud also helps prevent a "flare up" if a hose or fitting should fail during the shearing process. Shears with exposed flexible hydraulic lines will not be used.

f. Operate the shears at a slow and consistent speed. Careful operation of the shears will decrease the likelihood of "hot tears".

g. If the air temperature is below 40°F, or it is windy, raining or snowing, cover the weld with a cooling retarding material immediately after shearing. Remove the cover after the

weld cools to 700°F.

h. Base risers may be bent out slightly to make room for rough grinding. The angle between the riser and the rail head should not exceed 45°F. Care must be taken during bending to ensure that a hot tear is not created in the top of the base of the rail.

i. The wedges and weld base plate may be removed after 20 minutes in tangent track or 30 minutes in curved track. Use a mechanical or hydraulic jack to remove wedges to relive pressure in a switch area.

j. After cooling for 20 minutes, the slag basin may be moved to the selected waste area and emptied. Bury the hot debris in a shallow hole, making sure there is no water in the hole. If the ground is wet or covered in snow, let the debris cool before burying. Be careful of underground facilities on the right-of-way, such as signal cables, fiber optic cables, pipes, etc.

CAUTION: Do NOT throw debris into water or snow.

9. REPORTING

A welding report on the Engineering Gateway must be submitted at the completion of each work day, as well as a Track Disturbance Record for any Thermite weld made in the track structure. Be sure to use "WG" as the weld type instead of "BU" so that proper credit will be recorded when making Wide Gap Welds. Also record the thermite weld batch/serial numbers, tap times, and crucible type in DTW.

GRINDING OF THERMITE WELDS

1. ROUGH GRINDING THE WELD

a. Rough grinding can be performed immediately after shearing.

b. Prior to rough grinding, the base risers may be bent away from the rail head to provide clearance for the grinder. However, to avoid hot tears in the base, the risers should be bent the minimum distance that is required for clearance but not more than 45° from the vertical. The riser removal tool is available for this task.

c. The rough grinding is finished when the top surface of the railhead is about 0.030" high and the gage side has been ground.

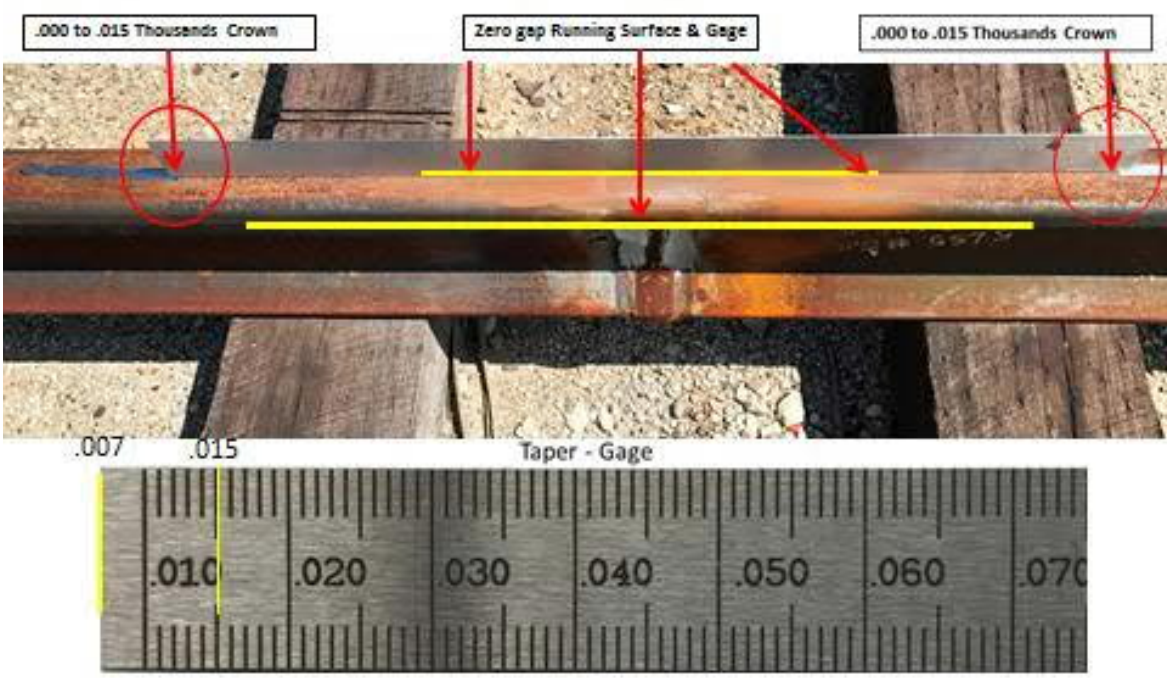
2. FINISH GRINDING THE WELD

a. All thermite welds must be ground before the heat leaves the weld. Do not re-introduce heat into the sides of the weld where it will be ground. **Do not finish grind the rail head freehand.**

b. Finish grinding may be performed while the weld is hot. The weld must be left high to

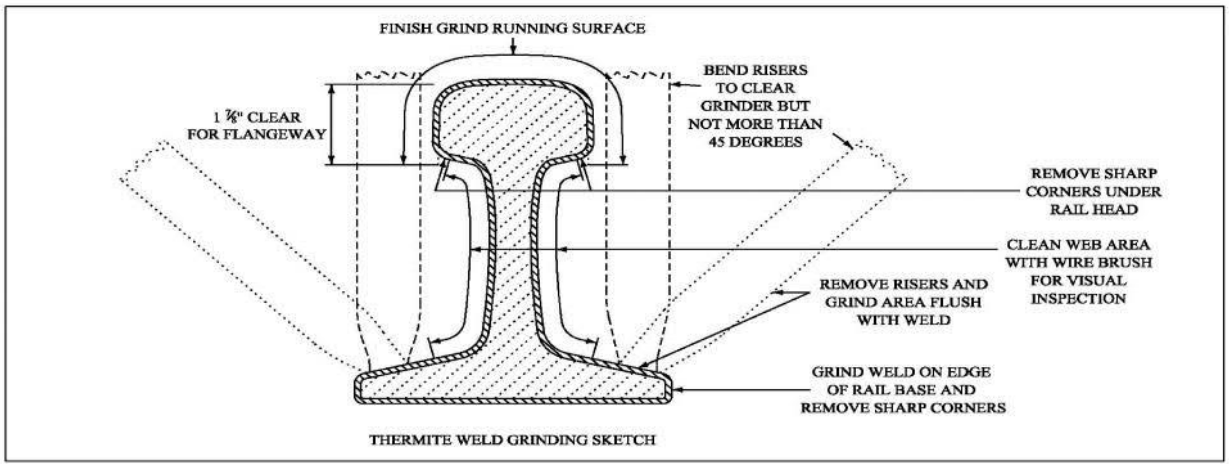
compensate for the reduction in crown that will occur during the cooling to ambient temperature. Leave the weld about 0.030" high if finish grinding is done at 900°F, or about 0.015" high if finish grinding is done at 600°F.

c. If the weld is at ambient temperature, the running surface will be ground within a tolerance of 0.000" low, 0.015" high. Check the final contour of the rail head with the 36" straightedge.



d. For most welds, finish grinding in the following sequence will require the least handling of the grinding equipment:

1) Sides of the railhead,
2) Edges of the rail base and base riser area,
3) Top of the railhead,
4) Rounding off of sharp corners under the rail head and at the rail base.



Sketch I-4

e. If the weld was made with a rail head mismatch, the higher rail will be runoff at the minimum rate of:
12" for each 1/16" difference in rail height for speeds of 40 MPH and less, and
18" for each 1/16" difference in rail height for speeds greater than 40 MPH.

If the weld was made with a gage face mismatch, the gage face will be ground to provide a gradual change. Check both surfaces with a 36" straightedge for any undesirable alignment.

f. Remove the base risers by bending them back toward the rail. After removing the base risers, grind the riser area flush with the top of the weld metal leaving a smooth surface to avoid any notch effect stresses.

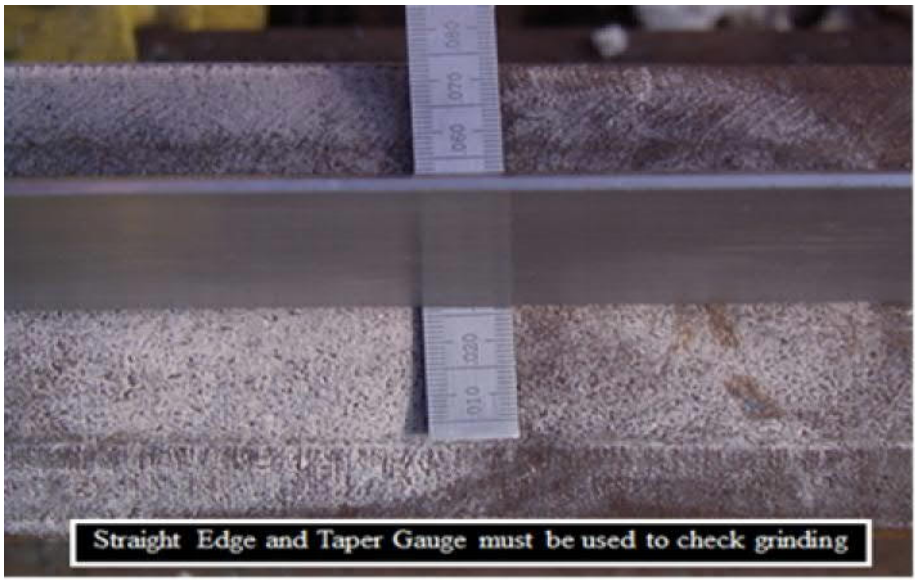
g. The web and base are to be cleaned by hand with a wire brush for inspection.

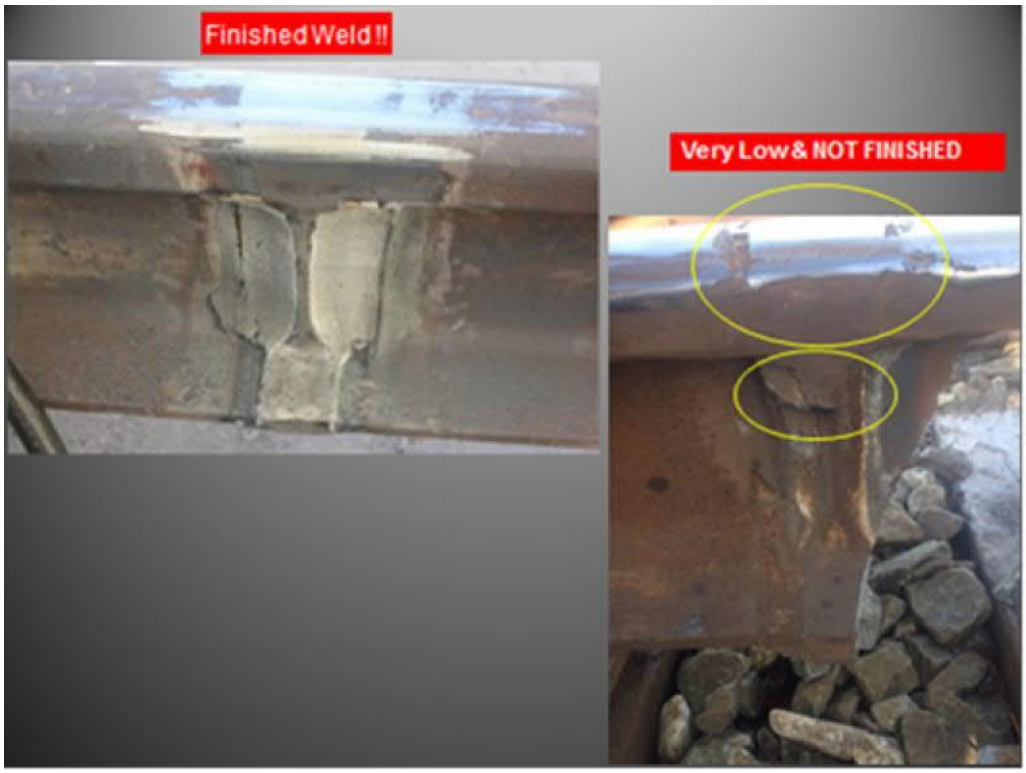
h. Grinding below the rail head should be done only where necessary to remove sharp edges and to grind the weld on the outside edges of the rail base.

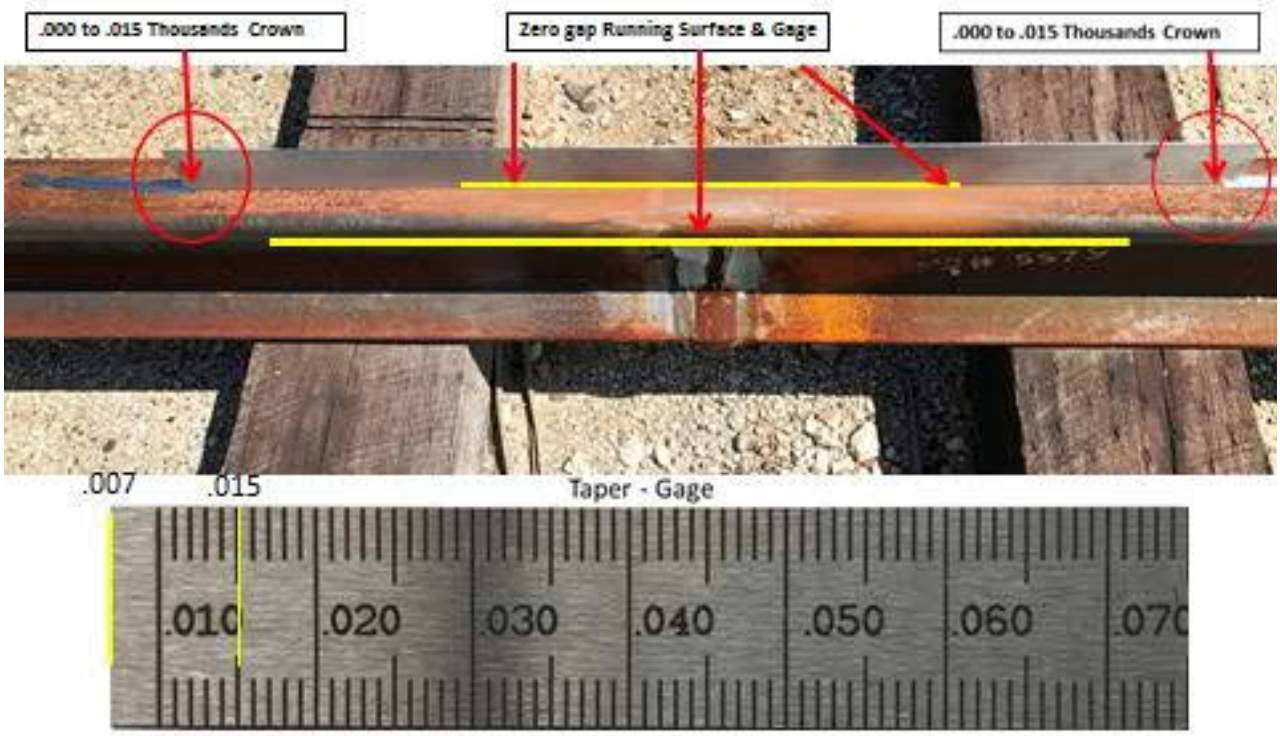
i. After finish grinding, a visual inspection must be made on every weld for hairline cracks and other visible defects. The Welder **must** use a 36" straight edge to verify proper crown.

j. Tamp up the ties on each side of the weld. Re-install any spikes, clips, or anchors removed or missing. On track with concrete ties, replace any clips, tie pads, or insulators.

k. The weld must have been completed for 20 minutes, ties tamped, the surface and gage side grinding completed, and the weld temperature below 500°F (check with a Tempilstik or a digital thermometer) before allowing a train to pass over.


Straight Edge and Taper Gauge must be used to check grinding


Finished Weld !!
Very Low & NOT FINISHED


.000 to .015 Thousands Crown
Zero gap Running Surface & Gage
.000 to .015 Thousands Crown
.007
.015
Taper - Gage
.010
.020
.030
.040
.050
.060

J. GRINDING EQUIPMENT

GENERAL

1. When operating power grinding machines and abrasive rail saws, the proper hand, leg, and eye protection must be worn. The operator must not place himself or allow others to be in a hazardous position while the machine is in operation.

2. An approved type of metal foot and shin protection or combination welding leggings or metal leggings must be worn when surface grinding, or when doing free hand grinding with plate mounted or cup wheels. Leather leggings must be worn for all other grinding.

3. All grinders and saws must be provided with suitable guards that must be maintained in the correct position for the protection of the operator.

4. When grinding wheels and abrasive blades are stored, they should be left in the original containers until used, and the oldest wheel received will be used first. Containers should be marked with manufacture date in large numbers so proper stock rotation can take place. The manufacturing date is also shown on wheels. **Wheels and blades that are older than 2 years or more specifically 24 months from the date of manufacture must not be used**.

5. For other than temporary storage, straight wheels should be stored on edge and thin wheels should be laid flat to prevent warping. Plate mounted, cylinder, and cup wheels should be stored on their flat sides with cushioning material, such as corrugated paper, between them.

6. Only enough grinding wheels for two or three days use should be kept in welding team trucks or equipment, and a specific place in the truck or equipment shall be provided for storage.

7. Wheels should be tested occasionally during use for balance, and if found out of balance, destroyed.

8. Grinding wheels and abrasive blades absorb moisture. They should not be exposed to rain, dew, or fog, or placed on damp or wet ground. Moisture will throw the wheel out of balance, causing excessive vibration while operating at high speeds, and may result in the breaking of the wheel, which may lead to injury.

9. Extreme care must be used in the mounting of grinding wheels and abrasive blades. Blotters must be used. Wheels must not be forced on the spindles or be too loose. When tightening spindle nuts, care must be taken to tighten them only enough to hold the grinding wheels firmly. Ends of spindles must be so threaded that the nuts on both ends will tend to tighten as the spindles revolve. Ensure that the same size mounting flanges are used on both sides.

10. Grinding wheels and abrasive blades are to be removed from equipment at the end of each days work and stored in original box in a dry location to protect the wheels and blades from moisture.

OPERATING GRINDING WHEELS AND ABRASIVE BLADES

1. Extreme care must be exercised in the use of grinding wheels and abrasive blades.

2. The operator must know that the spindle speed of his grinder or abrasive saw is not greater than the maximum operating speed shown on the grinding wheel or abrasive blade.

3. Grinding wheels and abrasive blades not plainly marked with the maximum operating speed will not be used. The Division Manager–Materials and Roadmaster will promptly be notified of receipt of unmarked wheels and blades.

4. Each wheel must be closely inspected before mounting to make sure it has not been damaged in any way.

5. Grinding wheels and abrasive blades have a date of manufacture on the label. **Wheels and blades that are older than 2 years or more specifically 24 months from the date of manufacture must not be used**. Undated wheels and abrasive blades will not be used.

6. The operator will check and record the speed of their grinder or abrasive saw with a tachometer daily or prior to use if not used daily. Enter speed, on daily RPM Form, and retain for 30 days. If necessary, adjustments will be made in the speed of the wheel spindle prior to use. It is mandatory to use a power blower when grinding manganese. If electricity is available, it is recommended to use a power blower for all grinding operations.

7. Roadway Mechanics are authorized to make adjustments in the speed of the wheel spindle with the Welder present. The Welder's tachometer will be checked at this time by comparing readings with the Mechanic's tachometer, and if found to vary by more than 5%, will be reported to the Roadmaster for adjustment or replacement.

8. Slotting of frogs may be accomplished by use of straight grinders, or electric grinders. Rail end slotting should be accomplished by use of an electric grinder, or slotting attachment.

TACHOMETERS

1. The present standard tachometer for Engineering Department use is a four digit non-contact optical model.

2. The method of operation of an optical tachometer may vary among manufacturers but is typically as follows:

    a. The piece of equipment that is to have its rotational speed checked must be stopped and a piece of adhesive backed reflective tape is stuck to the spindle.
    b. The equipment is started and brought up to a stable operating speed.
    c. The tachometer is aimed at the reflective tape. Some models have aiming bars or

other aids for aligning the tachometer with the tape.

d. The power button is pressed and a light parallel to the aiming bars comes from the tachometer as a visual aid in positioning the tachometer on the reflective tape while the reading is taken.
e. The power button is held on until the reading stabilizes. The speed recoding is obtained and recorded. This step is repeated three or four times and compared to the speeds obtained from each reading. This reading must be recorded on Owner's form RPM-1 and retained for 30 days.
f. The speeds obtained should be the same for each reading if the equipment is running at a constant speed, but a variation of a few RPM between readings is not unusual.
g. The speed obtained must be less than that permitted by Owner's rules or the speed shown on the grinding wheel, grinding disk, or abrasive blade, whichever speed is slower.
h. Most optical tachometers can be calibrated by aiming at a single tube florescent light and comparing the reading obtained with the reading given in the operating instructions of the tachometer.

3. Grinding on the flat sides of straight wheels is hazardous, and must be avoided.

4. If a grinding wheel or abrasive blade should break during operation, notify the Roadmaster and Manager–Welding. An inspection must be made to ensure that the hood, flanges, and nuts have not been damaged and that the spindle has not been bent or sprung out of balance. Also, the speed of the machine must be checked. Wheel fragments, mounting plates, and label should be collected in the event the manufacturer desires to perform laboratory tests.

5. Unless grinding equipment is permanently attached to a vehicle, the equipment must be removed from the vehicle before starting to grind.

6. Grinding wheels and abrasive blades must be stopped when a grinding machine is being moved. Care must be taken when moving a grinder so that the wheel does not strike anything that may crack it.

7. Operators must periodically inspect grinding machines and saws that are in use and report to their supervisory officer anything unusual in the operation of the saws or grinders such as peculiar noises, apparent increase in engine or spindle speed, vibration, wheels out of balance or badly worn, etc.

IN-TRACK ELECTRIC FLASH BUTT WELD GRINDING

1. Grinding precautions that are required for thermite welding are also applicable for in-track electric flash butt welding.

2. Due to limited space created by the machinery when rail puller is in place, grinding with a hand held disc grinder to prep the rail is not permitted.

K MISCELLANEOUS WELDING

MANGANESE COMPONENTS

1. Other manganese components, such as, manganese switch point tips and switch point guards, can be repaired in the field only when qualified to do so by a Manager-Welding. Use the electric-arc method and the techniques described in the "Repair of Frogs and Railroad Crossings" section.

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L AIR ARC METAL REMOVAL

GENERAL

1. The exact air quantity and pressure requirements vary with the specific torch used. In general, the compressed air required will vary from 80 to 100 PSI and 26 to 33 CFM for standard torches.

2. The amperage needed depends upon the electrode diameter. Best results are usually obtained when maximum amperage is used. The recommended current is:

3. Carbon, stainless, and manganese steels should be cut and gouged with the electrode on DC reverse polarity.

4. The initial rod position should be about 6" out from the holder and the length adjusted as required.

5. The Signal Maintainer will be notified in advance whenever welding is to be performed in track circuit territory.

6. See *Section "A", Safety*, for instructions for electric arc welding in track circuit territory.

PROCEDURE

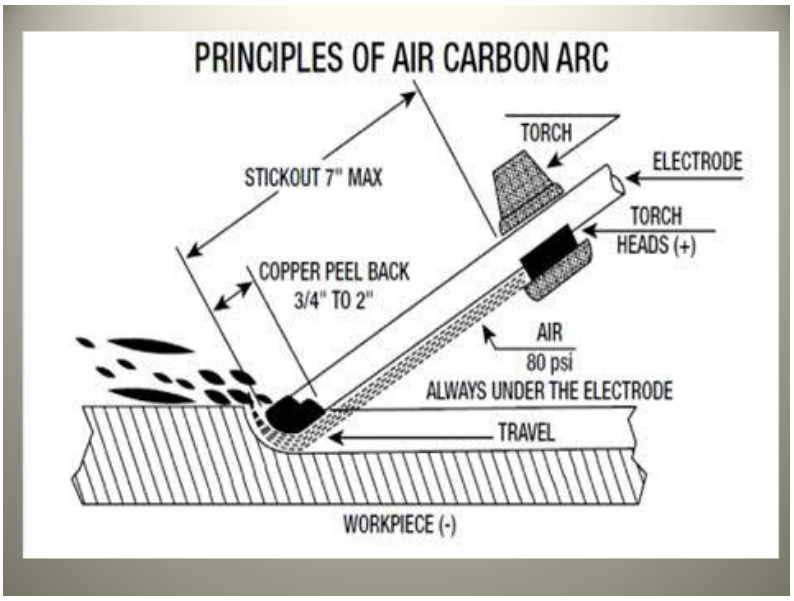
1. The welding machine should be set at the desired amperage.

2. The air should be on before starting to cut or gouge. The air should also be used to cool the cut.

3. The torch should be held so that the electrode slopes back from the direction of travel with the air blast below the electrode.

4. An electrode angle of approximately 45° is recommended.

5. The initial rod position should be about 6" out from the holder and the length adjusted as required by the work.



6. If the air blast is above (in front of) the electrode, the metal will not be properly removed and

the cut surface will be covered with oxide (dull appearance).

7. Use only a straightforward motion.

8. The depth and contour of the groove is controlled by the electrode angle and travel speed. For a narrow and deep groove, the electrode should be held at a steep angle and used at a slow travel speed. For a shallow groove, the electrode should be held at a flat angle and used at a fast travel speed.

9. The width of the groove is controlled by the size of the electrode. Generally the groove will be approximately 1/8" wider that the electrode diameter.

10. The travel speed should be uniform. The proper speed will produce a good, clean cut without appreciable oxide.

11. During gouging, a short arc must be maintained by progressing in the direction of the cut, fast enough to keep up with the metal removal.

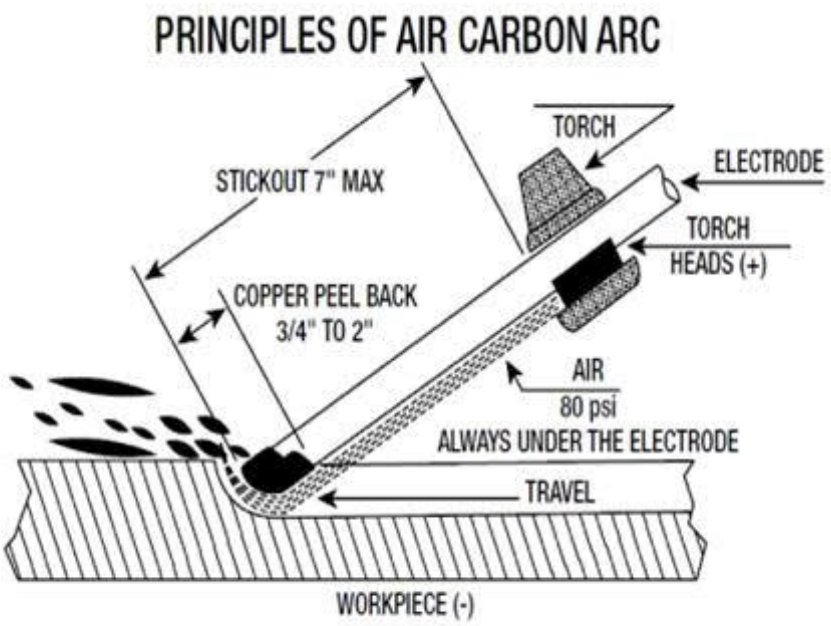
12. Low amperage and/or a bad ground will result in a sputtering arc and intermittent, skimpy cuts.

13. Irregular gouging action is a result of too slow a travel speed.

14. If the electrode is the wrong polarity, it will heat up rapidly and the arc will sputter.

15. If any slag is adhering to the edges of the cut, the air pressure is too low.

16. The cut surface should be ground to remove all traces of oxide, slag, and any other irregularities. The finished cut surface should be clean and smooth.



CAUTION: Do not use constant voltage power supplies. They may damage the torch. Only the slice torch is made for continuous cutting with power. Don't use the battery model torch or striker with a welding power supply. Electrical cables are smaller gauge, will overheat, and can possibly catch fire. The amperage setting on the welding machine should be set to around 195 to 200 amps.

WARNING: When cutting with power, be sure to use a welding helmet that has a number 10 or greater welding lens. The arc will damage the eyes and burn the skin if proper safety equipment is not used.

1. Ignition when using power and grounded work piece.

   WARNING: If any part of the cutting rod touches a grounded surface, the rod can ignite and the rest of the cutting rod may blow off. The rod will continue to burn as long as oxygen is supplied. If grounding occurs, release the oxygen lever immediately and remove the cutting rod from the work. The cutting rod is electrically "hot". Do not touch it unless the power is off. Electrical shock can injure. Know where the cut pieces may fall. Both sides of a cut should be adequately supported. When they can't be, clear the area where the cut pieces will fall. Do not aim the cutting rod at any hot surface when applying oxygen flow. This cutting rod should never be ignited on anything but the grounded work piece.

2. Procedure:

   a) Starting Oxygen Flow: - Start oxygen flow by squeezing oxygen lever in the torch handle. Be sure the hand is covered by the shield on the torch.

      NOTE: Oxygen pressure should be between 80 and 90 psi. The oxygen line must have a combination backflash arrestor/ reverse flow check valve on the regulator and a reverse flow check valve on the end that the slice torch line connects to. The apparatus will be checked for leaks the same as an oxy-propane outfit would be.

   b) Starting The Arc: - Touch the cutting rod to the grounded work piece. The resulting arc will ignite the cutting rod.

   c) Stopping the cutting rod: - Release the oxygen lever while removing the rod from the grounded work piece. The rod will continue to burn as long as oxygen is supplied and will continue to arc while touching the grounded work piece.

   d) Cutting Rod Fails to Ignite or Goes Out: - If the cutting rod doesn't ignite or if it goes out while in use, move the torch away from the work piece. Do not touch the hot tip of the cutting rod! Check to be sure the rod is getting enough oxygen. Try igniting the rod again. If the rod still doesn't ignite or if the rod continues to go out, check the oxygen flow, and also check to make sure the rod is not clogged nor have a hole in it.

3. Cutting Technique:

   a) Once the rod is burning, use the following technique: - Normal cutting is done by using a drag technique. Once the rod is in contact with the piece to be cut, drag the rod in the direction of the cut. If the operator can't see the kerf, the speed of cut is too fast. If the rod is being used too rapidly, the progress of the cut is too slow and the rod is being used without cutting. Remember, the cutting rods consume as long as the oxygen is flowing.

Maintain the proper travel speed at all times.

NOTE: Use a sawing motion when material to be cut is thicker than 1 ½ to 2 inches to ensure a complete melt through.

b) Use a smooth motion to complete the cut. Be careful not to hit nearby material with the rod when cutting in "close quarters". After completing the cut, release the oxygen control lever in the handle. Hold the rod away from your body until it cools. Once use of the slice torch is completed, shut down power supply, close the oxygen valve off at the cylinder and purge as with a regular torch outfit. Place rods, and slice torch in the storage area.

c) The slice torch is to be used only on removal of defective material in manganese components such as frogs, etc. Do NOT exceed 500°F. It will not be used to remove material from switch points, or rail ends. After the material has been removed with the slice torch, the grinder should be used to clean all torched surfaces. Areas unable to be ground will be cleaned with a chipping hammer or chisel, and a wire brush.

M. IN TRACK ELECTRIC FLASH BUTT WELDING

GENERAL

1. Rail Preparation Requirements

   a. All rails used for electric flash butt welds will have the scale removed down to bright metal 27" from each end of the rails where the welding current carrying electrodes contact the rail. Also, any raised mill marking in the web of the rail will be ground smooth.

   b. Rail ends will be clean of all foreign matter.

   c. Rail will be cut by using a rail saw. A weld may also be cut out by using an oxy-propane torch, but only if the new weld is made within 30 minutes of cutting. Torch cut rails, with cuts older than 30 minutes, will have the torch cuts removed by trimming 6" from each end with a rail saw before welding.

   d. Electric flash butt welds should not be located on a tie. If the weld location falls on a tie, reposition the tie off the weld.

   e. Electric flash butt welds will be marked on the field side web of the rail near the weld with an identifying marking. This marking will include the following information:

      1) The vender or Owner equipment making the weld.
      2) Holland Co.= HW
      3) Progress Rail = PR
      4) Owner Plasser = PW
      5) Owner Truck = TW
      6) The equipment number of the machine/truck making the weld.
      7) Was this a closure weld?
         a) If it was, insert a "C" before the sequence number.
         b) If not, leave blank.
      8) The weld sequence number.
      9) The date the weld was made.

      A sample marking for a closure weld made by the Holland Co., using their truck #406 follows:

      HW 406 C 1234 1/18/06

2. Parameters For Continuous Welded Rail

   a. Preheating of rail ends for the welding cycle will be done by pulsed flashing.

   b. When using a continuous flash welder, no interruption of platen travel or flashing

current within 1/2 inch of final flashing is allowed with a minimum of 7/16" (.40") upset required.

c. Low Rail Consumption will be no less then: 3/4".

d. Normal Rail Consumption: 1 1/8".

e. Upset Current: Must be a minimum of one second in duration.

f. Upset Blow: Upset to refusal within 5/8" is standard. Minimum upset required is 7/16" (.40") low consumption. When using puller, holding pressure until the weld has cooled to 700°F or less (approximately seven (7) minutes after upset) is mandatory for closure welds. No clamp slippage is allowed.

g. Weld Rejection: Welds rejected will be cut down through the middle of the weld with a rail saw or, if torch cut, re-weld within 30 minutes.

3. Welding Machine Setup

The following procedure is to be used in the preparation of the welding machine for welding a specific rail section.

a. Upsetting pressure will be adjusted to the proper setting for the rail section and metallurgy being welded.

b. Flashing time will be lengthened or shortened until the standard 5/8" upset is achieved.

4. Upsetting Pressure for any Rail Section

The minimum upset pressure is 40 metric tons or 44.1 US tons.

5. Chart Recorder

A chart recorder approved by the Owner is to be used to monitor welding current, platen displacement and hydraulic pressure.

6. Weld Finishing Requirements

a. All notches resulting from offsetting and shearing operations will be eliminated by grinding.

b. A finishing deviation of 0.015" will not be exceeded on the rail running surface.

c. A finishing deviation of 0.010" will not be exceeded on the gage and field sides of the

rail head.

d. The web zone (underside of rail head, web, and top of base) will be finished to within 1/8" of parent metal but not deeper than parent section. Care must be exercised to insure that finished grinding on the underside of the rail head and head to web fillets removes all sharp notches and leaves a smooth transition zone.

7. Weld Inspection

a. The electrode contact area will be visually inspected for electrode burns. Electrode burns may appear as small deposits of copper electrode on the rail or there may be evidence of metal flow of the parent rail steel (displacement of metal).

b. After finished grinding, a visual inspection is required.

c. When the external stripper or shear is used for removing the upset, the clamp area in the web will be inspected on every weld for gouges or slippage. Any excessive gouge in the parent metal will be rejected.

d. Any weld not meeting the specified tolerances and tests will be cut out and re-welded.

8. Weld Tolerance Measurement

a. Tools: A 36" straightedge and a taper gauge will be used to take measurements from the finished weld.

b. Procedure: Center the 36" straightedge over the weld against the high side. Gently slip the taper gauge under the extreme end of the straightedge lengthwise, reading the amount of variation from the taper gauge for offset and crown camber measurements.

c. The following tolerances were developed, assuming that like class rail is being welded; i.e. New to New, Class 1 to Class 1, etc.

9. Weld Tolerance Offset Limits for New, Class 1, 2 and 3 Relay Rail.

a. Rail Height Mismatch:

Maximum Height Differential	**0.250″**

b. Rail Head:

Vertical offset:	0.125"
Gage side horizontal offset:	0.050"
Horizontal kink:	0.025"

c. Rail Base:

Vertical offset:	0.125"

Horizontal offset:	0.100"

10. Surface Misalignment after Grinding:

Combined offset and crown camber:	0.015"
Combined offset and dip camber:	0.000"

11. Gage Misalignment after Grinding:

Combined offset and kink:	0.020"

REPAIR WELDING PROCEDURE

This procedure is designed to produce a quality rail weld and adjust the rail at the same time. It is based on 1 1/8" rail consumption per weld. In this procedure the following terms have been adopted to avoid confusion:

- Defect Plug - The piece of rail to be removed from the track. The normal length of a defect plug is 19'-0". This length has been selected to balance the physical characteristics of the various In-Track Welding Equipment and track surface and alignment requirements. When using Owner Plasser In-track welder, minimum plug length must be 27'.

- Replacement Plug - The piece of rail to be installed into the track. The normal replacement plug length is 19'- 1-1/8" This length is determined by adding 1-1/8" to the length of the defect plug.

- Current Rail Temperature - The rail temperature measured at the work site.

- Adjusted Rail Temperature - The desired rail laying temperature. It is location dependent and is specified in MWI 1125.

- Temperature Measuring Device - The In-Track Welding Team is normally equipped with an Owner approved laser thermometer. It reads instantly and temperature measurements can be made quickly.

- Reference Marks - Marks precisely measured and placed on web of the existing rail that will remain in track after the defect plug is removed. They are normally 2' on each side of the parent rail joint and are used for quality control purposes in this procedure.

- Plug Weld - The first weld made with the replacement plug, both ends are free.

- Closure Weld - The second weld made with the replacement plug, one end free. This weld restores the track's integrity.

- Closure Weld Release Temperature - The maximum temperature (700° F) at which the puller can be released without damaging a closure weld.

1. Mark the cut marks for the length of the Defect Plug on the top of the existing rail. The marks should be approximately centered in cribs to expedite the welding process. The normal length of a defect plug is 19'-0".

2. Make Reference Marks on the Web of the existing rail exactly 2' from cut marks. The Reference Marks should be approximately centered around the defect plug cut marks. Enter the measurement on the Track Disturbance form for referencing the information in DTW screen.

3. Measure the Current Rail Temperature with the digital thermometer. Enter the measurement on the Track Disturbance form.

4. Identify the proper Adjusted Rail Temperature from MWI 1125. Enter the temperature on the Track Disturbance form.

5. Determine the RNT for the Adjusted Rail Temperature using the CWR procedures and enter on the Track Disturbance form for the Division Track Works tablet.

6. Remove rail anchors and loosen any tight spikes for the Free Rail Length determined above. Ideally the Defect Plug should be in the center of the freed rail. However when installing plugs near fixed objects, such as bridges, turnouts, road crossings, railroad crossings, etc., the length of freed rail can be moved to a location that encompasses the Defect Plug. If possible, there should be at least 230' between the fixed object and the beginning of the freed rail.

7. The length of free rail must be examined for anything that would cause the rail to bind or restrict the movement of the rail in the direction of the weld. The weld process can not be initiated until the closest point between the possible obstruction and the adjacent tie/tie plate in the direction of the pull is 2" or greater. Reposition ties as necessary.

8. Polish the webs of the existing rails for electrical contact. Polish both sides of the webs for a distance of 27" from the weld location. Remove any branding in this area.

9. At the completion of the initial saw cut a gap should open or run in to obtain or calculate the CNRT.

10. The Team Supervisor evaluates the following conditions and determines the proper course of action by going through the CWR process to obtain the correct NRT.

13. Make the second cut to free the Defect Plug.

14. The preparation team removes the defective rail and replaces with plug rail, spikes up moves to next location and the welding team moves into place. The In-Track Welder backs to the

free weld of the Plug Rail put in tight, gapped or over lapped to obtain the NRT.

15. Align the rail ends nearest the In-Track Welder and complete the Free Weld. During the upsetting of this weld the rail ends at the Closure Weld location will pass each other (fall in place) or be gapped. (CWR – NRT) Return the existing rail to the tie plate seats.

16. At some locations it might be necessary to saw the rail after free weld is complete, to create a larger gap to properly adjust track to the proper NRT.

17. While the Plug Weld is cooling to the required Closure Weld Release Temperature (700 ° F), profile grinding the first weld can occur or move across weld and setup Closure Weld to be welded after cooling to 700° F.

18. After the-Free Weld has cooled below the 700° F pre align, and pull closed any gap to achieve the NRT after weld is complete. If gap cannot be closed to achieve enough upsetting forces, release the puller and pull the gap again. Read the puller force. It might be necessary to do this multiple times. It may also be necessary to remove more anchors to complete the weld.

19. Check puller force required to close the gap, determine in step #19 above, against the RNT and welder upset needed for the puller you are using to complete the weld. Determine if the puller has adequate capacity to complete the weld.

20. Align the rail ends and complete the Closure Weld. At the completion of the Closure Weld, record the rail measurements for the Track Disturbance in the DTW system.

21. Measure the distance between the Reference Marks. Record the final distance between the Witness Marks on the *Record of In-Track Welding* form. Determine the amount of rail added/removed during the welding process.

22. While the weld is cooling to the Closure Weld Release Temperature (700° F), re-spike and re-anchor the track. Begin at the Replacement Plug location and work away from it.

23. After the weld has cooled below the Closure Weld Release Temperature (700° F), release the puller, move the In-Track Welder to next location and profile grind the weld.

26. Compare the final and original Reference Mark measurements. The difference should be no less than the 10 ° F variation to ensure that the Actual Adjusted Rail Neutral Temperature is within +/- 10° F of the Desired Adjusted Rail Temperature.

27. If plug was already in track and reference marks and rail information for track disturbance is already there, all information and reference marks must be rewritten on the rail in the same location if ground away for electrical contact area for the Electric Flash Welder.

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N. APPROVED WELDING ELECTRODES AND WIRES

FOR USE WITH MANGANESE FROGS

Class and Item Number	*Name*	*Size*	*Polarity*	*Description*	*Use*
	Lincoln Frogmang ED026101 60 Pounds	3/16" Electrode	*DCRP*	Coated 22% manganese alloy.	Build-up and repair of manganese components in frogs and crossings.
	Lincoln Frogmang ED026106 25 Pounds	1/16" Wire	*DCRP*	Flux core, self shielded 25% manganese alloy.	Build-up and repair of manganese components in frogs and crossings.
	Lincoln Frogmang ED026105 25 Pounds	5/64" Wire	*DCRP*	Flux core, self shielded 25% manganese alloy.	Build-up and repair of manganese components in frogs and crossings.
	Lincoln Excalibur AWS E308L-16 Matweld 900	1/8" 5/32" 3/16" 3/16" Electrode	*DCRP*	Stainless Alloy Electrode	Repairing flangeway cracks and defects in manganese frogs and crossings, and starter pads for manganese build-up. Keep 3/4" below running surface.
	Lincoln	5/16"	*DCRP*	Flux core, self shielded	Used for welding pile splices on H-pile, Pipe pile, Sheet pile

FOR USE WITH RAILS

Class and Item Number	***Name***	***Size***	***Polarity***	***Description***	***Use***
	Lincoln Super Rail	3/16" Electrode	*DCRP*	Coated Carbon Steel Alloy. Deposit hardness 208 BHN. Work hardens to 390 BHN.	Build-up and repair of carbon steel components; rail ends, switch points engine burns, and rail, bolted frogs and crossings. Use approximately 190 amps.
	Lincoln Super Rail 25 Pounds 25 Pounds 9 Pounds 9Pounds 36 LB Maser Carton	 1/16"Wire 5/64" Wire 1/16"Wire 5/64" Wire	DCRP	Coated Carbon Steel Alloy. Deposit hardness 208 BHN. Work hardens to 390 BHN.	Build-up and repair of carbon steel components; rail ends, switch points engine burns, and rail, bolted frogs and crossings. Use approximately 28 Volts
	McKay M-932	1/8" 5/32" 3/16" Rod	DCRP	Hardalloy	Build-up and repair of carbon steel components; rail ends, switch points engine burns, and rail, bolted frogs and crossings.
	ESAB 6011	3/32" 1/8" 5/32" Rod	DCRP		For repairs on galvanized steel or mild steel with surface contaminants and pipe.

OTHER RODS

Class and Item Number	***Name***	***Size***	***Polarity***	***Description***	***Use***
	Slice Torch	1/4" x 22" 1/4" x 44"	*DCRP*	Tubular metal rod	For removal of defective material from manganese components
	Arc Air Pack of 50 rods	1/4" x 12" 5/16" x 12" 3/8" x 12" ½" X 12" 3/8" x 5/32" X12" 5/8" x 3/16" x 12"	Round Round Round Round Flat Flat	Copper coated carbon Arc AirVantage 600 Only	For removal of defective material by gouging. Flat for Cleaning NOT for gouging
	AWS 7018 10 lb packs	1/8" 5/32" 3/16" 3/32" 1/4"x18" Electrode	*DCRP*	Electrode made to AWS E7018E specifications. For Spring Frog Components.	Welding structural steel, repairing roadway machines, frames, etc.
	Lincoln Electric Innershield NR-211-MP 25 Pounds	5/64" 1/16" Wire	*DCRP*		For welding steel Structures on concrete road crossing panels.
	Lincoln Electric	5/64" Wire	*DCRP*	Innershield NR-305 25 Lb steel spool Lincoln ED034185	For welding frog gauge Plates Only

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O. WELDING SUPPLIES

Item Number	Description
	WELDING BOOKS
	Welding Manual.
	Welding Machine Inspection Booklet.

Item Number	Description
	ELECTRIC WELDING MATERIALS AND EQUIPMENT
	Cable, welding, number 2/0 AWG, 375 amp, 600 volt, neoprene jacket, Mylar separator.
	Cable, welding, number 3/0 AWG, 450 amp, 600 volt, neoprene jacket, Mylar separator.
	Connector, cable, male. Tweeco 4MPC-1 for 3/0 - 4/0 cable
	Connector, cable, female. Tweeco 4MBP-2 for 3/0 - 4/0 cable
	Connector, cable, ball point with neoprene cover, TWECO 9405-1100, model 1-MPB.
	Clamp, welding, ground, TWECO model TW GC-500.
	Ground Clamp - Magnetic - 600 Amp.
	Holder, Electrode, 400 Amp, 1/4" capacity, Tweco Model A-14HD.
	Holder, Electrode, 500 Amp, 3/8" capacity, Tweco Model A-38HD.
	Block, carbon, box of 4. Use in flangeway to repair frog.
	Brush, wire, metal cleaning, 1" X 13-3/4" curved hardwood handle.
	Gauge, flangeway check, frog and railroad crossing, AREMA Plan 790-55
	Gauge - Frog - Use on repair of Conformal Heavy Point Frog. Set of 2 gauges
	Grinder - W/Guard, 4-1/2" 8500 RPM - 115 V. - 5/8"X11 Spindle. Dewalt
	Grinder, Milwaukee 6066 - 9" Grounded – 6000 RPM - 3.5 HP
	Grinder, Dewalt D28499X Large Angle Grinder HD 7” & 9”, 5.3 HP, 6000 RPM, w/ Keyless Adjustable Guard HNA #I00213
	Needle Scaler Model 182LNA1 - Ingersol Rand - Requires Comp. Air 100 psi.
	Needles for Scaler - U/M = Set - 19 needles per set
	Wire Brush, 2-3/4" Knot Eagle Cup Wire Brush, .020 wire, 5/8"-11 A.H.
	Helmet - Welding - Lincoln Electric Viking, Viking Black 3350
	Filter - Auto Darkening - Replacement for Lincoln Electric Viking Helmet
	Lens - Cover External - for Lincoln Electric Viking Weld Helmet - Min. Order = 5
	Lens - Cover INTERNAL - for Lincoln Electric Viking Weld Helmet - Min. Order = 5
	Lens - Magnification X 1.25 - for Lincoln Electric Viking Weld Helmet
	Lens - Magnification X 1.50 - for Lincoln Electric Viking Weld Helmet
	Liner - Sweatband - for Lincoln Electric Viking Weld Helmet
	Helmet - Welding - Jackson Truesight - Digital Auto Darkening
	Filter - Auto Darkening - Replacement for Jackson Truesight Helmet.
	Lens - Cover External - for Jackson Truesight Weld Helmet - Min. Order = 10
	Lens - Cover INTERNAL - for Jackson Truesight Weld Helmet - Min. Order = 10
	Speedglas Welding Helmet - complete.
	Replacement batteries for Speedglas welding helmet.
	Speedglas Kit, inner & outer clear shield and batteries.
	Protection plate - inside - clear - for Speedglas Welding Helmet.
	Protection plate - outside - clear - for Speedglas Welding Helmet.

Item Number	Description
	Copper Plate - 24"L X 2"W X 1/4"T - For Welding Switch Points.
	Copper Plate - 24"L X 2"W X 1/8"T - For Welding Switch Points.
	Hammer - Ball Peen - 32 oz. Grade B Steel W/Fiberglas Handle.
	Hammer - Slag - Wooden Handle - Vaughn.
	Hammer - Chipping - Vaughn
	Wire Feeder - Lincoln - LN-25 PRO. - Does NOT include Mig Gun.
	Mig Gun - Lincoln - K-126-12 - Fits LN-25 and LN-25 PRO Feeders.
	Liner, Replacement - Mig Gun - Lincoln - K-126-12
	Lead, Lincoln S17211-7 Ground lead assembly for wire feeder
	62° Goose Neck for K126-12
	Tip Insulator for K126-12
	Tip Holder for K126-12 Magnum Tips
	5/64 Magnum Tips for K126-12
	Seat - Track Welders W/3 Adj. legs and back support. Eidos Track Master Model 110
	Seat - Track Welders W/Three way air splitter - fold down back rest. Model BRET17
	Shield - Heat - Fits Lincoln K-126 Mig. Gun.
	Drive Roller Kit - Lincoln - 1/16th dia. - Fits LN-25 PRO Feeder.
	Drive Roller Kit - Lincoln - 5/64th dia. - Fits LN-25 PRO Feeder.
	Wire - Grounding - Lincoln - Connects K-126 Mig Gun to LN-25 Wire Feeder.
	Pliers - Mig Welding - Welper 8 in 1 Pliers.
	Blower, Utility, Portable 12" Electric - Outdoor Rated 120V. Global Ind. Sourced to IRS. Mandatory use when Welding or Grinding of Manganese.
	WELDING PPE
	Glasses - Cutting - Shade 5 (Clear face shield must be worn also)
	Gloves, welding, leather with aluminized back.
	Gloves, welding, leather. Size Small.
	Gloves, welding, leather. Size Medium.
	Gloves, welding, leather. Size Large.
	Gloves, welding, leather. Size X-Large.
	Gloves, welding, leather. Size XX-Large.
	Jacket, Welding 30" length SMALL - Orange Flame Retardant - W/Reflective Stripes.
	Jacket, Welding 30" length MEDIUM - Orange Flame Retardant - W/Reflective Stripes.
	Jacket, Welding 30" length LARGE - Orange Flame Retardant - W/Reflective Stripes.
	Jacket, Welding 30" length X- LARGE - Orange Flame Retardant - W/Reflective Stripes.
	Jacket, Welding 30" length 2X- LARGE - Orange Flame Retardant - W/Reflective Stripes.
	Jacket, Welding 30" length 3X- LARGE - Orange Flame Retardant - W/Reflective Stripes.
	Jacket, Welding 30" length 4X- LARGE - Orange Flame Retardant - W/Reflective Stripes.
	Jacket, Welding 30" length 5X- LARGE - Orange Flame Retardant - W/Reflective Stripes.
	Sleeves, Welding 18”
	Leggings - New Combination Leather and Metal - full wrap around Velcro Flap.

Item Number	Description
	Leggings – Includes longer shoe flap and three spring straps over toe. Geismar PD-101-L
	CUTTING TORCH EQUIPMENT
	Torch, Arc-Air Electric - Model H-3 with 7 ft. Swivel Cable. Carbon Arc Gouging.
	Torch, SLICE - Metal Removal.
	Gas Cylinder Cap Wrench
	Gas Grab – for lifting oxygen tanks w/ two men
	Long Torch, Cutting, 36 inches long - Airco - 822-9555, 75 deg. Head.
	Two Stage Harris Regulator – Oxygen 9200-125-540 **Mandatory for Thermite Welding**
	Two Stage Harris Regulator – Propane 9200-125-540 **Mandatory for Thermite Welding**
	Single Stage Gage-less Harris Regulator – Oxygen **Section Team or Inspector Only**
	Single Stage Gage-less Harris Regulator – Propane **Section Team or Inspector Only**
	Single Stage w/gage Harris Regulator – Oxygen Cutting Only 25GX-145-540 for **Section Teams Only**
	Single Stage w/gage Harris Regulator – Propane Cutting Only 25GX-50-510P for **Section Team Only**
	Torch, Cutting Attachment, Harris, 90 DEG head #1300440, Model 49-3F
	Torch, Cutting Attachment, Harris, 70 DEG head #1300430, Model 49-3AF
	Tip, Cutting, Propane, Harris #1501030, Model 6290-2NFF 5/8”-2” Depth of Cut
	Tip, Cutting, Propane, Harris #1501040, Model 6290-3NFF 2”–4” Depth of Cut
	Tip, Cutting, Propane, Harris #1501050, Model 6290-4NFF (for cutting rail with Harris 49-3F Cutting Attachment) 4”-7” Depth of Cut
	Tip, Cutting, Propane, Harris #1501060, Model 6290-5NFF (for cutting rail with Harris 49-3F Cutting Attachment)
	Tip, Cutting, Propane, Harris #1501070, Model 6290-6NFF (for cutting rail with Harris 49-3F Cutting Attachment)
	Tip, Cutting, Propane, Harris #1501080, Model 6290-7NFF (for cutting rail with Harris 49-3F Cutting Attachment)
	Torch Handle, Harris, #1401150, Model 43-2, 9.5 inches long
	Preheating Head, Thermite, Harris #1800242, Model QC2SCT7777
	One Piece Harris Cutting Torch 18" long 90 degree head
	One Piece Harris Cutting Torch 21" long 90 degree head
	Long Torch, 36” Harris, #1003400 Model 62-5AFL, 70 deg. head
	Long Torch, 48” Harris, #1003481, Model 62-5FL, 90 DEG Head
	Torch cutting guide for Harris Torch (guide wheel rollers)
	Torch, Cutting Attachment, Victor - CA-2460, 90 deg. Head.
	Torch, Cutting Attachment, Victor - CA-2461, 75 deg. Head.
	Tip, Cutting, Propane - Size # 3 HPN - Victor # 033-0325.
	Tip, Cutting, Propane - Size # 4 HPN - Victor # 033-0326.
	Tip, Cutting, Propane - Size # 5 HPN - Victor # 033-0327.
	Torch, Handle, Victor - HD 310C Note: Has Rev. Flow Check Valves Built-in. D0 NOT ADD.
	Check Valves, Torch #4300390 (Oxy-Pro) Harris 88-6CVT
	Preheating Head, Victor - Flathead - TWNB-5 (for preheating field welds)

Item Number	Description
	Mount - Oxygen-Propane Gauge Assembly Holder
	Regulator, Oxygen, VICTOR, single stage W/Guards - Smaller Design. For track inspectors only
	Regulator, Propane, VICTOR, single stage W/Guards - Smaller Design. For track inspectors only
	Flashback Arrestor, Regulator #4301651 Set (Oxy-Pro) Harris 88-5FBR
	Check Valves - Torch, #4300390 set (oxy & pro) Harris 88-6CVT Lincoln Electric
	Gauge, Harris #QC2GAU7700, in-line test, 1 Oxygen + 1 propane Set
	Plug - Safety - Propane Tank - Brass With Chain & Ring.
	Protector, Cylinder Non-Rotating Valve - Oxygen, Wesco Model WES-010
	Protector, Cylinder Non-Rotating Valve - Propane, Wesco Model WES-008
	Igniter, torch, three flint, Shurlite Model 4501.
	Flint, renewal, for Shurlite Model 4501 igniter.
	Cleaner, tip, Wypo Number 1 Standard Set.
	Wrench, Cylinder, 10 Way combination. Forged steel, not stamped.
	Detector, external leak, SNOOP, 8 oz. bottle. Not for use to mounting hoses to fittings.
	Hose Reel - 1/4" ID - 100' Twin Hose Capacity.
	Hose Reel - 3/8" ID - 75' Capacity.
	Hose - welding, Grade T - 100' twin 1/4" dia. W/Fittings. Requires verbal approval of Weld. Manager.
	Hose - welding, Grade T - 100' twin 3/8" dia. W/Fittings. Requires verbal approval of Weld. Manager.
	Hose, welding, Grade T - 50' twin 1/4" dia. with fittings.
	Hose, welding, Grade T - 50' twin 3/8" dia. with fittings.
	Kit, welding hose repair, with crimper and fittings.
	BOUTET WELD FIELD KITS & ACCESSORIES
	Boutet Weld Field Kit 85 lb.
	Boutet Weld Field Kit 115 lb.1/4" Worn Both Sides.
	Boutet Weld Field Kit 115 lb. New to 1/4" Worn.
	Boutet Weld Field Kit 115 lb. 3/8" Worn Both Sides.
	Boutet Weld Field Kit 115 lb. New to 3/8" Worn.
	Boutet Weld Field Kit 132 lb. 1/4" Worn Both Sides.
	Boutet Weld Field Kit 132 lb. New to 1/4" Worn.
	Boutet Weld Field Kit 132 lb. 3/8" Worn Both Sides.
	Boutet Weld Field Kit 132 lb. New to 3/8" Worn.
	Boutet Weld Field Kit 133 lb. 3/8" Worn Both Sides.
	Boutet Weld Field Kit 133 lb. New to 1/4" Worn.
	Boutet Weld Field Kit 136 lb. New to 1/4" Worn.
	Boutet Weld Field Kit 136 lb. New to 3/8" Worn.
	Boutet Weld Field Kit 136 lb. 1/4" Worn Both Sides.
	Boutet Weld Field Kit 136 lb. 3/8" Worn Both Sides.
	Boutet Weld Field Kit 100RA / 105 DUDLEY
	Boutet Weld Field Kit 100RE
	Boutet Weld Field Kit 100RB
	Boutet Weld Field Kit 110RE

Item Number	Description
	Boutet Weld Field Kit 115RE
	Boutet Weld Field Kit 122CB
	Boutet Weld Field Kit 127 DUDLEY
	Boutet Weld Field Kit 155#
	Boutet Weld Field Kit 132RE
	Boutet Weld Field Kit 136RE
	Boutet Weld Field Kit 140RE
	Boutet Weld Field Kit 141RE
	Boutet Weld Comp. Field Weld Kit 100RE/85
	Boutet Weld Comp. Field Weld Kit 100RE/90RA
	Boutet Weld Comp. Field Weld Kit 100RE/90RB
	Boutet Weld Comp. Field Weld Kit 100RE/100RB
	Boutet Weld Comp. Field Weld Kit 115RE/90RA Right Hand.
	Boutet Weld Comp. Field Weld Kit 115RE/90RA Left Hand.
	Boutet Weld Comp. Field Weld Kit 115RE/100RA
	Boutet Weld Comp. Field Weld Kit 115RE/100RE
	Boutet Weld Comp. Field Weld Kit 115RE/100NW Left Hand.
	Boutet Weld Comp. Field Weld Kit 115RE/100NW Right Hand.
	Boutet Weld Comp. Field Weld Kit 119/100 Left Hand.
	Boutet Weld Comp. Field Weld Kit 119/100 Right Hand.
	Boutet Weld Comp. Field Weld Kit 119/115
	Boutet Weld Comp. Field Weld Kit 127/115 Left Hand.
	Boutet Weld Comp. Field Weld Kit 127/115 Right Hand.
	Boutet Weld Comp. Field Weld Kit 122CB/100RB
	Boutet Weld Comp. Field Weld Kit 122CB/100RE
	Boutet Weld Comp. Field Weld Kit 122CB/115RE Right Hand.
	Boutet Weld Comp. Field Weld Kit 122CB/115RE Left Hand.
	Boutet Weld Comp. Field Weld Kit 132RE/122CB
	Boutet Weld Comp. Field Weld Kit 132RE/127
	Boutet Weld Comp. Field Weld Kit 132RE/115RE Right Hand.
	Boutet Weld Comp. Field Weld Kit 132RE/115RE Left Hand.
	Boutet Weld Comp. Field Weld Kit 136RE/115RE Right Hand.
	Boutet Weld Comp. Field Weld Kit 133RE/115RE Left Hand.
	Boutet Weld Comp. Field Weld Kit 133RE/115RE Right Hand.
	Boutet Weld Comp. Field Weld Kit 136RE/115RE Left Hand.
	Boutet Weld Comp. Field Weld Kit 136-141RE/122CB
	Boutet Weld Comp. Field Weld Kit 136RE/119RE Left Hand.
	Boutet Weld Comp. Field Weld Kit 136RE/119RE Right Hand.
	Boutet Weld Comp. Field Weld Kit 136-141RE/132RE
	Boutet Weld Comp. Field Weld Kit 136RE/133RE
	Boutet Weld Comp. Field Weld Kit 140RE/127RE
	Boutet Weld Comp. Field Weld Kit 140RE/132RE Left Hand.
	Boutet Weld Comp. Field Weld Kit 140RE/132RE Right Hand.
	Boutet Wide Gap Weld Kit 115RE.
	Boutet Wide Gap Weld Kit 119RE.

Item Number	Description
	Boutet Wide Gap Weld Kit 122CB.
	Boutet Wide Gap Weld Kit 132RE.
	Boutet Wide Gap Weld Kit 133RE.
	Boutet Wide Gap Weld Kit 136RE.
	Boutet Wide Gap Weld Kit 141RE.
	Boutet Crucible - CJ One Shot - Single Crucible Only.
	Boutet Refractory Paste
	Boutet Packing Felt
	Boutet Packing Sand (MUD) 8 lb. Individual Brick (5 per case).
	Boutet Igniter (Sparkler) U/M = each. Come 20 Igniters per tube.
	Dry Sand - 50 lb. Bag
	Dry Sand - 1 lb. Bag.
	BOUTET HARDWARE
	Boutet Mold Jacket 110-141#
	Boutet Base Plate 107-141#
	Boutet Mold Clamp
	Boutet Slag Pan
	Boutet Crucible Fork W/Extension Guard
	Railtech Torch Stand - New Style - Fully Adjustable.
	Boutet Comp. Mold Jacket
	Boutet Base Plate - Small Rail - 85-105#
	Boutet Mold Jacket - Small Rail - 85-105#
	Boutet Base Plate Wide Gap Weld 110-141#
	Boutet Mold Jacket - Wide Gap Weld 110-141#
	Boutet Base Plate Compromise - 4 Ear Adjustable
	Boutet Cooling Retarder Cap
	Hydraulic Jack - Stanley
	Thermite Welding Alignment Jacks - set of 2
	Boutet Close Quarters Mold Jackets
	Boutet Close Quarters Base Plate with Detachable Ears.
	BOUTET WELD HAND TOOLS
	Hot Cut Chisel with 36" Handle
	Sledge Hammer, Dead Blow Quick-Change Nupla part # 09374, Requires two replacement tips part # 15309
	Tip, Replacement part # 15309 for use with Nupla Quick-Change Dead Blow hammer – Need 2 tips per hammer, for Welders only
	Hammer - Dead Blow - Vaughn -W / Replaceable Striking Surfaces.
	Replaceable Striking Surfaces for Vaughn Dead Blow Hammer - White Need 2 ea.
	Wedge - Curved - 12" X 1-1/8" With Strike Protection Installed.
	Protector - Chip - Rubber - Large
	Protector - Chip - Rubber - X-Large
	Alignment Plates - Rail - Thermite Welding - IRS # LMT02R - U/M = Pair.
	Plates, Welders Rail Alignment Slip Over Design For All Thermite Welds Including Headwash-Head Repairs.
	Canting Tool - Ratcheting tool to remove rail twist.

Item Number	Description
	Boutet Weld Demolder - Fits Standard and WGW's.
	Boutet Riser Removal Tool
	Shear Blades - Matweld
	Blade Shear Stanley PN 27948 for rail sizes 122LB to 142LB
	Weld Shear Stanley hold down kit PN 73394
	Firetong - To remove mold jackets from molds
	Removal Tool – Base plate and mold jackets
	Gap Gauge and Torch height GT-001
	Straight Edge - Railtech Magnetic Adjustable
	Tool Set - Welders - Includes Tool Box.
	Fork - Garden - Narrow - D-Handle 8 Tine
	Hammer - Sledge 8 lb. Tampo W/36" Handle
	Maul - Spike - 10 lb. Grade B W/36" Handle
	Shovel - Size 2 - Square Point W/48" Handle
	Shovel Trenching Round Nose
	Punch - Track Grade B W/36" Handle
	Bar - Claw - per AREMA Drawing 11-97
	Mattock Pick W/Handle 6 lb.
	Lifter - Spike - W/Chip protector
	Protector - Spike Lifter Cover Kit.
	Ball Ratchet tool insulated
	Base Ratchet tool insulated
	Blanket, Silica Welding - control heat loss.
	Jumper Wire - 50 ft. With Orange Flags - attaches to ball of rail only.
	File - 14" Carbide Grit X-Course - No rubber handle - Used for filing Thermite Weld Molds.
	File - 14"- Carbide Grit Course -W/Rubber handle - Used for filing Thermite Weld Molds.
	Puller - Hyd. Rail - 120 TN. Simplex Model RP-120B
	Rail Grips - Replacement for Simplex Puller.
	Puller - Hyd. Rail - 120 TN. Geismar (Modern Track) Model TH-120
	Rail Grips - Replacement for Geismar (Modern Track) Puller.
	Height Blocks, Geismar (Modern Track) Rail Puller Model TH-120
	Geismar TH-120 Lifting Pins with Safety Chain
	Geismar TH-120 Pressure Gauge 245-ML-16B
	Geismar TH-120 Needle/Locking Valve PT-9575
	Hydraulic Hose Reel with Hose
	Hydraulic Quick Disconnect Fitting (Female)
	Hydraulic Quick Disconnect Fitting (Male)
	Cushion, KNEELMATE, 24" X 30" Orange Vinyl.
	MISCELLANEOUS
	Organizer - Tool - for bucket - 61 compartments - yellow/black - Grainger 4ZB46
	Bucket - Plastic 5 gal. - to be used with bucket organizer above.
	Umbrella - 9 ft.-3 inches - Wide coverage - With Stake.
	Stopwatch - Digital W/Breakaway Lanyard.

Item Number	Description
	Fire Extinguisher - 2-1/2 Gal.- Stainless Steel - Fill with Water - Pressurize with Air. Comp.
	Sprayer - Water Tank - 5 Gal. Indian. IRS
	Sprayer - Water Tank - 15 Gal. Plastic tank with 12 Volt pump.
	Lube, Graphite, 12 oz. spray cans, 12 per case. Lube Hyd. Rail Puller Swingarms.
	Knife - Penguin HD P900C
	Knife - Cutter - EasyCut
	Replacement Blades for EasyCut Knife.
	Thermometer - Infrared - Laser Pointing with Case and batteries. IRS.
	Thermometer, Rail - Magnetic - Part # Dwg 34-2.
	Tempilstik Marker - 300 Degree F., Box of 12.
	Tempilstik Marker - 450 Degree F., Box of 12.
	Tempilstik Marker - 500 Degree F., Box of 12.
	Tempilstik Marker - 700 Degree F., Box of 12.
	Tempilstik Marker - 800 Degree F., Box of 12.
	Spill Kit
	Red Box - Storage for aerosol cans.
	Hand cleaner - pop up dispenser
	Hand Towels - Blue - Disposable - Roll.
	Tachometer, optical, digital readout, non-contact, instructions, case, batteries, tape.
	Reflective Tape for optical tachometer, 5 ft. roll.
	Sling, cylinder, nylon, 1000 lb. capacity. Liftex CG10A
	Tag Line - 3/8" X 30FT. Snap Lock End - Nylon Rope
	Tag Line - 1/2" X 30FT. Snap Lock End - Nylon Rope
	Marker - Valve Action - For Marking Rail - White
	Marker - Valve Action - For Marking Rail - Yellow
	Marker - White - For Marking Rail.- Pump Style
	Marker - Green - For Marking Rail.- Pump Style
	Box - Saw Blade Storage 14" Dia. Blades
	Box - Saw Blade Storage 16" Dia. Blades
	Ratchet Strap 2" X18' long 3,330 lb. Load limit, D-ring hooks.To Secure Hyd.Rail Puller
	Ratchet Strap 1" X 12'- S-Hooks Load Limit = 1,000 lbs. Secure Welding Cylinders
	Spark Shield (Little Sparky) Shield for Grinding
	Straight Edge W/ Frog Ruler
	Straight Edge, 18" long, Starrett Number 385-18- For Track Inspectors Only
	Straight Edge, 36" long, Starrett Number 385-36
	Gauge, taper, 6-1/4" long X 0.150" thick, Starrett Number 270.
	Gauge, step gauge up to 7/8" H (in 1/8" increments). Use with conformal frog gauge.
	Kit, straight edge for Track Weld Auditing Complete with carrying case and 8 gauges, IRS P/N XX309
	Oil, Welding Machine Compressor Oil for Lincoln Air Vantage Compressors, 4 Liter Container, Lincoln Electric #9SS28937-3
	Lube Pads for Wire Cleaning
	Locking Pin Replacement kit part number 00412

Item Number	Description
	Saw Arm
	Flange, blade flange for changing hand grinder, Railtech Matweld 046011
	Weld Aide LubeMatic Wire Cleaner and Lubricant
	Ground Fault Circuit Interrupter, 2' Cord

APPROVED ABRASIVE BLADES AND WHEELS

Item Number	Description
CUTTING RAIL	
	14" X 1/8" X 1" Abrasive saw blade, fully reinforced, Norton Maximum 5400 RPM
	16" X 1/8" X 1" Abrasive saw blade, Fully Reinforced Premium Geismar GS-MTX-16Z 10 per box, Max 4800 RPM P&M is working sourcing issue
	16" X 1/8" X 1" Abrasive saw blade, Norton RX Gen II, double reinforced, Max 4800 RPM
	16" X 1/8" X 1" Abrasive saw blade, Norton A48 Railcut, double reinforced, Max 4800 RPM
	16" X 1/8" X 1" Abrasive saw blade, Type 1 A36X Rail Cut fully reinforced, Maximum 4800 RPM P&M is working sourcing issue
	26" X 7/32" X 1-3/4" Abrasive saw blade, fully reinforced, Maximum 2090 RPM
SLOTTING RAIL	
	8" X 1/8" X 5/8" Abrasive slotting wheel, fully reinforced, Maximum 7640 RPM.
GENERAL GRINDING	
	4-1/2" X 1/4" X 5/8"-11 Abrasive Grinding - MINI Disk.
	8" X 1" X 5/8" Abrasive grinding wheel, fully reinforced, Bluefire Type 1, Maximum 6000 RPM,
	9" X 1/4" X 5/8"-11 Abrasive grinding wheel, fully reinforced, Type 27, Maximum 6600 RPM.
	9" X 1/8" X 5/8"-11 Abrasive grinding wheel, fully reinforced, Type 27, Maximum 6600 RPM.
SURFACE GRINDING	
	6" X 3" X 5/8" - 11 Type 6 grinding wheel, Norton Bluefire, Max 6000 RPM
	4" X 3" X 5/8" grinding wheel for Matweld Frog Grinder 09200A
	8" X 2" X 2" Plate mounted, 4 bolt grinding wheel, tape wound, Maximum 4500 RPM
	6/4-3/4" X 2" X 5/8" -11 Flaring cup abrasive grinding wheel, Maximum 6000 RPM
	9" X 1/4" X 7/8" Abrasive grinding wheel, fully reinforced, Maximum 6600 RPM
STOCK RAIL & SWITCH POINT GRINDING MACHINE	
	10" X 1-1/2" X 1" Recess one side 6" X ½", abrasive grinding wheel, fully reinforced, Maximum 3630 RPM.
WEB GRINDING	
	6" X 2-1/4" X 1" Recess one side 2-3/8" X 1", abrasive grinding wheel, fully

	reinforced , Maximum 6050 RPM.
	8" X 1/2" X 5/8" Wire brush wheel, Maximum 6000 RPM

Appendix B

MWI 1101-05 Continuous Welded Rail Projects

Issued: _____ Revised: _____

PURPOSE:	To set instructions governing the planning and installation of CWR.
SAFETY:	Observe all applicable safe job procedures and safety rules and regulations.
LOCATION:	All Owner tracks and property.
ENVIRONMENTAL:	Observe all applicable Federal, State and Local environmental rules and regulations.
REFERENCES:	MWI 701 Use of Premium Rail Fasteners with CWR MWI 702 Reclamation and Reuse of Track Spikes and Rail Anchors MWI 703 Rail Anchoring Policy MWI 901 Road Crossing Installation MWI 1125 Installation and Thermal Adjustment of CWR 2512, 2513, 2514 Spiking Patterns

I. DISCUSSION

A. The goal of this continuous welded rail policy is to ensure that the work meets all Owner Standards as well as Owner's Chief Engineer's goals for safety, quality, and cost effectiveness. Because rail is laid in a wide variety of conditions, these instructions will define the process by which the agreed upon results can be obtained. The success of this process will require a coordinated effort from a team consisting of Chief Engineer and his designated managers.

B. Once the rail laying program has been established any changes after the program is finalized must be submitted through the change order process and have the approval of the Chief Engineer. The Chief Engineer shall notify the Roadmaster of the changes to the rail laying program in writing.

C. The Chief Engineer will ensure that any revisions to the program or schedule are distributed.

II. PROCEDURE

A. PLANNING

1. A Roadmaster designated by the Chief Engineer will arrange a "pre-trip" meeting with railroad personnel, a minimum of three months prior to the scheduled laying date of the welded rail, to inspect the work site, and to plan the work activity.

2. Staff for the pre-trip meeting must include the Chief Engineer, Roadmaster, and other designated managers for r (Signals, Bridges, and Construction), whom are responsible for the maintenance of the track section on which the rail is to be laid.

3. This group will hi-rail the proposed rail laying site to determine what personnel must do to prepare the track for welded rail, to validate the program and quantities of material required and to ensure this material is available for installation. This inspection should include identification of any rail determined to be suitable for reuse "self-help rail". Refer to MWI 508 for certified rail requirements.

4. If there is any item(s) on which agreement cannot be reached during the inspection, the jointly discuss the item(s) with the Roadmaster and Chief Engineer for a decision. The decision made will be added to the inspection notes.

5. The Roadmaster will attach the pre-trip packet mentioned in Paragraph B.2. (below) to the notes and forward copies to all individuals making the inspection for their review. The final packet will be distributed to at least the Chief Engineer and the Roadmaster.

B. PRELIMINARY WORK

1. The Chief Engineer will advise the group of the method, equipment, and team that will be used to lay the rail. The Roadmaster will maintain the inspection notes listing the work which needs to be done before the rail can be laid.

2. The Roadmaster Chief Engineer designated manager will prepare a pre-trip packet of the project. Items to be included in the packet are but not limited to the following:

   a) Straight line sketch of the work area
   b) Starting and ending locations.

c) Storage areas for released track material.
d) Identify rail for self-help and method of communicating this information to preclude errors by contractors or employees.
e) Equipment clearing and tie up points.
f) Road Crossings at grade: If to be worked, give locations, lengths, material to be used, and specific work details, including street name or DOT crossing number. (see MWI 901 for additional reference)
g) Turnouts to be replaced: Give size and hand, type of rail fastening system, power or hand operated, type frog to be installed, length of rail required for diverging side so compromise joints are off the switch ties, milepost location or name of switch. If panelized turnouts will be used, identify locations, methods of unloading and installation.
h) Railroad Crossings at grade: If to be replaced, give angle, type of crossing, tie condition, milepost location.
i) Indicate any special track or signal material to protect wayside equipment.
j) Identify the locations for insulated joints, compromise joints, and transition rails.
k) Identify the existing fastening system and the planned fastening system.
l) Locations using relay rail will use relay tie plates, when available. Relay tie plates may be used with new rail on tangent track with less than 25 MGT, when available.
m) Identify screw spike and lock spike (hairpins) locations.
n) Locations of recent curve patch, which do not meet the relay criteria, will be inspected and tie-in points identified.
o) Spot check of tie spacing in each mile to assist in ordering tie plates and anchors.
p) Bridge types and lengths. Standard Open Deck Bridge Tie Fastening must be complied with before welded rail can be laid across a bridge.
q) Tunnel locations and lengths. Arrange for lighting, ventilation, and air quality monitoring if required.
r) Locations at which special track material is required, and other items that may affect rail installation.
s) Indicate Bridge locations that require fall protection.
t) Prepare a local Emergency Response Plan including telephone numbers and highway directions to the nearest hospital or medical facility, police and fire departments, and rescue service.

3. The Roadmaster will be responsible for coordinating activities prior to the arrival of the rail laying team. This includes but is not limited to:

a) Preparing the list of track material required and ordering in accordance with current instructions.
b) Coordinating with Chief Engineer to ensure that materials arrive on time.
c) Performing any track work specified on the inspection notes.

d) Distributing track material as stated in the pre-trip packet.
e) Uniquely identifying rail approved for self-help.
f) Unloading rail from rail trains. Ribbons to be unloaded end to end but miss-matched, so that the rail ends cannot bind against each other.
g) Arrangements should be made to unload rail through road crossings. Unloading for turnouts should be accomplished with only one cut.
h) Discussing the proposed work and curfews with the local Transportation Officers to obtain the maximum possible track time.
i) Identifying high density road crossing areas, develop plan to assist rail team to maintain maximum productivity.
j) Coordinating the blocking of road crossings with state and local authorities.
k) Cutting bituminous concrete at road crossings beyond heads of ties to allow room for cribbing and adzing ties.
l) Monitoring the progress of work listed on the inspection notes.

4. The Bridge Roadmaster Manager designate will be responsible for:

a) Checking bridges to see that they comply with current instructions for laying welded rail and bringing them into compliance where necessary.
b) Providing the location of all bridges that require special handling before welded rail can be laid over them to the Bridges department.
c) Arranging for tunnel ventilation and/or lighting as needed.
d) Arranging for outriggers on bridges without sufficient width to support both the new rail being laid and the rail being removed.
e) Assist in any special needs for fall protection equipment or bridge specific systems.
f) Developing a fire prevention plan for open deck bridges to allow heating of the rail if rail temperature adjustment is necessary. Arrange for a water truck if necessary to protect bridge structures.

5. The Chief EngineeSignal Manager designater will advise the Roadmaster of any installations in the work area that do not conform to current Owner signal standards and could be changed economically to the current Standard. Consideration should be given to scheduling Signal maintenance or construction activities at this time to take advantage of the curfew or track time given to the rail laying gang.

C. MATERIAL DISTRIBUTION PRIOR to ARRIVAL of TEAM

1. The Owner uses bulk delivery for much of the material needs to reduce double handling and eliminate waste. Those materials not handled bulk by the team need to be arranged for by the Chief Engineer working with the Roadmaster. Details of material distribution requirements follow:

a) Propane for rail heaters. Chief Engineer will advise Roadmaster of required amount.
b) Tie Plates, two (2) per tie right side up within the rails if plates are to be replaced. They must be placed along of the centerline of the track. One plate on the tie, one in the crib. Care must be taken to ensure that tie plates do NOT interfere with the Signal System. (bridging track circuit)
c) Compromise joints specific to the project will be supplied at the beginning of the project and unloading as designated in the pre-trip inspection. Joint bars must be available in case welding cannot be completed by the end of the day.
d) Rail anchors, spikes, screws, or Pandrol clips will be handled bulk through team supply chain.
e) Track bolts, nuts, and washers, will be handled bulk through team supply chain.
f) Tie plugging material or tie plugs will be handled bulk through team supply chain.

2. At specific locations within the rail laying area.

a) Distribute insulated joints and transition rails adjacent to their installation location
b) At turnout locations: Depending on the method of installation outlined in the pre-trip packet, the frog, switch points, stock rails, guard rails, etc., are to be turned in the proper direction for installation and unloaded as near as possible to the installation location.
c) At bridges: Tie pads for bridge ties.
d) At road crossings: Crossing material and hardware.

3. The track material distribution shown in Paragraph II.B. 1 – 3 above is based on typical CWR projects installed by system production teams. If CWR is laid by division teams, material unloading may be adjusted, as needed, to accommodate specific project requirements and method of installation.

E. MATERIAL RELEASED from RAIL LAYING

1. Track material released from rail laying will be placed for pickup on the side of track away from the ballast line. Walkways and ditches must be kept clear. Do not place beneath overhead wire lines.

2. Tie plates will be placed apart from other material. If spikes, anchors, and joint bars are picked up separately during rail laying, they will be kept and loaded separately. If spikes, anchors and joint bars are picked up mixed during rail laying, they will be loaded mixed.

3. Empty gondolas will be arranged and spotted in an accessible location by the

Roadmaster to be loaded with scrap OTM and scrap rail.

4. OTM and self-help rail should be clearly marked and discussed during the job briefing to ensure understanding by all parties. Contact Chief Engineer if there are any questions regarding self-help rail authority.

F. QUALITY CONTROL

1. The Chief Engineer or his designated representative will continuously monitor the quality of the work and ensure that all work is completed in a quality manner.

2. The Roadmaster will hi-rail behind the team every week or for short rail lots, upon completion of the rail lot, to verify the quality of the work, the completeness of the project and to confirm that the plan is being followed.

3. The Roadmaster will make frequent trips to the team and observe the quality of the work. Where practicable, the rail lot should be inspected by hi-rail with the Chief Engineer before the team leaves the rail laying location. This trip must occur with sufficient time before the team completes the project to allow for any corrective action to be taken prior to the team's departure from the project. If there is any question concerning any of the work underway or completed, they will immediately discuss with the Roadmaster.

EMERGENCY RESPONSE PLAN

WORK LOCATION

_____ Starting Date: _____

_____ _____

Starting Milepost: _____ _____ Ending Milepost: _____

EMERGENCY RESPONSE
DIRECTIONS FROM WORK LOCATION TO NEAREST MEDICAL FACILITY

_____

_____

_____

_____

_____

(Give highway exit numbers and other landmarks that will aid in finding the facility. Give mileage to the nearest tenth of a mile.)

EMERGENCY TELEPHONE NUMBERS

Rescue: (_____) _____ Name: _____

Police: (_____) _____ Name: _____

Fire: (_____) _____ Name: _____

Radio Channel for Dispatcher: _____

Chief Dispatcher: (_____) _____

Chief Engineer: (_____) _____

Roadmaster: (_____) _____

III. REPORTS

A. The Roadmaster will ensure that the Daily Production Reports are input into the appropriate computer system in the Owner Engineering system. These reports must be completed for each day's production. Care must be exercised to ensure that all information is accurate.

B. The Chief Engineer will prepare and forward the pre-trip packet as identified in Paragraph A.6 within one (1) week of the completion of the hi-rail trip.

C. The Roadmaster will ensure that the rail laid and released in the CWR project is properly charged out in their inventory account within one (1) week after the rail team moves to the next project.

Prepared by:

Reviewed by: _____

Approved: _____

SECTION 341127 - EROSION AND SEDIMENTATION CONTROL

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Prior to the start of work, Contractor shall furnish and install all erosion and sedimentation control devices in accordance with the Contract Plans, Scope of Work, Technical Specifications, Special Conditions, and all Local, Federal, and State DEP Regulations per the Environmental Permit requirements.

1.3 GENERAL

A. The Contractor shall install erosion control measures as required and/or determined necessary by the Engineer in order to protect Environmental Resources due to the Contractors staging areasand means of accessing the project location, in addition to protecting the Environmental Resources due to the Contractors means and methods of completing the work.

B. This Section specifies installing straw bales or compost filter tubes and silt fences for the control of erosion and sedimentation on site.

C. Straw bale siltation barrier shall consist of straw bales/silt fence or compost filter tubes as detailed in the Contract Documents.

D. This Section specifies installing turbidity curtain (staked floating siltation barrier) for the control of erosion and sedimentation on site. The type of turbidity curtain shall be determined by the manufacturer for the body of water the work is being performed in.

PART 2 - PRODUCTS

2.1 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. The silt fence fabric shall be furnished with suitable wrapping for protection against moisture and extended ultraviolet exposure prior to placement.

B. Each roll of fabric or erosion control mat shall be labeled or tagged to provide product identification sufficient for field identification, as well as inventory and quality control purposes.

C. Each roll of fabric shall be stored in a manner that will protect them from the elements. If stored outdoors, they shall be elevated and protected with a waterproof cover.

D. Straw bales or compost filter tubes shall be stored in a manner that will protect them from the elements. If stored outdoors, they shall be elevated and protected with a waterproof cover.

E. Turbidity curtains shall be labeled or tagged to provide product identification sufficient for field identification.

2.2 MATERIALS AND EQUIPMENT

A. Straw bales or compost filter tubes shall be individually banded and staked into the ground.

1. Straw bales or compost filter tubes shall consist of straw for outdoor use banded with wire or nylon cord (minimum two bands per bale or equal per compost filter tube) and shall be stakedfor securing into the ground as shown on the Drawings.

2. Stakes for straw bales shall be standard steel pickets, 2 inch by 2 inch wood stakes, or approved equal.

3. The compost filter tubes shall be a minimum of twelve (12) inch compost filled tube of flexible netting material. It shall be a machine-produced tube containing a long term, wood fiber mulch compost that is certified weed free, by a manufacturer. The netting shall consist of seamless, high density polyethylene and ethyl vinyl acetate and contain ultra-violet inhibitors. The compost shall conform to AASHTO Standard MP 9-06 – Compost for Erosion/Sediment Control. Wood chips, bark chips and reprocessed wood products will not be acceptable.

4. Stakes shall be applied to the compost filter tubes per the manufacturer's specifications.

B. Silt fence shall consist of a self or wire supported geotextile silt fence with support posts

1. Fibers used in the manufacture of geotextiles, and the threads used in joining geotextiles by sewing, shall consist of long chain synthetic polymers composed of at least 85% by weight polyolefins, or polyesters.

2. Both the geotextile and threads shall be resistant to chemical attack, mildew, and rot.

3. Geotextiles shall conform to the following physical requirements in accordance with the acceptance criteria required by ASTM D4759. Values shown are minimum average roll values. Strength values are in the weaker principal direction.

   a. Tensile Grab Strength: ASTM D4632; 90 pounds minimum.

   b. Elongation at 50% Minimum Tensile Strength: ASTM D4632; 50% maximum for self-supported fences.

   c. Permittivity: ASTM D4491; 0.0 10 per second minimum.

   d. Apparent Opening Size (AOS): ASTM D4751; 0.84 millimeters maximum.

   e. Ultraviolet Degradation: ASTM D4759; at 500 hours exposure, 70% strength retained forall cases.

4. Posts for Silt Fence: Wood, steel, or synthetic posts may be used. Posts shall have a minimumlength of 30" plus burial depth, be of sufficient strength to resist damage during installation, and support applied loads.

5. Wire Support: 12-gauge wire supports at 6-inch maximum spacing each way shall be used when geotextile fabric is not strong enough to support applied loads as specified. Provide hogring supports as detailed.

6. Prefabricated fence systems may be used provided they meet all of the above materialrequirements.

C. Turbidity Curtain:

1. Barriers should be a bright color (yellow or “international” orange are recommended) thatwill attract the attention of nearby boaters.

2. The turbidity curtain fabric shall conform to the following minimum physical property requirements:

   a. Thickness: 45 mils minimum

   b. Weight

      1) Type I: 18 Oz./SY minimum

      2) Type II: 18 or 22 Oz./SY

      3) Type III: 22 Oz./SY minimum

   c. Grab Tensile Strength: 300 lbs. minimum

   d. Ultraviolet Inhibitor: must be included

3. Seams in the fabric shall be either vulcanized welded or sewn and shall develop the full strength of the fabric.

4. Floatation devices shall be flexible, buoyant units contained in an individual floatation sleeveor collar attached to the curtain. Buoyancy provided by the floatation units shall be sufficient to support the weight of the curtain and maintain a freeboard of at least 3 inches above thewater surface level.

5. Load lines must be fabricated into the bottom of all floating turbidity curtains. Type II and Type III must have load lines also fabricated into the top of the fabric. The top load line shall consist of woven webbing or vinyl-sheathed steel cable and shall have minimum breaking strength of 9,800 pounds. The supplemental (bottom) load line shall consist of a chain incorporated into the bottom hem of the curtain of sufficient weight to serve as ballast to holdthe curtain in a vertical position. Additional anchorage shall be provided as necessary. The load lines shall have suitable connecting devices to maintain full breaking strength in connecting to load lines in adjacent sections.

6. External anchors may consist of wooden or metal stakes (2 inch x 4 inch or 2 1/2 – inch minimum diameter wood or 1.33 pounds/linear foot steel) when Type I Installation is used; when Type II or Type III installation are used, bottom anchors should be used.

7. Bottom anchors must be sufficient to hold the curtain in the same position relative to the bottom of the watercourse without interfering with the action of the curtain. The anchor may dig into the bottom (grappling hook, plow, or fluke-type) or may be weighted (mushroom type) and should be attached to a floating anchor buoy via an anchor line. The anchor line will then run from the buoy to the top load line of the curtain. When used with Type III installation, these lines must contain enough slack to allow the buoy and curtain to floatfreely with tidal changes without pulling the buoy or curtain down and must be checked regularly to make sure they do not become entangled

with debris. As previously noted, anchor spacing will vary with current velocity and potential wind and wave action. Manufacture's recommendations should be followed. Follow the manufactures orientation ofthe external anchors and anchor buoys for tidal installation.

D. Silt sack catch basin inlet protection shall fit freely suspended inside the catch basin.

1. Silt sacks shall be made of woven polypropylene filter fabric with polypropylene boot at the top on which the grate sits to hold the silt sack in place.

2. A manufactured overflow opening shall be provided below the boot, just under the grate.

3. The silt sack filter shall have the following properties:

a. Constructed of woven polypropylene fabric

b. Maximum overflow rate of 200 GPM/SF.

c. Maximum permeability of 1.5 sec $^{-1}$

d. Minimum UV resistance @ 500 hrs. of 90%

e. Minimum tensile grab strength at 165 lbs. (ASTM 4632)

PART 3 - EXECUTION

3.1 TEMPORARY EROSION CONTROL

A. Method of stripping vegetation shall be such as to minimize erosion. Fills shall be placed and compacted in such a manner that soil sliding and erosion is minimized. Grading shall be done in such a manner as not to divert water on to the property adjoining the construction site without expressed written permission of the landowner and the local Conservation Commission. IfContractor fails to employ adequate and acceptable erosion control techniques duringconstruction, Engineer may order a suspension of the work until implementation of satisfactory techniques are agreed upon and demonstrated, and Contractor shall have no claim for damages or time extension resulting from such delays.

B. Staked straw bales/silt fences and/or compost filter tubes shall be installed at the following locations:

1. Toe of embankment construction.

2. Toe of abutments and retaining walls.

3. Across construction ditches prior to entry into any drainage system or waterway.

4. Toe of temporary earthwork stockpiles.

5. Other locations shown on the Contract Drawings or designated by Engineer.

C. Abut straw bales or overlap compost filter tubes to form a continuous barrier. Silt Fence shall be entrenched 4" minimum as shown in the Drawings. Secure straw bales or compost filter tubes in place with two stakes per bale.

D. Silt fence construction shall be adequate to handle the stress from sediment loading. Geotextile at the bottom of the fence shall be buried a minimum of six (6) inches deep in a trench as shown on the drawings so that no flow can pass under the barrier. Trench shall be backfilled, and the soil compacted over the geotextile. Fence height shall be as shown on the drawings, but in no case shall exceed thirty (30) inches above ground surface. Geotextile shall be spliced together only at asupport post with a minimum six (6) inch overlap. Posts shall be spaced as indicated on the Contract Drawings. Where a twelve (12) inch depth is not possible, the post shall be adequately secured to prevent overturning of the fence due to sediment or wind loading.

E. Sediment controls shall be in place prior to any soil disturbing activities including, but not limitedto clearing and grubbing, earthwork, dewatering, and excavation.

F. Any disturbed soils shall be stabilized, either permanently or temporarily, within two (2) weeks of disturbance.

G. Staked straw bales or compost filter tubes shall be placed at the toe of ballast in all excavation areas adjacent to existing track. Straw bales or compost filter tubes in these areas shall beinspected daily for any defects and repaired immediately.

H. Turbidity Curtain Installation

1. In the calm water of lakes or ponds (Type I installation) it is usually sufficient to merely set the curtain end stakes or anchor points (using anchor buoys if bottom anchors are employed), then tow the curtain in the furled condition out and attach it to these stakes or anchor points. Following this, any additional stakes or buoyed anchors required to maintain the desired location of the curtain may be set and these anchor points made fast to the curtain. Only then,the furling lines should be cut to the curtain skirt drop.

2. In rivers or in other moving water (Type II or Type III installations) it is important to set all the curtain anchor points. Care must be taken to ensure that anchor points are of sufficient holding power to retain the curtain under the existing current conditions, prior to putting the furled curtain into the water. Again, anchor buoys should be employed on all anchors to prevent the current from submerging the flotation at the anchor points. If the moving water into which the curtain is being installed is tidal and will subject the curtain to currents in both directions as the tide changes, it is important to provide anchors on both sides of the curtain for two reasons:

    a. Curtain movement will be minimized during tidal current reversals.

    b. The curtain will not overrun the anchors and pull them out when the tide reverses.

3. When the anchors are secure, the furled curtain should be secured to the upstream anchor point and then sequentially attached to each next downstream anchor point until the entire curtain is in position. At this point, and before unfurling, the “lay” of the curtain should be assessed and any necessary adjustments made to the anchors. Finally, when the location is ascertained to be as desired, the furling lines should be cut to allow the skirt to drop.

4. Always attach anchor lines to the floatation device, not to the bottom of the curtain. The anchoring line attached to the floatation device on the downstream side will provide support for the curtain. Attaching the anchors to the bottom of the curtain could cause premature failure of the curtain due to the stresses imparted on the middle section of the curtain.

5. There is an exception to the rule that turbidity curtains should not be installed across channel flows; it occurs when there is a danger of creating a silt build-up in the middle of a watercourse, thereby blocking access, or creating a sand bar. Curtains have been usedeffectively in large areas of moving water by forming a very long-sided, sharp "V" to deflect clean water around a work site, confine a large part of the silt-laden water to the work area inside the "V" and direct much of the silt towards the shoreline. Care must be taken, however, not to install the curtain perpendicular to the water current.

6. Contractor shall follow the manufacture's typical installation layout for the type of curtain.

I. Catch basin inlet protection silt sacks shall be placed to protect all catch basins within the work area that will be receiving any construction area runoff drainage.

3.2 MAINTENANCE AND CLEANUP

A. Maintain the integrity of staked straw bale/silt fence barriers and compost filter tubes as long as they are necessary to contain sediment runoff. Promptly repair or replace ineffective strawbale/silt fence barriers and compost filter tubes while the barrier is still necessary.

B. Inspect all temporary straw bale/silt fence barriers and compost filter tubes immediately after each rainfall and at least daily during prolonged rainfall. Any deficiencies shall be immediately corrected. Make a daily review of the location of straw bale/silt fence barriers and compost filter tubes in areas where construction activities have changed the natural contour and drainage runoff to ensure that the straw bale/silt fence barriers and compost filter tubes are properly located for effectiveness. Where deficiencies exist, additional straw bale/silt fence barriers or compost filter tubes and erosion control measures shall be installed as directed by Engineer.

C. Sediment deposits shall either be removed when the deposit reaches approximately one-half ofthe height of the straw bale/silt fence barrier or compost filter tube, or a second straw bale/silt fence barrier or compost filter tube shall be installed as directed by Engineer. Sediment shall be removed and disposed of periodically from behind straw bale/silt fence barriers and compostfilter tubes. In no case shall the accumulated sediment be allowed to rise above the mid height of the straw bale or compost filter tube. All sediment shall be disposed of in an approved manner.

D. Straw bale/silt fence barriers and compost filter tubes shall remain in place until Engineer directs that they be removed. Upon removal, remove and dispose of any excess silt accumulations, dress the area to give a pleasing appearance, and vegetate all bare areas with approved seed mix.

E. Straw bales, compost filter tubes, silt fences, and stakes will remain the property of Contractor, may be re-used at other locations provided the materials meet the requirements, and shall be removed and disposed of upon acceptance of the respective work unless directed otherwise by Engineer.

F. Turbidity curtain maintenance:

1. Contractor shall be responsible for maintenance of the turbidity curtain for the duration of the project in order to ensure the continuous protection of the watercourse.

2. Should repairs to the geotextile fabric become necessary, there are normally repair kits available from the manufacturers; manufacture's instruction must be followed to ensure the adequacy of the repair.

G. Turbidity curtain removal:

3. Care should be taken to protect the skirt from damage as the turbidity curtain is dragged from the water.

4. The site selected to bring the curtain ashore should be free of sharp rocks, broken concrete, debris, etc. so as to minimize damage when hauling the curtain over the area.

5. If the curtain has a deep skirt, it can be further protected by running a small boat along its length with a crew installing furling lines before attempting to remove the curtain from the water.

6. When the curtain is no longer required as determined by the inspector, the curtain and related components shall be removed is such a manner as to minimize turbidity. Remaining sedimentshall be sufficiently settled before removing the curtain. Sediment may be removed, and the original depth (or plan elevation) restored. Any spoils must be taken to upland area and be stabilized.

H. Inspect all silt sack inlet protection immediately after each rainfall and at least daily during a prolonged rainfall.

I. Sediment deposits in the silt sack shall be removed when the deposit reaches one inch (1”) below the overflow opening in the filter. Remove silt sack from catch basins, empty, and rinse out the filter. Reshape the silt sack and re-install into the catch basin.

SECTION 341128 - EXISTING SITE UTILITIES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Prior to the start of work, Contractor shall be responsible for coordinating with the local utility companies for maintenance, protection, and relocation of their facilities as required for the construction. The engineer assumes no responsibility for damages incurred as result of utility omitted or inaccurately shown on the plans. Contractor shall notify DIG-SAFE least 72 business hours before any construction begins.

1.3 DESCRIPTION OF WORK

A. Work Included: This Section specifies the maintenance, support, protection, relocation, reconstruction and adjustment-to-grade, restoration, and abandonment of existing utilities affected by the construction work.

B. For the purpose of this Section, utility means any public or private service, such as electric light and power systems; gas distribution systems; telephone, telegraph, cable television and other communication services; water distribution; storm drain and sanitary sewer services; police and fire communication systems; street lighting and traffic signs and signals; parking meters; and steam distribution systems.

C. Coordination and work between utility companies and Contractor will be required.

D. Coordination between Contractor and JAXPORT Signal Maintenance group shall be required to locate existing signal cables.

1.4 GENERAL

A. The location of existing underground pipes, cables, conduits, and structures as shown on thePlans have been collected from the best available sources. JAXPORT (Owner) together with its agents do not imply nor guarantee the data and information in connection with the underground pipes, cables, conduits, structures, and other parts as to their completeness nor their locations indicated. Contractor shall contact utility owners and request marking location of all their lines in the work areas. Contractor shall assume there are existing water, gas, electric andother utility connections to every building and structure, whether they appear on the Drawings or not. Any expense and/or damage to these shall be the responsibility of Contractor.

B. Foundations and lines for services, police and fire alarm boxes, street and pedestrian lights, and traffic signals may not be shown on the Drawings. The appropriate utility companies and/or agencies shall be contacted and consulted for locations of the above.

C. All utility companies, public and private, shall be notified, including those in control of utilities not shown on the Drawings prior to designing, excavating, blasting, installing, backfilling, grading, or

restoring pavement. Contractor shall premark the area of excavation or work and notify Dig Safe Center (1-888-DIG-SAFE) at least three (3) business days prior to any excavation or work. In addition, notification shall be given toall affected private and/or public utilities to permit street marking of their lines.

D. Some unknown utilities may exist in the areas to be excavated. Contractor shall take thenecessary precautions when excavated in areas of potential utility conflict. Precautions may include, but are not limited to soil vacuum excavation, hand digging, or other non-destructive means. Contractor shall further be prepared to pre-excavate or pre-trench to locate potential utility conflicts prior to performing such activities as, but not limited to jacking, tunneling, installing temporary excavation support, etc.

E. Interruptions of utilities shall not be permitted without written consent of the utility owner. Contractor shall coordinate with all utilities and provide all temporary utilities and connections to avoid interruptions.

1.5 SUBMITTALS

A. Submit working drawings and, if applicable, shop drawings showing the details, procedures, and scheduling for performance of the existing utility work. Show actual location of existing utility facilities; interferences which these facilities present to the new work; location of settlement markers; method proposed to proceed with the construction; details of proposed support systems; and, if applicable, method of testing and procedure for restoration.

B. Submit written evidence of affected utility owners' approval of the details, procedure, and scheduling.

C. Provide written notice two (2) weeks in advance of the intended date to commence operations to affected utility owners and parties having surface, subsurface or overhead structures in theconstruction area. Furnish Engineer copies of all notices.

D. If a settlement or movement monitoring system is required, submit copies of readings to Engineerand affected utility owner within 24 hours of the reading.

E. Submit to Engineer, certifications from the respective suppliers that the products to be incorporated in the work are in conformance with applicable requirements.

1.6 NOTIFICATION

A. Notify the appropriate utility agencies and Engineer at least 48 hours prior to starting any work involving or adjacent to utility service facilities.

B. Where an existing utility facility is encountered that is not indicated or that is determined to be a different utility facility than that indicated, promptly notify the Authority. Contractor is responsible for determining the owner of the facility and the disposition of the facility.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Products and materials shall be as specified in the Technical Specifications or by the utility company.

2.2 SALVAGE MATERIAL

A. Reuse materials designated to be salvaged, provided they are inspected and approved by the respective utility owner and Engineer. Salvaged material not designated for reuse or returned to utility owner shall become the property of Contractor.

B. Maintain and have available for inspection by Engineer a detailed record, including signedvouchers and receipts, of new and salvaged materials received from, used, or returned to the various utility owners.

PART 3 - EXECUTION

3.1 EXECUTION

A. Conform to the specifications and standard practices of the affected utility owners. Coordinate with utility owners, which work shall be done by Contractor and which work shall be done by utility owner at Contractor's expense. Ensure continuity of all existing utility services to all users except when the utility owner determines that temporary interruption is required.

B. Unless otherwise indicated or authorized in writing by Engineer, maintain all utility facilities complete in place.

C. Abandoned Facilities

1. Demolish and remove abandoned utility facilities in conflict with work.

2. Do not undertake demolition or removal of the service until written approval for such workhas been obtained from the utility owner. When abandoned facilities are indicated to be left in place, plug, or cap or bulkhead the ends of conduits and pipes, as indicated. Pipe or conduit greater than 15 inches in diameter shall be completely filled with Controlled Density Fill. Remove abandoned utility manholes, junction boxes, and similar structures to a minimum depth of two (2) feet below finish grade and fill the remaining void with sand or select fill, as specified in the Excavation and BackfillSection of the Technical Specifications, after the plugging, or capping, or bulkheading of conduits and pipes has been completed. Puncture or break the bottom slabs of manholes and similar structures to provide drainage. Backfill and compact excavations resulting from removal of utility facilities, as required.

3. Bulkheads for pipes greater than 15 inches in diameter shall be constructed of solid concrete masonry bricks or solid concrete masonry blocks with full mortar joints. The bulkhead shall be watertight. Recess the bulkhead ½ inch and seal with non-shrink grout.

D. Furnish, install, and maintain all temporary facilities required to provide interim utility service when a utility facility is to be relocated and when a utility facility to be replaced is abandoned prior to replacement.

E. Where an existing utility facility is encountered which is not indicated, or which is determined to be a different utility service than that indicated, promptly notify Engineer who will assist in determining the owner of the facility and the disposition of the facility.

F. If, upon exposure, the condition or location of a facility to be supported complete-in-place is found by Engineer to be unsafe for support or for maintenance of service, replace or reconstruct the facility as required, with prior approval of Engineer and the utility owner.

3.2 SETTLEMENT OR MOVEMENT

A. Provide suitable settlement or movement monitoring systems where indicated or required by the affected utility owner.

B. In case of settlement or other movement which might cause damage, take immediate remedial measures to correct the conditions and damages caused by the settlement.

3.3 RECONSTRUCTION AND ADJUSTMENT-TO-GRADE

A. Relay, reset, or otherwise reconstruct miscellaneous structures and facilities as indicated.

B. Adjust-to-grade manholes and inlets as indicated, by raising or lowering the upper portion thereof.

C. Backfill under utilities supported or exposed using controlled density fill to allow for the proper support and compaction under the utility. Contractor shall coordinate with the utility owner to determine the acceptability of the use of controlled density fill and shall work with the utility owner to develop alternate means to ensure the proper backfill and compaction under the utility.

3.4 AS-BUILT UTILITY LOCATION AND CONDITION SURVEY

A. For each new or relocated utility installed, including those installed or relocated by others in the project area, perform an as-built location survey by coordinates prior to backfilling the excavation.

B. The survey data shall be obtained by Global Positioning Survey (GPS) and certified by a Professional Land Surveyor registered in Florida. A complete digital base plan shall be provided in AutoCAD DWG format Release 2000i or later on a Compact Disk (CD), properly referenced to the coordinate system established in the contract.The following standards shall be applicable:

1. Text: Text shall be drawn using a STYLE of "L100-XX" (where XX refers to the plotted scale) and a font file of "SIMPLEX" as defined in the AutoCAD survey template provided by Engineer. The style shall be defined as a "fixed height" style and have a height of 0.10 times the drawing plotted scale. (i.e. 4.0 for 40 scale plan, 2.0 for 20 scale plan, etc.).

2. Precision and Accuracy:

   a. Horizontal Survey:

      1) Precision: Horizontal control and surveyed points shall maintain a minimum precision of 1:10,000.

      2) Accuracy: No more than 10% of the survey points shall be in error by more than 1/100 inch or 0.25 mm when viewed at the requested scale.

   b. Vertical Survey:

      1) Precision: Vertical Control shall have a maximum error of closure no greater than

      .075 feet or .02 meters.

      2) Accuracy: No more than 10% of elevations when interpolated from a Surface shall be in error of more than 1/2 a contour interval.

3. Surface Data: The data format shall conform to Autodesk AutoCAD Civil 3D Project files.If Contractor uses a different software product to create a surface, then the surface must be represented as a TIN (Triangulated Irregular Network) of 3D lines on a separate, distinctlayer within the AutoCAD drawing file. 3D faces or 2 dimensional lines are NOT acceptable.

SECTION 341129 - PROTECTION OF WORK AND PROPERTY

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Contractor shall be responsible for temporarily protecting all existing site features. All damage to existing site features caused by the Contractor shall be repaired by the Contractor at NO additional cost to Client.

1.3 GENERAL

A. Work Included: This Section specifies the general requirements for the temporary protection ofwork and property during the Contract period.

PART 2 – PRODUCTS (not used)

PART 3 - EXECUTION

3.1 TEMPORARY PROTECTION

A. Protect the following:

1. Existing mainline, siding, and yard tracks from damage and impacts.
2. Existing railroad culverts, bridges, and grade crossings.
3. Existing public and private access paths and utility easements and crossings.
4. Existing overhead bridge and the private yard facilities and property.
5. Existing railroad ties, rail, turnouts, OTM, bumping posts and signal equipment.
6. Existing railroad rolling stock and railroad equipment within the work area.
7. Existing platforms, buildings, and maintenance facilities.
8. Existing track drainage ditch, drainage pipes and drainage structures.
9. Existing on site utility structures
10. Existing wetland, stream and river areas and wooded areas adjacent to the track corridor.

B. After work is properly completed, be responsible for protecting work and for repairing, replacing,and cleaning of damaged work, so that all work is complete at the time of acceptance of the work.

C. Remove all temporary protection and coverings at the completion of the Work.

SECTION 341130 - AS-BUILT CONSTRUCTION PLANS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Contractor shall be responsible for preparing As-Built plans of each crossing.

1.3 DESCRIPTION OF WORK

A. This Section specifies the general requirements and procedures for preparing As-Built Construction Plans. As-Built plans are not intended to document final quantities but are intended to show approved revisions to the contract design including, but not limited to revised profiles and cross sections; revised typical sections; revised drainage and utilities installations; revised track and signal design; revised structure details and/or any changes to the demolition andremoval items and any other changes to the original design or details.

1.4 GENERAL

A. Contractor shall document all plan changes in the field as they are approved and occur. A dedicated plan set shall be kept by Contractor on site to record all such changes and modifications.

B. Survey data shall be obtained by Global Positioning Survey (GPS) and certified by a ProfessionalLand Surveyor registered in Florida.

C. Contractor shall furnish paper “AS BUILT” plans, two (2) paper 11x17 bound copies of the completed project plans, and two (2) electronic file in AutoCAD 2018 Civil 3D on a labeled disk or portable USB drive to Engineer. These “AS BUILT” plans shall be furnished prior to the date of the final acceptance. Engineer will make the original drawings available to Contractor for the making of duplicates for use in preparing the as-built drawings.

D. The following standards shall be applicable:

1. Text: Text shall be drawn using a STYLE of "L100-XX" (where XX refers to the plotted scale) and a font file of "SIMPLEX" as defined in the AutoCAD survey template provided bythe Engineer. The style shall be defined as a "fixed height" style and have a height of 0.10 times the drawing plotted scale. (i.e. 4.0 for 40 scale plan, 2.0 for 20 scale etc.).

2. Precision and Accuracy:

    a. Horizontal Survey:

        1) Precision: Horizontal control and surveyed points shall maintain a minimum precision of 1:10,000.

        2) Accuracy: No more than 10% of the survey points shall be in error by more than 1/100 inch or 0.25 mm when viewed at the requested scale.

b. Vertical Survey:

1) Precision: Vertical Control shall have a maximum error of closure no greater than .075 feet or .02 meters.

2) Accuracy: No more than 10% of elevations when interpolated from a Surface shallbe in error of more than 1/2 a contour interval.

3. Surface Data: The data format shall conform to Autodesk Civil 3D Project files. If the Contractor uses a different software product to create a surface, then the surface must be represented as a TIN (Triangulated Irregular Network) of 3D lines on a separate, distinctlayer within the AutoCAD drawing file. 3D faces or 2 dimensional.

E. Drawings shall include approved design changes during construction. The plan sheets (or any other "job site record document") revised after award of contract shall include a complete accountand detail of the revisions and design changes. The party responsible for the revisions shall have the signed seal of a Professional Engineer (P.E.) registered in Florida on each altered plan sheet (or any other "job site record document" with a seal). This documented information is to be partof the As-Built Plan requirements.

F. As-built plans shall be neat, legible and of the correct size. Project plans shall include Plan, Profile, Cross-Section, and Detail Sheets which shall be full size. As-built plan size shall match the issued plan set size. In general, if the plan set was issued at 11"x17", theAs-Built shall be 11"x17".

G. All revisions to the original plans shall be delineated in red, located properly on the drawing, theyshall be legible and true to scale.

H. As-built plan, profile, cross section, and detail sheets shall be designated as such by note or stamp "As-Built" in black. As-built plans shall be bound in the same manner as they were issued.

I. Changes to the issued design by any outside agency shall have their plans added to the As-built plan set. This includes but is not limited to encroachment permit projects, enhancements, procurements, inter-governmental agreements (IGA), local public agency (LPA) projects and any other agency, private or public, making changes to the existing infrastructure or design. For each new or relocated utility installed, including those installed or relocated by others in the project area, perform an as-built location survey by coordinates prior to backfilling the excavation.

1.5 SUBMITTALS

A. The person or agency responsible for the work shall submit to the Engineer a set of As-built planswhich meet the requirements of this specification.

B. A complete digital base plan shall be provided in AutoCAD Civil 3D DWG format Release 2014 or later on a Compact Disk (CD) or portable USB drive, properly referenced to the proper coordinate system. The final As-built plans shall be submitted within forty-five (45) days following the substantial work complete date of the project.

PART 2 – PRODUCTS (not used)

PART 3 – EXECUTION (not used)

SECTION 341131 – TIMBERING POLICY

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Surface and line all four crossing approaches to the restore the track geometry. A minimum of two (2) tamping passes required. Installed Ballast to be regulated and broomed once surfacing and lining complete.

B. Related Requirements:

1. Section 341126 - Railroad Track Ballast

1.3 GENERAL

A. The goal of this timbering policy is to ensure that the work meets all Owner Standards as well as goals for safety, quality, and cost effectiveness. Because ties are replaced in a wide variety of conditions, these instructions will define the process by which agreed upon results can be obtained. The success of this process will require a coordinated effort from a team consisting of Transportation, Maintenance of Way, and C&S.

B. The tie program will be established by request from the Roadmaster. Any changes after the program are finalized must be submitted through the change order process and have the approval of the Chief Engineer.

C. Any revisions to the program or schedule are to be distributed to all involved.

D. Tie Markings – As soon as the program is established, the other officer designated by the Chief Engineer will mark all ties and switch timber in the lot. The tie marking must be completed at least two months prior to the start of the tie team. Ties will be marked on the web of rail gage side with yellow paint.

PART 2 – PRODUCTS (not used)

PART 3 – EXECUTION

3.1 PROCEDURES:

A. PLANNING

1. Manager designated by the Chief Engineer will arrange a meeting with appropriate personnel a minimum of two months prior to the scheduled installation date of new ties to inspect the work site and to plan the work activity.

2. Personnel at the meeting must include: (1) either the Chief Engineer or Engineer Track, (2) Roadmaster, (3) Manager - Bridges, and (4) Manager – C&S, responsible for the maintenance of the section on which the project is scheduled.

3. This group will hi-rail the proposed project location to determine:

   a) Scope of work

   b) Who is responsible for various activities

4. If there are any item(s) on which agreement cannot be reached during the inspection, the Representatives will jointly discuss the item(s) with the Chief Engineer for a decision. The decision made will be added to the inspection notes.

5. Following the inspection, each individual will sign the Project Agreement (Appendix B). The pretrip packet mentioned in Paragraph II.B.2 (below) will be attached to the notes and copies forwarded to each individual making the inspection, and to the Chief Engineer.

B. PRELIMINARY WORK

1. The Chief Engineer will advise the group of the method and equipment that will be used for this project. The Roadmaster will maintain the inspection notes listing the work which needs to be done before the ties can be installed.

2. The Roadmaster, with input from the Chief Engineer, will prepare a pretrip packet of the project. Items to be in the packet include, but are not limited to the following:

   a. Straight line sketch of project area.

   b. Starting and ending locations.

   c. Storage areas for released track material.

   d. Equipment clearing and tie up points.

   e. Locations where the track gage exceeds limitations outlined in paragraph II.E.8 and out of face gaging is required. (Roadmaster to furnish the latest track geometry data)

   f. Extra spiking in existing ties.

   g. Road Crossings (refer to MWI 901 for additional information):

      1. Give locations, lengths, rail section, and surface material to be used).

      2. The street name or AAR-DOT crossing number.

      3. Identify high traffic density road crossing areas, develop plan to assist the team to maintain maximum productivity, and/or work crossings ahead of time.

      4. Ballast to be stockpiled

      5. Closure plan

   h. Ballast requirements

   i. Turnouts (switch ties to install or turnouts to retire):

1. Milepost location or name of switch. Identify switch ties to be replaced.

2. Give size, type of rail fastening system

j. Any special track material required by the C&S department

k. Wayside equipment defect detectors and other equipment; develop plan to protect (MWI 1121)

l. Locations at which the anchor pattern or spiking pattern is to be changed during timbering and amount of material needed.

m. Locations where special tie plates or positive restraint fasteners exist and if these plates and fasteners will be re-worked during timbering.

n. Identify screw spike and lock spike (hairpins) locations.

o. Check for tie plate damage or wear and rail anchor condition to assist in ordering tie plates and anchors.

p. Bridge types and lengths.

1. Inspect timber condition.

2. Removing and replacing ballast curbs.

3. Fall protection requirements and methods to be used.

q. Tunnel locations and lengths and the ventilation and lighting plan if required

r. Locations at which special track material is required, and other items that may affect timbering.

s. Team lodging

3. Roadmaster will be responsible for coordinating activities prior to the arrival of the team. This includes but is not limited to:

a. Ensuring that material is ordered and monitoring its delivery.

b. Unloading ties, switch ties, and other track material.

c. Coordinating with the Manager Material to ensure that materials arrive on time.

d. Distributing track material as stated in this instruction when it is received.

e. Discussing the proposed work and curfews with Transportation Managers to obtain the maximum possible track time, including participating in the curfew conference call.

f. Coordinating the closure of road crossings with state and local authorities.

g. Saw cutting bituminous concrete at road crossings if crossing is to be worked.

h. Preparing and furnishing to the team, upon its arrival, a local Emergency Response Plan (See page appendix A) including telephone numbers and highway directions to the nearest hospital or medical facility, police, and fire departments, and rescue service.

i. Doing any track work specified on the inspection notes.

j. Monitoring the progress of work listed on the inspection notes.

4. The Chief Engineer or Bridge Designate will be responsible for:

a. Altering ballast retention curbs to permit tie replacement and subsequent ballast retention.

b. Assist in any special needs for fall projection equipment or bridge specific systems on bridges requiring the use of fall protection.

c. Arranging for tunnel ventilation and/or lighting as needed.

C. MATERIAL DISTRIBUTION BY ROADMASTER PRIOR TO ARRIVAL OF TEAM

1. System Production Teams employ bulk delivery for much of the material required for the project to eliminate multiple handling of material items and to help eliminate waste of material. Ensure that adequate quantities of bulk material are available for the project.

2. The Roadmaster will be responsible for unloading ties in the proper quantities and locations.

3. Material unloading locations should be selected to prevent items from falling into ditches or rolling down steep banks. Keep walkways and drainage facilities clear.

4. At specific locations within the project area.

a. At designated tie up locations ensure team fuel and supply cars are spotted so that the material handling truck other mechanized system may access supplies, such as spikes, screw spikes, anchors, fuel, and plugging material, to be replenished on each machine daily.

b. At turnout locations: Appropriate length timbers. Quantities depend on the work planned.

c. At bridges and wood-to-concrete tie transition zones: Appropriate 10’ ties for transition zones. See plans 2607 and 2616.

d. At road crossings: Crossing material and hardware will be provided. Stockpile approved ballast that is sufficient to fill the track per the crossing design. If the plan calls for installation by another force, the material should be distributed at this time to take advantage of the curfew and the work train.

D. MATERIAL RELEASED

1. Old ties and track material released from the project will be stacked to facilitate removal. Walkways and ditches must be kept clear, and stacks must not impede sight distance at road crossings. Material shall not be placed beneath overhead wire lines.

2. Roadmaster, Manager Program Construction, Supervisor Program Construction, or Engineer Track will ensure proper removal of ties and designate storage locations.

3. Asphalt and other crossing materials removed from crossings must be disposed of properly.

E. TIE INSTALLATION

1. The ties to be replaced will be clearly marked with paint by the paint gage buggy operating at the front of the team. The operator will use the tie markings to make larger marks for the spike pullers and tie removers.

2. Ties should be placed in track with the heart wood face down so the tie sheds water. Tie should be square to the line of the rail. One end of the tie should be stamped, when this stamping is right side up the heart will be down. An alternate method of identifying the top of tie is by positioning the precut 1/ 8 inch deep saw cut, “kerf mark” (found 6 inches from the end of the tie) facing up.

3. Track ties will be installed square to the rails. The end of the tie on the line side will be 18” to 18-1/2” from base of rail.

4. At field welds, new ties will be spaced so that the weld does not fall on a tie or employ rubber tie plate under welds when crossties cannot be relocated.

5. Tie plates will be installed on all new and existing ties. Broken, damaged, or excessively worn plates must be replaced on ties being replaced.

6. Tie plates will be positioned so the field side shoulder bears evenly against the base of the rail and centered on the top of the tie. TIE PLATE SHOULDERS AND SPIKES WILL NOT BE LEFT UNDER THE RAIL.

7. At insulated joint locations: If a supported insulated joint tie is replaced, a new rubber tie plate will be used.

8. Ties will be spiked to existing track gage unless gage is:

    a. Greater than 57 inches on Class 1 through 4 track

    b. Greater than 56 3/4 inches on Class 5 and 6 track

    Proper gaging involves pulling spikes on old ties, plugging the holes, and spiking ties. Out of face gaging will be brought to 56 ½ inches. Spot gauging will be brought to a uniform gage compliant with the limits noted above.

    NOTE: Care must be taken with spike drivers equipped with automatic gaging devices to avoid inconsistent gage which may lead to premature gage widening and alignment problems.

9. The standard track spiking patterns are detailed in the current revision of Standard Drawings 2512, 2513, and 2514. Ties are spiked to standard spiking pattern at the time of installation.

10. If positive restraint fasteners are present, the proper tie fastener must be used (screw spike, Lewis Evergrip screw spike, or cut spike). If Pandrol plates with 6 square holes are used, insert 4 cut spikes. Refer to MWI 701 for additional instructions.

11. The standard rail anchor patterns are detailed in the current revision of MWI 703, Rail Anchoring Policy. Care must be taken to ensure that all rail is anchored to standard. Anchors in excess of present standard, except within road crossings, need not be removed. Site specific areas, approved by the Chief Engineer, where anchors in excess of standard are required to restrain rail movement are to be maintained.

12. Communication and Signal Equipment - Care must be taken during timbering operations to avoid damage to wayside C & S equipment. Refer to MWI 1121, Performing Track Work Near Equipment Defect Detectors for additional instructions.

13. The application of temporary slow orders will be governed by MWI 1109:

    a. The track is to remain restricted to a maximum of 25 MPH until surfaced.

    b. System Production Teams will completely surface all ties installed by the end of the work week. Refer to MWI 1103 for additional instructions.

    c. The Roadmaster or designated representative is responsible for changing or removing the restriction after personal inspection of the track.

14. The Roadmaster or designated representative will complete the Track Disturbance Management System on the Owner Records System on a daily basis.

15. Road Crossings:

    a. Materials unloaded for use in reworking road crossings and materials removed from road crossings should be placed in a vacant quadrant of the crossing, where possible. These materials should be placed in a manner that will not interfere with the clear line of sight for a highway user or rail equipment operator and will not interfere with the functioning of the road crossing signal equipment. Care must be taken to maintain visibility, walking conditions and not impede drainage.

    b. Refer to MWI 901 governing the installation of road crossings.

    c. Crossings that are worked should be raised so that at least one future surfacing cycle can be raised into the crossing without placing it in a hole. The runoff must not begin within 50 feet of the pavement.

    d. d) Where crossings are removed and are not put back, standard roadbed section will be provided. Road approaches will be cut down and ditches re-established. (See drawing 2523 and 2601)

16. Prior to releasing track to run trains:

    a. The Roadmaster or his designated Qualified Foreman shall inspect the entire limits of the work performed

    b. The Manager of the Team or his designated Qualified Foreman must inform the Employee-In-Charge that:

        1. All equipment and personnel are in the clear

2. All switches and derails are restored to the proper position

3. All temporary speed restrictions have been put in place at the proper locations

4. Any other conditions that would prohibit the safe passage of trains at timetable speed

5. The clearing location of equipment and method of securing the equipment in the clearing location.

F. QUALITY CONTROL

1. All Foreman and Assistant Foreman will ensure that all work is done in a quality manner within their area of responsibility.

2. The Roadmaster or Foreman will spot check individual ties installed during the day to verify the quality of the work. The Roadmaster or Foreman will inspect the track behind the team daily.

3. The Roadmaster and Foreman will jointly hi-rail behind the team every week or for short stretches, upon completion of the job, to verify the quality of the work and to confirm that the plan is being followed.

4. The Chief Engineer will make frequent trips to the team and observe the quality of the work. The job should be inspected by hi-rail with the Roadmaster before the team leaves the project location. If there is any question concerning any of the work underway or completed, they will immediately discuss with the Chief Engineer.

5. All work behind the team shall be in conformance with the provisions outlined in MWI 1113. In addition, the track shall be inspected in accordance with MWI 110. On a weekly basis, the Roadmaster or Foreman shall complete the Production Quality Control Review; the form shall be provided to the Chief Engineer for all projects.

3.2 REPORTS

A. The Roadmaster or Foreman will ensure that the Daily Production Reports are submitted. These reports must be completed at the end of each production day. Care must be exercised to ensure that all information is accurate.

B. The Roadmaster will prepare and forward the pre-trip packet as identified in Paragraph II A.6.

C. The Roadmaster or Foreman will ensure that the Production Quality Control Review form is submitted in accordance with MWI 110.

Prepared by:

Reviewed: _____

Approved: _____

Approved: _____

APPENDIX A

EMERGENCY RESPONSE PLAN

WORK LOCATION

Division: _____ Starting Date: _____

Subdivision: _____ Team Number: _____

Starting Milepost: _____ _____ Ending Milepost: _____

_____

EMERGENCY RESPONSE
DIRECTIONS FROM WORK LOCATION TO NEAREST MEDICAL FACILITY

_____

_____

_____

_____

_____

(Give highway exit numbers and other landmarks that will aid in finding the facility. Give mileage to the nearest tenth of a mile.)

EMERGENCY TELEPHONE NUMBERS

Rescue: (_____) _____ Name: _____

Police: (_____) _____ Name: _____

Fire: (_____) _____ Name: _____

Radio Channel for Dispatcher: _____

Chief Dispatcher: (_____) _____

Chief Engineer: (_____) _____

Roadmaster: (_____) _____

APPENDIX B

PROJECT AGREEMENT

Division _____ Date: _____

Subdivision: _____

Type Lot: _____

MP: _____ MP_____

Attached:

1. Record of Trip _____
2. Straight Line Drawing. _____
3. Curve Chart _____
4. Clearance Diagrams _____
5. Requisitions _____

We the undersigned have reviewed the above referenced lot and agree with the attached plan to accomplish the work.

Chief Engineer _____

Engineer Track _____

System Representative _____

Roadmaster _____

Bridge Representative _____

Signal Representative _____

Construction Representation _____

SECTION 341132 – RAILROAD SURFACING POLICY

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Surface and line all four crossing approaches to the restore the track geometry. A minimum of two (2) tamping passes required. Installed Ballast to be regulated and broomed once surfacing and lining complete.

B. Related Requirements:

1. Section 341126 - Railroad Track Ballast

1.3 GENERAL

A. The goal of this track surfacing policy is to ensure that the work meets or exceeds all Owner and FRA Standards, as well as Owner goals for safety and quality. Because surfacing work is done in a wide variety of conditions, these instructions will define the process by whichagreed upon results can be obtained. The success of this process will require a coordinatedeffort from a team consisting of representatives, including Transportation, Maintenance of Way, and Signal.

B. All surfacing operations must be performed in the proper sequence and in a uniform manner. Special attention must be placed on crossing, and restricted clearance location work. It must be kept as close as possible to the general surfacing.

C. The track being worked will be protected by an appropriate temporary speed restriction during any period that it is not safe for authorized speed. Refer to MWI 1109.

D. Current instructions governing jointed and welded rail track maintenance in hot weather will be followed carefully. The Roadmaster will arrange to adjust rail, which requires adjustment by cutting, ahead of surfacing operation. Muddy or fouled ballast locations should be cribbed or undercut in advance of surfacing operations where possible. The forces, as agreed upon in the planning meeting, will do this work. Ballast cleaning, if required, should be done in advance of the surfacing.

E. Switch timber or spot tie installations should be done in advance of the surfacing operation.The forces, as agreed upon in the planning meeting, will do these installations. G. Road crossings are most efficiently re-worked during the System Production Timbering Program. The surfacing program normally ties into the existing road crossings. Only thosecrossings, which have drainage or geometry defects, should be re-worked within the surfacing program.

F. System Production Teams will completely surface all ties installed at the end of each workweek.

PART 2 – PRODUCTS (not used)

PART 3 - EXECUTION

3.1 PROCEDURES

A. DISTRIBUTION OF BALLAST

2. When distributing ballast, care must be taken to control the flow of the material. TheRoadmaster will ensure that the proper amount of ballast is unloaded, consistent with the required raise and the Owner Standard Ballast Section (refer to standard drawing 2602).

3. Ballast will not be unloaded on highway crossings, or other areas where it will damage equipment or interfere with operations. Special care must be taken to ensure that switches can be properly thrown.

4. When cars are discovered containing excess fines, or other non-standard materials, theemployee in charge of unloading will inform the Roadmaster. The Roadmaster is responsible to see that the car number(s) are reported to the Dispatcher responsible forballast cars.

5. Ballast unloading will be kept current with all surfacing operations.

B. SURFACING OPERATING

3. The Roadmaster will determine the amount of track raise. The track raise will be basedon the available ballast and the following criteria:

   a. The minimum height necessary to maintain proper profile, superelevation, andstandard ballast section.

   b. Sufficient space under the tie to allow ballast to be inserted and compacted.

2. When more than one tamping machine is working in tandem, the foremen and operatorsmust have a clear understanding concerning which ties each tamper will tamp.

3. When more than one tamping machine is working in adjacent areas, operators must have a clear understanding concerning the reference rail and runoffs made between tampers.

4. If a tamper malfunctions during surfacing operations in a manner that adversely affectsthe quality of the raising, aligning or ballast compaction, the following actions are required:

   a. A temporary runoff of superelevation or track raise, appropriate to the temporary speed restriction, will be made.

   b. The track will be protected by a temporary speed restriction, not exceeding 25 MPH. Use Reason Code 140 - Surfacing Team.

   Before this temporary speed restriction is removed, the entire limits of the affected area (including the entire curve) must be checked, and reworked if necessary, with a fully functioning tamper to ensure that the quality of the line and surface is consistent with Owner Standards.

   Some examples of applicable malfunctions are ineffective tamping tools, lifting, lining, or slewing component problems, as well as measurement and data system componentsproblems, etc.

5. The foreman and operators will make inspections, on at least a daily basis or when therail height changes, to ensure that tamping tools are maintained and adjusted as follows:

   a. All tamping tools must be in place and functional.

   b. Tamping tools should be adjusted so that the top of the tool pad is ½” below thebottom of the crosstie at full insertion.

c. Tamping tools should be replaced when the tamping tool pad wears to a dimension of less than 1-3/4" high x 4” wide as measured on the smallest side.

d. When changing tamping tools, the tamping tool pad must not be struck with a hammer due to the danger of metal chipping from the hardened surface of the pad. The tamping tool will be removed by the method recommended by the machine manufacturer.

e. Special attention must be used when tamping concrete ties to ensure correct depth penetration is obtained. Failure to have correct depth penetration will result in damage to the ties if the tamping tool pads press against the side of theties during the squeeze cycle. Also, care must be used to avoid unintended tie movement and damage to the concrete tie pads.

6. Surfacing operations on or near bridges, at tunnels, at overhead bridges or at other areasof restrictive clearance will conform to the following:

a. Ballast section at the ends of bridges will be kept clean and well drained with ties fully supported at proper elevation to conform to that of the bridge.

b. Tracks at ends of the bridges, trestles and through tunnels must be kept in goodline and surface at all times.

c. The surface of track shall conform to the existing approach profile of open deckbridges and tunnels.

d. Standard ballast section must be maintained on ballast deck bridges. Therefore,the track shall not exceed an elevation that allows the top of ties to be more than:

1) Four (4) inches above the ballast curb on concrete bridges; or

2) Nine (9) inches above the timber ballast curb on timber bridges.

CAUTION: Ensure that materials do not fall onto roadways or into waterways.

e. There shall be no changes that reduce the clearance of tracks through tunnels without the prior approval of the Chief Engineer.

f. Tracks under overhead structures must not be raised to a height that reduces theminimum route clearance, without the prior approval of the Chief Engineer. Ingeneral, the clearance under each structure should be reviewed to ensure that future route clearance improvement projects would not be adversely impacted.

g. Track centers will not be reduced below the minimum route clearance during lining. Maintenance personnel will check restrictive locations in advance of thesurfacing team. The track alignment on ballast deck bridges must not be changed without prior approval from the Chief Engineer.

7. Ballast will be pulled into shy areas as quickly as possible behind the tamping machineand before the end of the workday. Pulling fouled ballast into the ballast section is notpermitted.

8. The foreman will make periodic inspections during ballast regulation operations to ensure that care is being taken:

a. Do not damage adjacent property, especially at highway underpasses.

b. Do not pull fouled ballast or other undesirable material into road crossings. Theregulator should work away from the crossings whenever possible.

c. Do not damage rail fastening systems.

9. Special care must be taken to ensure that rail anchors within the work area are properlyseated against the ties. In elastic fastener areas, ensure that missing fasteners are replaced. When the entire curve is worked, the completed project will comply with MWI 1113.

10. When a track stabilizer is used, a sufficient ballast section must be established beforethe stabilizer passes.

C. MAINTAINING CURVE GEOMETRY

1. Both vertical and horizontal curve geometry and superelevation will conform to OwnerStandards. Refer to MWI 1104.

2. The Roadmaster will ensure that the Surfacing/Smoothing Team has an accurate copyof the Master Track Attributes—Curve from the Owner Records System, that conforms to current Owner Standards, before the work begins. He or a qualified designated employee will determine if advance curve measurement is required for the surfacing/smoothing work and furnish the information to the Surfacing/Smoothing Team.

3. The Roadmaster or designated representative working with the surfacing unit, will mark the control points (TS, SC, CS, and ST) on all curves worked within out-of-face,smoothing, and spot surfacing projects with blue paint.

4. If the surfacing/smoothing work will be done utilizing a tamper equipped with a Computer Aided Geometry System (CAGS) or equal, the tamper can be used to measure the curves. The TS, SC, CS, and ST points will be located while tamping andmarked by painting the inside and outside web of the rail blue. All curve data generatedby the CAGS must be furnished to the Roadmaster before the surfacing team leaves theRoadmaster's territory.

5. If the surfacing/smoothing work will be done utilizing a tamper that is not equipped with CAGS or capable lining system, the starting and ending points of each curve canbe located using a 62-foot chord. Data furnished from a Geometry Vehicle, which hasa system that furnishes the information, should be used to determine the accuracy of existing records and if any advance work will be necessary prior to commencing the surfacing and lining operation. The TS, SC, CS, and ST points will be located and marked by painting the inside and outside web of the rail blue.

6. The following procedure will be followed to ensure that track stability is maintainedon main and branch lines where:

- the track is laid with continuous welded rail,
- on curves one degree (1º) or greater where the maximum authorized speed is 25 miles per hour or greater or on all curves greater than three degrees (3°),
- and an expected rail temperature of 50° Fahrenheit or below within 24 hours of the work.

Work during these conditions can create situations that lead to “adding” rail to the track, thereby affecting the track’s neutral temperature. The following procedures will assist in evaluating the track.

a. When the track is to be disturbed, the Roadmaster must ensure references are set at five or more locations before the work is performed. The references will be located at:

- tangent to spiral (TS)
- spiral to curve (SC)
- mid-point of the curve
- within the body of the curve, as necessary,
- curve to spiral (CS)
- spiral to tangent (ST)

The reference may be a fixed object or a 2” x 2” x 12” wood stake. They should be spaced no more than listed below if practicable:

- 100 feet apart on curves 9º and above,
- 200 feet apart on 4º to 9º curves,
- 400 feet apart on 2º to 4º curves,
- 800 feet apart on 1º to 2º curves,

and must be clear of maintenance activities. Do not place stakes at the endsof ties or in walking areas.

Measurements should be taken from the field side head of the near rail to the face of the fixed object or the top near face of the stake. The tape usedto make the measurement should not slope more than 1 vertical to 4 horizontal. A record of the reference stake location information will be furnished to the Roadmaster before the Surfacing or Smoothing Team leaves the territory. Use the Curve Alignment Reference Form that is included with this MWI to document this information.

b. During the work the rail temperature will be measured three times during the workday. The high and low temperatures will be recorded on the Track Disturbance Record and the report will be furnished to the Roadmaster. The measurements will be taken at the beginning, middle, and the end of the workday on the shady side of the rail web with an approved thermometer. Theappropriate temperatures will be recorded on the Curve Alignment Reference Form and the Track Disturbance Rail Addition Record and the reports will be furnished to the Roadmaster. The Track Disturbance Rail Addition Record is to be faxed to the number on the form.

c. The Roadmaster or his designated representative will record the amount of movement periodically for up to 15 days after the work has been completed. If the curve moves inward more than an average of 1”, a Track Disturbance Rail Addition record must be completed. The Roadmaster is responsible for remedial action prior to hot weather. Corrective action will be one or more of the following:

- Place the curve on its original alignment.
- Adjust the rail.

- Place a temporary speed restriction not to exceed 25 MPH until one of the above is accomplished.

Stakes, that could become a tripping hazard, should be removed as soon aspossible.

7. Freshly surfaced track will require a temporary speed restriction. See MWI 1109 forproper application of the temporary speed restriction.

D. FINISHED TRACK GEOMETRY

1. The minimum quality information shown below applies to out-of-face and smoothing teams. Teams with mechanical equipment must comply with MWI 1113, Surfacing Section.
2. The deviation from zero (0) cross level on tangent and designated elevation on curve will not be more than:

Track Class	1	½”
Track Class	2	½”
Track Classes	3 & 4	3/8"
Track Class	5	1/8"
Track Class	6	1/8"

3. The deviation from uniform profile (sags or humps) in 62 feet will not be more than:

Track Class	1	1”
Track Class	2	¾”
Track Classes	3 & 4	½”
Track Class	5	3/8”
Track Class	6	¼”

4. The deviation from proper alignment on spirals and curves at the midpoint of a 62 footchord will not be more than:

Track Classes	1 & 2	1"
Track Classes	3 & 4	3/8"
Track Class	5	1/8"
Track Class	6	1/8"

5. Line swings at the end of spirals will not be permitted. Line swings on tangents whichdeviate from true line at the rate of more than one inch per hundred feet will not be permitted.
6. Rates of runoffs will be equal to or less than one (1) inch in 100 feet at the end of finished work.
7. Runoffs on the diverging portion of turnouts must be located off the long ties and mustcomply with paragraphs D 2, 3, and 4 above.

E. FINISHED BALLAST SECTION

1. The cross section of dressed ballast after compaction and expected settlement will havefull cribs and shoulders that conform to the Standard Ballast Section. Refer to OwnerStandard Drawing 2602.
2. Excess ballast on the shoulder or in the track will not be permitted at highway and railroad crossing approaches, or defect detectors.
3. Excess ballast will be removed from bridge walkways, abutments and curbs, station platforms, and turnouts.

F. OTHER

1. Communication & Signal Equipment - Care must be taken during surfacing operationsto avoid damage to wayside Communication & Signal equipment. When surfacing inand near defect detectors, refer to MWI 1121 for detailed procedures.
2. When surfacing switches, use care around snow melters. Do not damage equipment.
3. Road Crossings - Materials unloaded for use in reworking road crossings and materialsremoved from road crossings should be placed in a vacant quadrant of the crossing, where possible. These materials should be placed in a manner that will not interfere with the clear line of sight for a highway user or rail equipment operator and will not interfere with the functioning of the road crossing control signal equipment. Care mustbe taken to maintain visibility, walking conditions and not impede drainage. Disposal of asphalt and other materials removed from the crossing will use a method consistentwith Owner environmental policy. See MWI 901 for detailed road crossing information.

G. REPORTS

1. The Roadmaster will ensure that:
   a. Daily Production Reports are completed and submitted at the end of each production day,
   b. Track Disturbance Record is completed daily,
   c. All curve data generated by the CAGS is furnished to the Roadmaster before the surfacing team leaves the Roadmaster's territory, and
   d. A record of the reference stake location information will be furnished to the Roadmaster before the Surfacing/Smoothing Team leaves his territory. Use the CurveAlignment Reference Form that is included with this MWI to document this information. An Excel version of this form is also available in the Owner InformationSystem.

H. The Roadmaster will ensure that the Master Track Attributes—Curve, information in the Owner Record System is updated within 30 days after completion of the work.

Prepared by:

Reviewed: _____

Approved: _____

Approved: _____

CURVE ALIGNMENT REFERENCE FORM

Division _____ Subdivision _____ Track _____ Deg Curve _____

Milepost: Prefix _____ Begin _____ End _____

Work Direction: (low to high MP) (high to low MP)

Type of Fasteners: (rail anchors) (Pandrol plates) (other _____)

Team No. _____ Team Type _____

	DATE				
	RAIL TEMPERATURE				
	RECORDER				
NO	DESCRIPTION	MEASUREMENT 1 Before Work	MEASUREMENT 2 After Work	MEASUREMENT 3 Follow Up	MEASUREMENT 4 Follow Up

NOTES:

References should be marked fixed objects or wood stakes if practicable.
Number reference points in sequence in the direction of work.
In "Description", note TS, SC, CS, ST, and identify reference.
Measure from the field side of the near rail to the face of fixed object or stake.
References should be spaced no more than:

- 100 feet on curves 9 degrees and above
- 200 feet on 9 degree to 4 degree curves
- 400 feet on 4 degree to 2 degree curves
- 800 feet on 2 degree to 1 degree curves

Reference stakes must be clear of maintenance activities, walking areas, and tie ends.

SECTION 344200 – GENERAL SIGNAL REQUIREMENTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section describes the concepts and basic technical signal requirements for work to be performed by the Contractor. Scope of work for the Automatic Highway Crossing Warning (AHCW) System includes the technical requirements specific to each signal subsystem and shall be found in each of the corresponding subsystem sections as listed herein.

PART 2 – PRODUCTS

2.1 MATERIALS FURNISHED & INSTALLED BY CONTRACTOR

A. Automatic Highway Crossing Warning (AHCW) System - The Contractor shall furnish all material described within these Specifications and shown on the Contract Drawings which shall include but not be limited to mast mounted flashing light units, gate layouts, foundations, gates, electronic bells, instrument housing, train detection system, crossing controllers, battery chargers, battery banks, power-off indicator lights and underground cables and conduits. Contractor shall design purchase and install all AHCW material in accordance with the provisions of the Contract Drawings, Specifications, AREMA Recommended Practices and FRA Rules, Standards, and Instructions.

B. Galvanized Rigid Steel (GRS) Conduit and Schedule 80 PVC Conduit - The Contractor shall furnish and install one 4” GRS conduit under the track on both ends of the grade crossing surface and two 4” Schedule 80 PVC signal conduit under the roadway on one side of the grade crossing surface at each crossing location.

2.2 REMOVAL AND DISPOSAL OF MISCELLANEOUS MATERIAL

A. Miscellaneous Materials -The Contractor shall remove and dispose of all materials including all protective materials from the signal equipment delivery and dispose of that material off-site. In addition, dispose of all other materials that may be exposed as result of their work under this Contract including any hazardous materials. Disposal of all materials shall be done at no additional cost to JAXPORT.

PART 3 – EXECUTION

3.1 PROTECTION OF FACILITIES

A. The Contractor shall protect in place and avoid damage to all permanent infrastructure during the execution of the work.

B. The Contractor shall protect the existing track structure from damage and shall protect the existing ballast from contamination.

C. Any equipment damaged by Contractor shall be replaced in-kind with new, without time extension or additional cost to JAXPORT.

D. Any excavation shall be returned to final grade.

3.2 JAXPORT COORDINATION

A. JAXPORT is the independent government agency in Jacksonville, Florida, that owns and operates much of the seaport system at the Port of Jacksonville. They control the docks and wharfs, cranes, a passenger cruise terminal, warehouses, paved open storage areas, and road connections to the public highway system and is the independent government agency in Jacksonville, Florida, that owns and operates much of the seaport system at the Port of Jacksonville. Over 30% of the terminal's shipments utilize on-dock rail service provided by CSX Corporation directly. The grade crossing is on Blount Island Marine Terminal, which is JAXPORT's largest container facility, handling 80% of all container cargo at the port. The Contractors work windows will be restricted during times when offloading of container ships are scheduled. During these busy times for JAXPORT they will work with the Contractor to ensure there are sufficient work windows available, however Port operations will take precedence over Contract installation work.

B. Daily meetings will be required between the on-site representatives of Contractor and the JAXPORT Representative EIC in Charge (EIC) to ensure coordination of work activities and JAXPORT offloading and CSX freight rail service. During working hours, the track shall remain passable for scheduled freight train moves. All personnel, equipment and material shall be cleared and secured from the track, and all switches shall be normalized and properly lined up as directed by The EIC in charge. At the end of each shift: any in service track must meet FRA Class 2 criteria (Class 5 upon completion of a turnout); all personnel, equipment and materials shall be cleared and secured from the track, and all switches shall be normalized, in working order and secured as directed by the EIC.

C. The protection of trains, overall safe operations, and the protection of workmen and JAXPORT personnel are paramount objectives in executing the Work. All personnel entering the JAXPORT Right-of-Way must have Roadway Worker Protection (RWP) training in accordance with the Roadway Worker Protection Manual and On-Track Safety Program.

3.3 WORK HOURS AND NOISE CONTROL

A. Municipalities through which JAXPORT operates have varying ordinances which control various activities such as work hours. While JAXPORT believes that the ICC Termination Act exempts JAXPORT activities from local regulation, JAXPORT has adopted a “Good Neighbor Policy” and one element of that policy limits, to the extent consistent with efficiency and safety, early morning, and late night operations. Accordingly, unless otherwise controlled or allowed by local ordinances, work shall not start before 6:30AM and shall end before 7:00PM daily. Work on weekends and Holidays is encouraged due to no train operations on those days.

B. Noise control is a part of JAXPORT’s “Good Neighbor Policy” and includes many of the activities discussed above. Noise from trackwork operations shall be controlled to the extent possible, including the sounding of horns and warning devices on railway maintenance and construction machinery. Nothing set forth in this Section shall relieve Contractors from full compliance with FRA and Commonwealth regulations regarding sounding of horns, whistles and/or bells at crossings and approaching and passing through work zones.

3.4 JAXPORT PROVIDED SUPPORT SERVICES

A. Coordination of on-track safety protection for the Contractor and/or Subcontractor's personnel and equipment. Contractors will be provided the following required Support Services by JAXPORT personnel:

1. Railway Worker Protection ("RWP") training will be provided by to each Contractor and/or Subcontractor employee on the Project site. RWP Training is mandatory and must be successfully completed prior to accessing the ROW. Contractor will be charged a nominal fee by JAXPORT for each worker trained in RWP. Contractor shall be responsible for all other costs incurred by workers related to the RWP training.

2. Daily onsite worker safety inspections by ;

3. One full time Employee in Charge (EIC) and additional personnel as required supplied by JAXPORT for the duration of Contractor and/or Subcontractor's presence on site. The EIC will provide the following services to Contractor and/or Subcontractor:

   a. Daily Job Briefings at the beginning of each work-day and anytime work conditions change.

   b. Coordination of on-track safety protection for Contractor and/or Subcontractor's personnel and equipment.

   c. Flagging of all train movements through Contractor and/or Subcontractor's work location.

   d. Flagging of all vehicles at highway crossings fouled by Contractor and/or Subcontractor's personnel and/or equipment; and

   e. Daily end of work track inspections required to place track worked on by Contractor and/or Subcontractor back in service.

3.5 PROJECT OVERSIGHT

A. At least one full-time JAXPORT representative will be present on-site for the duration of the project for the purpose of representing Owner's interests with regard to this project and will provide:

1. Oversight and Construction Inspection Services;

2. Act as a liaison between the Contractor and JAXPORT;

3. Daily end of day employee production reporting.

SECTION 344252 - COMMERCIAL METERED POWER SERVICES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes a description of work for designing, furnishing, and installing signal power distribution and supply systems.

B. Related Requirements:

1. 344200 General Signal Requirements
2. 344258 Signal System Testing
3. 344264 Automatic Highway Crossing Warning System
4. 344266 Signal Drawings and Record Plans

1.3 GENERAL

A. The Work to be done under this Section consists of furnishing and installing a new 60 Hz single-phase 120/240 VAC commercial metered power service at the locations specified within Scope of Work Section of these specifications.

B. The Contractor shall conduct site inspection for coordination with utility company and shall obtain all required permits.

C. This work shall conform to the standards and recommendations of the supplying power utility and the National Electrical Code to obtain the commercial metered power services.

1.4 QUALITY ASSURANCE

A. All material and equipment furnished and installed shall conform to all applicable state and local ordinances pertaining to electrical power installations and the latest edition of the National Electrical Code (NEC).

1.5 SUBMITTALS

A. The Contractor shall submit for approval all materials and methods of installation to be provided under this section.

1.6 GENERAL REQUIREMENTS

A. The Contractor, in coordination with the JAXPORT shall obtain all permits, licenses, and agreements with the supplying utility company and be responsible for all user installation costs that the utility requires.

B. The Contractor shall coordinate the connection and interface of new cables and equipment with the Operating RR utilities in accordance with their standards.

C. The Contractor shall install all power cables underground at a minimum depth of 48” unless otherwise agreed to by the EIC.

D. The Contractor in coordination with the Operating RR shall arrange for all required inspections by the local electrical inspector.

E. The Contractor in coordination with the Operating RR shall make the necessary arrangements with the supplying utility to provide the power requirements.

1.7 SCHEDULE

A. The power service shall be energized prior to the scheduled field-testing date.

PART 2 – PRODUCTS

2.1 MATERIALS

A. POWER SERVICE EQUIPMENT

1. The Contractor shall provide power meter enclosure, meter support facility, all required cable, and all miscellaneous material and conduits in accordance with these specifications. Meter will be provided by Utility Company.

2. Existing circuit breakers inside the instrument enclosure shall be sized and replaced by the Contractor with new, unless otherwise directed by the EIC.

B. SERVICE ENTRANCE CONDUCTORS

1. Service entrance conductors shall be installed in accordance with the supplying utility's requirements and the National Electrical Code (NEC).

PART 3 – EXECUTION

3.1 INSTALLATION

A. GENERAL

1. The installation of the various equipment and materials for the new commercial metered power services that are specified herein and in other Sections of these Specifications shall be installed in accordance with the supplying utility's requirements and the National Electrical Code (NEC).

2. The requirements included within this Section shall cover all incidental installation work necessary to affect an integrated, tested, and operable power supply system for the project.

B. POWER SERVICE ENCLOSURES AND LINE DROPS

1. Power service enclosures shall be installed on 30 foot (minimum) wood poles.

2. Cable connections of the service entrance conductors to the incoming utility feeders shall be made by the supplying utility.

C. GROUNDING

1. Power service grounding shall be installed in accordance with the latest edition of the National Electrical Code (NEC), and the supplying utility's requirements. If there is a conflict the supplying utility's requirement shall govern.

3.2 TESTING AND INSPECTION

A. Simulated load tests, in accordance with approved signal power system test procedure, shall be satisfactorily completed prior to final connection of signal facilities at each equipment location.

B. Prior to acceptance, the Contractor shall have new ac power service approved by electrical inspectors.

SECTION 344258 – SIGNAL SYSTEM TESTING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes all tests and inspections to be performed by the Contractor to demonstrate that systems, subsystems, assemblies, sub-assemblies, and components supplied under this Contract are in compliance with the Specifications.

B. In event of design errors or failure to meet Specification requirements, any corrections made, all tests or retests to prove compliance, and any necessary regression testing shall be included in the work, at no additional cost to the Owner.

C. Work shall include all necessary test-purpose disconnecting and reconnecting. The Tests included in this section are intended to be representative but not exhaustive. The Contractor shall include all manufacturers and Contract required testing.

D. Related Requirements:

1. 344200 General Signal Requirements
2. 344252 Commercial Metered Power Services
3. 344264 Automatic Highway Crossing Warning System
4. 344266 Signal Drawings and Record Plans

PART 2 – PRODUCTS (not used)

PART 3 – EXECUTION

3.1 TESTING

A. QUALITY ASSURANCE TESTING PROCEDURES

1. All test procedures and inspection procedures shall be subject to the approval of the EIC and shall comply with all FRA rules and regulations.

2. Test equipment of the proper type, capacity, range, and accuracy shall be supplied by the Contractor to perform the required tests and inspections. This equipment shall be in good working order and properly calibrated at the time the tests or inspections are conducted.

3. Each component and unit of the AHCW system shall have an inspection performed at its point of manufacture, and evidence of this inspection and acceptability shall be indicated on the item where practicable.

4. Within 3 days prior to placing in service, the Contractor shall adjust all rectifiers and dc power supplies for maximum output for a period of 24 hours. Following this operation, the Contractor shall adjust the output in excess of the load requirements in accordance with the battery manufacturer's recommendations.

5. The EIC shall witness any or all field tests conducted. The EIC shall be notified in writing at least 48 hours prior to each field test. No part of the AHCW system shall be placed in service without the EIC being present and witnessing the in-service tests, unless otherwise authorized by the EIC.

6. The work shall include all tests required to ensure the proper and safe operation of all systems and subsystems and to prove the adequacy and acceptability of the total installation specified herein. The tests to be performed shall cause each system and subsystem to be sequenced through its required operations, including the imposition of simulated conditions to prove that the installation complies with all specified fail-safe requirements.

7. In the event of the test failure or if the system does not meet the specification requirements, necessary corrections shall be made and any and all tests or restarts to prove compliance shall be included in the work, without any additional cost to the Contract.

B. FIELD TEST PROCEDURES

1. The field tests performed shall cause each installed system and subsystem to be sequenced through its required operations, including the imposition of simulated conditions, to demonstrate that the installation complies with all specified fail-safe design requirements and operational functions.

2. The quality of the installation shall be demonstrated by field tests for continuity, insulation resistance, resistance of ground connections, circuit breakdown, visual inspection, and any other tests required by this specification. These tests shall be performed prior to any operational testing of systems or subsystems.

3. The Contractor's test procedures shall consist of pre-printed data sheets or inspection sheets for each test. When completed by the field test personnel and checked for accuracy and completeness, the sheet shall be submitted as the test report.

4. When tests require specific meter or test instrument readings, the pre-printed data sheet shall show the allowable range of values for each part of the test. The test report shall also contain a check-off system for each action and a blank space adjacent to the expected value in which to record the test readings.

5. The test report shall also contain a final description sheet on which the Contractor shall record discrepancies found and action taken. This document shall be furnished to the EIC.

6. All test reports shall be dated and signed by the responsible employee of the Contractor or subcontractor on the day the test is performed. Space shall also be provided for the signature of the witnessing EIC or JAXPORT inspector.

7. The report shall show the specific test instruments used on each test, with the instruments identified by name, type, serial number, and calibration due date.

8. Should an error be discovered during field testing, due to field wiring and connections that do not agree with the approved circuit plans, the Contractor may correct such errors without prior approval

of the EIC. The Contractor shall not, however, make any changes which affect safety of operation of the approved circuit(s) as designed, without prior written approval of the EIC.

9. The EIC will make all final determinations as to whether only a part, or the whole test, shall be rerun when any specific field test does not meet the requirements specified for the test.

10. Any changes made after completion of test procedure shall be retested in accordance with the applicable test procedure.

C. FIELD TESTS AND INSPECTION

1. General Field Tests. General field tests shall include, but not be limited to, the following:

   a. Ground verification test.

   b. Power racks – energy distribution system and failure alarm checks.

   c. Wiring verification of all circuitry.

   d. Vital function tests.

   e. Operating tests

   f. All applicable tests prescribed by AREMA Signal Manual Part 2.4.1, where the AREMA inspections and tests do not conflict with the requirements of these specifications.

2. Specific Field Tests

   a. Ground Resistance Testing

      1) The Contractor shall perform testing of all signal locations using a ground resistance direct-reading single test meter utilizing alternating current fall-of-potential method and two reference electrodes.

      2) Test Procedure

         a) The ground electrode to be tested and the two reference electrodes shall be oriented in a straight line spaced a minimum of 50 feet apart.

         b) The two reference electrodes shall be driven 5 feet deep.

         c) The maximum resistance value goal of the main ground for wayside outdoor locations shall be within a range of 1 to 5 ohms. If it is found that the resistance value of the main ground exceeds this range, the Contractor shall install additional ground rods, a maximum of 4. Additional ground rods shall be spaced no less than 10 feet apart. If, after additional ground rods are installed, excessive resistance readings persist, the Contractor shall notify the EIC.

         d) The Contractor may propose an alternate method to the fall-of-potential method for approval by the EIC. Any such alternate method shall be supported by documentation that validates that the resultant measurement readings are analogous.

b. Insulation Resistance Tests

1) The test procedure for testing of insulation resistance shall include tests to verify the following:

a) All wire and cable installed for vital circuits along the right-of-way and wire and cable entering or leaving wayside instrument housings shall be tested after installation to ensure that insulation of wires and cable and connected equipment meet the specified resistance value. A direct reading instrument, having a 0-megohm to 200-megohm-scale range and a self-contained dc power supply rated 500 volts minimum to 1000 volts maximum, shall be used to measure the insulation resistance. Resistance between conductors and ground shall not be less than that specified in the Federal JAXPORT Administration Grade Crossing Signal System Safety and State Action Plans, Part 234.267.

b) The insulation resistance of each conductor to ground and between each conductor and all other conductors in each multi-conductor cable shall be tested. Power sources, made grounds, and connections to the rails shall be disconnected from the circuits during testing.

c) The point used as ground shall be the most convenient ground available.

d) Insulation resistance test values shall be recorded on approved Insulation Resistance Record Forms and turned over to the EIC upon their acceptance of this test requirement.

c. Energy Distribution

1) Energy-Off Tests

a) With all power to SIH or Instrument Case off, the following checks and tests shall be performed. These tests shall include but not be limited to:

1. Verify that circuit breaker size compares to that of the approved circuit plans.

2. All energy distributions shall be checked using a resistance test instrument acceptable to the EIC to verify agreement with the approved plans.

3. Compare wire gauges with those called for on the approved circuit drawings. All discrepancies in wire sizes shall be replaced with the proper size wire.

4. Terminal board tags shall be verified for proper nomenclature and terminal location.

5. Each energy bus shall be tested to all other energy buses to ensure that no crosses exist.

2) Energy-On Tests

a) Upon completion of the energy-off tests, the following checks and tests shall be performed. These tests shall include but not be limited to:

1. Insert circuit breakers for power supply feeds and verify proper size according to the approved circuit drawings.

2. Turn on energy feeds and test operation of power transfer for proper operation.

3. Each ac voltage input shall be measured and recorded.

4. Each power supply or charger output voltage shall be measured and recorded.

5. Verify that the proper voltage is present at all distribution points.

6. Check circuit power failure alarms, and all other alarms that indicate to Central Control.

7. Check battery water level and specific gravity of all cells.

3) Circuit Continuity Tests

a) All wire and cable installed by the Contractor shall be tested to verify the continuity of each conductor and that each conductor is connected to the proper terminal as shown on the approved drawings. Where parallel circuits exist, each parallel path shall be tested independently to verify the continuity of each path.

4) Circuit Wiring Verification

a) All vital and non-vital circuit wiring shall be checked for accuracy against the approved circuit plans. Tests may be done with energy on or off and shall verify, but not be limited to, the following:

1. Point to point wiring

2. A wiring count of all field installed wires shall be made for each terminal, relay contact, etc. to ensure that only the number of wires called for on the approved circuit plans is present at each terminal, relay contact, etc. Any discrepancies found shall be corrected.

3. Verify tags and nomenclature where applicable.

4. Verify that all components, relays, resistors, etc. are the same as called for on the approved circuit drawings and located in proper positions.

5) Breakdown of Control Circuits

a) Each circuit shall be tested by simulating all operating conditions to verify that the circuit operates in accordance with these specifications and approved plans.

6) Power Tests

a) The following power tests shall be made and recorded:

1. The voltage of the main power feeders shall be measured and recorded.

2. A check of all circuit breakers shall be made for correct size and type.

3. All power supplies, battery chargers, and batteries shall be checked for correct setting and quantities.

4. Bus-to-bus checks shall be made to determine that no shorts, crosses, or grounds exist.

7) AHCW Operational System Tests

a) A test train shall be used to verify that any AHCW motion sensor and/or CWCS equipment installed under this Contract has the specified warning time at each highway grade crossing.

b) Tests of the AHCW systems shall be performed in both directions at various speeds to the satisfaction of the EIC.

c) As an alternate to test train operation, the Contractor may propose a field train simulation test procedure for the approval of the Agency and the maintaining JAXPORT. Any such alternate procedure proposed shall be accompanied with verification documentation of such field tests performed by the Contractor for similar AHCW installation projects.

SECTION 344264 – AUTOMATIC HIGHWAY CROSSING WARNING SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes specifications for designing, furnishing, and installing Highway-Rail Grade Crossing Warning systems as specified herein and shown on the Contract Drawings.

B. The Contractor shall provide and install crossing gates and mechanisms, flashing lights, bells, signs, and all of the associated control equipment at all of the crossings.

C. The Contractor shall visit each crossing with state and local regulatory bodies to review the layout of each crossing.

D. Related Requirements:

1. 344200 General Signal Requirements
2. 344252 Commercial Metered Power Services
3. 344258 Signal System Testing
4. 344266 Signal Drawings and Record Plans.

1.3 GENERAL

A. This Section specifies the work to be performed by the Contractor which consists of designing, furnishing, installing, testing, and placing in service the upgrade to Automatic Highway-Rail Grade Crossing Warning (AHCW) systems at the locations listed within the Scope of Work Section of these specifications.

B. The Contractor shall provide all labor, material, equipment, and hardware required for safe and reliable operating AHCW System as described herein and shown on the Contract Drawings. The existing grade crossing warning control system at Dave Rawls Blvd that currently activates the warning devices at each of these crossings shall remain in place, except where control equipment is specified for upgrade.

C. The Contract Drawings provided are representative only of the general principles and concepts upon which the Contractor shall base their design. The Contractor is responsible for the specific layout and location of AHCW equipment proposed for installation.

D. The Contractor shall provide protection-in-place of all existing and new equipment during construction. The Contractor shall replace all equipment and facilities damaged during construction with new in-kind equipment and facilities at no cost to the Contract.

1.4 QUALITY ASSURANCE

A. The design and workmanship of the apparatus shall comply in every respect with the "Rules, Standards and Instructions for the Installation, Inspection, Maintenance and Repair of AHCW Systems," as set forth by the latest edition of Federal Administration (FRA) Highway Grade Crossing Rules and Regulations Governing Testing Maintenance and Inspection, latest edition.

B. The Contract Drawings illustrate the final conditions at these crossings. These plans are intended to illustrate the layout criteria necessary to implement the basic requirements of the Contract. It shall be the Contractor's responsibility to finalize the system design, receive approval of the EIC and provide as-built and record drawings after acceptance of work by the JAXPORT and by the state or federal regulatory authorities having jurisdiction for review and approval.

C. The AHCW system and all its elements shall be of the most modern type, including the latest equipment versions and designs, which shall provide the highest degree of safety and reliability for train service. The AHCW system shall be so designed as to meet all the applicable Signal Manual Parts of the American Railway Engineering and Maintenance Association (AREMA), except that where the word "may" appear in the Manual, as part of a directive, the word "Shall" is to be substituted.

D. Unless otherwise specified herein, all items furnished and installed under this Contract shall be in accordance with applicable sections of AREMA, Institute of Electrical and Electronic EICs IEEE, NEMA, FRA Part 234 and 236, Manual on Uniform Traffic Control Devices (MUTCD) Part VIII, and of JAXPORTs standards, practices, and recommendations. In cases of conflict the priority shall be:

1. Federal, State, and local laws and regulations
2. Manual on Uniform Traffic Control Devices (MUTCD)
3. State and Local Permits
4. Contract Drawings
5. Contract Specifications
6. JAXPORT Standards
7. AREMA Communications & Signals Recommended Practices
8. Institute of Electrical and Electronic EICs (IEEE) Standards
9. NEMA Standards

E. All apparatus, and all other miscellaneous components that form a complete system, shall be furnished completely factory wired and tested.

F. The Contractor shall complete the testing and inspection of the equipment prior to shipment in accordance with the approved Factory Test and Inspection Procedure.

G. All components and products provided under this Contract shall be new and free of manufacturing defects and shall be clearly and permanently labeled with value and type.

H. All electrical components shall be rated to operate at power, voltage, current, and temperature levels exceeding by 20 percent those which the components will be subject to in service, unless otherwise specified herein.

1.5 SUBMITTALS

A. Submittals will be reviewed for general conformance with the intent of the Contract Documents only. This review will not relieve Contractor of final responsibility for the means, methods, procedures, and sequences to be utilized. All submittals shall comply with the Submittals section of these specifications.

B. The Contractor shall submit the following for approval:

1. Catalog cuts, shop drawings, fabrication drawings and descriptive literature for all equipment and material proposed to be furnished under this Contract shall be shown in accordance with a detailed bill of materials on a per location basis.

2. Every submittal must clearly identify the intended use and proposed application of submitted material for submittal to be reviewed. Submittals that do not comply with this requirement will not be reviewed and will be rejected regardless of the contents.

3. The assembly drawing of each AHCW layouts.

4. Detailed installation drawings for each layout indicating the specific location, equipment dimensions and distances to roadway and JAXPORT elements.

5. The sizes and types of all cables and internal wire that the Contractor proposes to furnish and install.

6. Drawings showing the existing as-in-service (AIS) circuits and wiring diagrams shall be field verified prior to beginning of construction to ensure accuracy. Any inconsistency between existing drawings and actual installation shall be addressed with the JAXPORT representative on site, marked on the field copy retained inside the housing and on the copy of project AIS drawings.

7. The Contractor shall submit drawings showing proposed modifications to the existing crossing layout and circuits, including proposed modifications to the existing equipment arrangement within instrument housing if required to install approved equipment.

8. All work shall be performed in accordance with approved circuits, detail plans and installation drawings. After completion of installation, testing and placing in the Contractor shall provide one set of revised marked-up plans and test forms to remain inside the instrument housing and shall submit another set for approval.

1.6 DELIVERY, STORAGE AND HANDLING

A. All equipment shipped shall be properly fastened and braced to prevent damage during transit. Any equipment damaged during transit shall be replaced at no additional cost to the Contract.

B. Batteries shall be shipped filled to the correct level and in a fully charged state. Each battery shall be equipped with transit plugs, or rubber stoppers, to prevent spillage of the electrolyte. Batteries shall be shipped separately from the housing.

C. All cable shall be shipped on reels, adequately protected from damage in shipment by heavy wrapping or wood lagging to avoid the reels moving obliquely against each other. The manufacturer shall also be responsible for any change in the shape of the cable occurring in normal transit which results in an increase in the maximum diameter beyond that specified. The external protective wrapping on reels shall be secured by at least two steel bands to ensure damage free shipment.

D. Each length of cable shall be wound on a separate reel. Reels shall be able to withstand handling and shall be so designed that the inner end of the cable is secured and accessible but protected from injury. If the inner end of the cable projects through the flange of the reel, the inner end shall be protected by a suitable cover of metal having rounded ends and sides and securely fastened in place to protect the cable end. Both ends of cable on reel will be secured in place, to prevent their becoming loose in transit or handling of reel. The diameter of the reel drum shall be at least (14) times the cable diameter to prevent damage to the cable during reeling. The arbor hole shall admit a spindle 2-1/2 (two and a half) inches in diameter without binding. The reels shall be designated and constructed as nonreturnable when drum size and cable weight and volume permit. The maximum width of reel shall not exceed 48 inches unless otherwise specified.

E. After passing factory tests, cable shall be effectively sealed against the entrance of moisture. Both ends of each length of cable shall be protected by wrappings of rubber tape and plastic tape, an effective boot taped or sealed into place, or other suitable means approved by the EIC. The use of friction tape, other than an external mechanical protection over an adequate rubber and/or plastic tape, will not be accepted. The cable end protection will be adequate to protect the cable in shipment and prolonged external storage in the weather if not immediately employed without regard to the position of the reel while so stored.

F. Cable shall be closely and tightly wound, in a uniform manner, in each layer on reels. An arrow shall be painted on one head of each reel pointing the opposite direction from the outer end of the cable with the words "Roll This Way" employing letters not less than 3/4 inch height and an arrow not less than six inches in length and 1/2 inch in width.

G. LED units shall be packaged separately from flashing light units in which they are to be used.

PART 2 - PRODUCTS

2.1 GENERAL

A. All equipment specified herein shall be manufactured and supplied by one manufacturer as a complete system package unless otherwise approved, to ensure proper integration of components into a complete highway crossing signal layout. Manufacturers shall be Alstom, Siemens, Western Cullen Hayes, Hitachi Rail (Ansaldo STS) or approved equal.

B. Highway crossing warning equipment shall meet the requirements established by AREMA Signal Manual, Automatic Highway-Rail Grade Crossing Warning Systems, Part 3.3.1, and Recommended Functional/Operating Guidelines for Control of Automatic Highway–Rail Grade Crossing Warning Systems, Part 3.1.15, except where such instructions and requisites conflict with this specification.

C. FLASHING LIGHTS SIGNAL LAYOUT

1. The flashing light signal layout shall be equipped with a standard reflective Railroad Crossing Sign (crossbuck), flashing light units, and, where required, electronic bell and number of tracks sign as specified herein and shown on the Contract Drawings.

2. The flashing light signal shall be 12-inch LED uniform look type in accordance with these specifications and also conform to AREMA Signal Manual, Parts 3.2.5, 3.2.35 and 3.2.50.

3. Flashing light signal assemblies shall be double direction back-to-back or single direction as shown on the Contract Drawings and shall be provided complete with new cross arms, junction boxes, elbows, brackets including all required mounting hardware.

4. Each lamp housing shall be constructed of a rigid material which is not affected by atmospheric conditions or by changes in temperature as defined by Class B in AREMA manual part 11.5.1. A protective finish shall be applied to housings made of materials susceptible to corrosion, weathering, and degradation from ultraviolet rays or other elements identified in Class B in AREMA manual part 11.5.1. The housing shall be equipped with a door with front access, hinged at one side with a weatherproof seal. A ventilation opening shall be provided at the bottom of the housing and covered with brass, or copper, wire screen. A sidelight shall be provided on both sides of the lamp housing complete with gasket, lens, and retainer.

5. All masts shall be 16' minimum height, 5” diameter (except when otherwise indicated in these Contract Documents), of aluminum construction complete with pinnacle cap and aluminum split base junction box. Pinnacle cap will not be required when bell is used.

6. The Contractor shall ensure that the crossing masts provided are of sufficient height to maintain the required minimum clearances and support the multiple flashing light and gate configuration of each layout. A strip of ASTM Type III or Type V retroreflective white material not less than two inches in width, shall be used on each mast for the full length of the front and back of the mast from the crossbuck sign or number of tracks sign to junction box base, unless otherwise directed by the EIC.

7. The LED signal module shall be 12 inches in size and shall have either a clear or red lens. White LED sidelights shall be included. Any gasket or similar sealing material shall be made in accordance with AREMA Manual Part 15.2.10 (Recommended Functional Guidelines for Gasket Material Suitable for Circuit Controllers, Signal Cases and Other Signal Apparatus Housings).

8. The LED signal module shall operate over an ambient temperature range of -40ºF to 158ºF per AREMA part 11.5.1. It shall be protected against dust and moisture intrusion as per the requirements of NEMA Standard 250-1991, Sections 4.7.2.1 and 4.7.3.2, for Type 4 enclosures.

9. The LED signal module shall meet mechanical vibration and shock requirements as per AREMA Signal Manual Part 11.5.1., and the lens shall be UV stabilized.

10. Cross-arms for flashing light units for signal layout without gate shall be in accordance with AREMA Drawing, Part 3.2.50 as approved by the EIC.

11. Railroad Crossing Signs (Crossbuck R15-1) shall be white reflex-reflective sheeting on sheet aluminum with the words 'RAILROAD CROSSING' in black letters, and a 5 inch reflective stripe on the rear, in accordance with MUTCD, Chapter 8B, Section 8B-03.

12. Number-of-track signs shall be constructed of aluminum alloy and be corrosion resistant. Black letters and numbers on a white background shall be of reflex-reflective sheeting on sheet aluminum.

13. Signal malfunction / Emergency Notification signs R15-4, I-13, or I-13a shall be in accordance with Chapter 8, Section 8 B.09 of the latest version of the Florida MUTCD.

14. Flashing light signal assemblies shall have uniform look and shall be as manufactured by GE Lighting (RG6), Western Cullen Hayes (WCH) Model 985-801, Alstom Signal Type AURORA, Siemens (Safetran) FLX-4000 LED, Hitachi Rail (Ansaldo) Type HC-120, or approved equal.

15. Electronic bell shall be provided with a weatherproof housing and installed at the top of the mast instead of pinnacle at location shown on the Contract Drawings and approved by the EIC. The housing shall be constructed of aluminum. The bell shall conform to AREMA Signal Manual, Part 3.2.61. Normal operating voltage shall be 10 volts dc. Electronic Bell shall be as manufactured by General Signals, Inc. or approved equal, shall have no moving parts and the sound shall closely resemble sound and volume of mechanical bell. It shall be controlled by the same AHCW equipment as mechanical bell and require no additional wiring.

D. AHCW GATE LAYOUTS

1. AHCW gate layouts shall be complete with gate mechanism, gate keepers, gate arm, counterweights, LED gate arm lights, high-wind brackets, mast mounted flashing light units, railroad crossing signs, number of track signs, extension brackets for signs, and, where required, bell(s). For gates that do not require a bell, the signal mast shall have a pinnacle together with all necessary hardware as specified herein, in accordance with AREMA C&S Manual, Part 3.2.15, and as shown on the Contract Drawings.

2. The ground-mounted mast for supporting a gate mechanism shall be constructed of five inch diameter aluminum pipe, complete with pinnacle cap and cast aluminum split base with double sided junction box. Junction boxes shall be provided with AREMA terminals, gaskets, and provisions for padlocking both sides. The gate mechanisms shall be supplied with an internal wiring diagram protected by a plastic laminate and shall be fastened to the inside of mechanism cover. Binding posts, nuts, washer, and insulators shall conform to AREMA C&S Manual, Part 14.1.11.

3. The highway crossing gate mechanism shall be Siemens (Safetran) S-40 model, Western-Cullen-Hayes, model 10 layout with mechanism 3597 or approved equal. Mechanism shall include 115VAC nominal heater element to prevent formation of frost on controller contacts. The Contractor shall refer to gate mechanism manufacturer’s wiring requirements to ensure that required operational voltage does not drop below the voltage specified by the manufacturer.

4. The general design, painting and striping of the gate arm shall conform to AREMA C&S Manual, Part 3.2.20 or 3.2.24. The striping shall consist of 16-inch alternate reflectorized red and white stripe on both sides of the arm. The arm shall be constructed of non-conductive fiberglass and be designed to ensure reasonable durability and rigidity to prevent undue sway or whipping. The clearance between the gate arm and any fixed portion of the assembly shall be a minimum of two inches.

5. The highway crossing gate arms shall be of sufficient length to extend to within one foot of the centerline of the roadway but in no case less than 90% of the roadway width and provide a minimum clearance of two feet from overhead wire and cable.

6. All roadway gates shall be equipped with high wind support devices. The wind support devices shall be as specified in AREMA C&S Manual, Part 3.2.22.

7. All roadway gates, except those mounted on cantilevers, shall be equipped with self-restoring gate arm devices. The self-restoring gate arm devices shall be as specified in AREMA C&S Manual,

Part 3.2.23 and shall operate with a gate 32 feet or less in length. The self-restoring gate arm devices shall be by-directional and shall allow for arm rotation parallel to the roadway for maintenance as manufactured by Western Cullen Hayes “Gate Gard”, National Electric Gate Co. “Gate Saver”, and General Signal Industries “Gate Keeper” or approved equal. Additional counterweights shall be provided as required.

8. Ten volt weatherproof, bi-directional LED gate arm lights shall be provided in accordance with AREMA C&S Manual, Part 3.2.40 with highway crossing red lenses. Gate arm lights shall be adjustable to permit focusing of lights at gate installations parallel to the tracks but not perpendicular to the roadway.

9. A mechanism support shall be furnished with each gate mechanism. The mechanism support shall provide a base upon which the gate mechanism rests and shall support the weight of the mechanism when it is necessary to swing the mechanism and gate for repairs. Mechanism support shall be similar to WCH 3565-380A, or approved equal, and shall be complete for mounting on a 5" pipe.

10. Crossarms for flashing light units installed on the signal with mast shall be constructed of cast aluminum and shall be in accordance with AREMA Signal Manual, Part 3.2.50 and Part 3.2.51, as approved by the EIC.

E. WIRING

1. Internal wiring for vital circuits shall be in accordance with applicable AREMA Signal Manual Parts, unless otherwise specified herein. No. 16 AWG 19 strand flexible wire shall be used for all circuits, except for No. 10 AWG, or larger, flexible stranded shall be used for signal lighting, track connections to the main terminal board and battery and rectifier bus circuits. Solderless terminals, for stranded wire, shall be in accordance with these specifications.

2. Solid terminal connectors shall be used for all short terminal jumpers.

F. WIRING RACEWAY

1. All internal enclosure wiring shall be contained within surface mounted plastic raceway. Raceway shall be of a polycarbonate, low smoke type with a solid snap-on cover and flexible side walls. The side walls shall be of “finger” type construction allowing for insertion and removal of wire runs with terminations attached. Sizes shall be determined by the manufacturer. Fill capacity shall not exceed 40%.

G. PAINTING

1. The exterior of non-aluminum housings shall be painted in accordance with AREMA Signal Manual Part 1.5.10. The finish color shall be aluminum. The battery trays shall be painted with two coats of acid-resistant black paint.

2. All paint shall be fire retardant.

H. POWER OFF AND EQUIPMENT STATUS INDICATION LIGHTS

1. The Contractor shall design, furnish, and install a power-off indication lights on both sides of new and existing instrument housings to be visible to the train crew. The control circuit shall include

Power Transfer relay or other proposed and approved method of power-off indication. It shall be installed inside instrument housing and shall keep the power-off lights lighted when power is on.

2. Power-off indication lights shall be twelve-volt LED. Lights and bases shall be mounted inside the crossing instrument housing behind a single "fisheye" Lexan lens equipped with a gasket and a silicon seal to weatherproof the opening in case wall.

3. The Contractor shall submit and obtain approval of the proposed power indication system prior to providing equipment.

I. TRAIN DETECTION

1. The Contractor shall provide new PMD-4/4R Motion Detecting equipment as manufactured by Alstom or approved equal at as part of the new crossing control system at Intermodal Drive and Dave Rawls Blvd as specified within Scope of Work.

2. At Dave Rawls Blvd the existing Style "C" equipment shall be replaced with new PMD-4/4R system for the purpose of replacing the outdated equipment at that location.

3. The motion detecting equipment provided shall include train motion detection, crossing island train detection, vital inputs monitoring and vital relay drive output control. The motion detecting equipment shall have provisions for expansion to wireless crossing control and prediction capabilities with the optional selective function upgrade.

4. Motion Detector shall have a built-in recorder that logs time-stamped vital and non-vital events as well as state changes, crossing performance data, and failures/reset information. All recorded events shall be user printable both track-side and in the office.

5. The Motion Detector shall consist of a central processor, track and I/O controllers, communications interface, and LCD display with keypad/button interface. Front panel indicators display module shall provide health status and indicators for monitoring active I/O signals.

J. SOLID STATE CROSSING CONTROLLER

1. Vital control logic and circuiting shall be implemented in a solid-state crossing controller such as the SSCCIV as manufactured by Siemens (Safetran) or approved equal. The functioning of the Controller is described in this Specification as if the functions were implemented using discreet components, but the logic shall be implemented using the Controller.

2. A solid-state crossing controller shall be provided for each AHCW location as indicated on the Contract Drawings. The solid-state crossing controller shall meet all requirements of the FRA 234 rules for Highway/Rail grade Crossing Warning devices and AREMA C&S Manual, Part 3.1.25 and Part 3.1.15 as approved by the Authority.

3. The crossing controller shall be fully integrated, vital, solid state circuitry device, providing control operation to lamps, bells and crossing gates.

4. The crossing controller shall provide a voltage adjustment feature. The output voltage once adjusted shall be constant.

5. The solid-state crossing controller shall be voltage surge protected.

6. The lamp flash rate shall be 45 to 50 flashes per minute.

K. MANUAL CONTROL BOX (CUT-OUT SWITCH)

1. The Contractor shall furnish and install a Manual Control (MC) Box, mounted on the roadway side of the instrument housing.

2. MC Box shall contain a three-position control switch for placing the operation of the crossing in Test, Normal and Override state of control. The labels “Test” on the left, “Normal” in the middle and “Override” on the right shall be installed to correspond to switch operation positions.

3. The MC Box shall be of cast iron or cast aluminum construction, complete with a hinged and gasketed door to provide a dustproof and weatherproof seal.

4. The method of mounting the MC Box on the side of the instrument housing shall provide a weatherproof seal (gasket and a silicon seal) between the back of the MC Box and the side of the SIH or Instrument Case. A pipe nipple with locknuts and bushings, or similar approved means, shall be provided between the inside of the housing and the inside rear of the MC Box to house and protect the flexible internal wiring between the housing and the terminals on the control switch within the MC Box.

5. An approved means of securing and locking the door with a standard padlock shall be provided.

6. A pocket shall be provided on the inside of the MC Box door to hold the Crossing Test Record booklet.

7. The MC Box shall be fitted complete with an internal face-plate panel marked “Manual Control". The panel shall be made from one-quarter inch black micarta, satin finish. The letters shall be etched and filed with an approved white pigment.

8. A warning sign shall be placed above the switch that reads “PLACING CROSSING CONTROL SWITCH IN OVERRIDE POSITION COMPLETELY DISABLES THE CROSSING WARNING SYSTEM. NOTIFY PROPER AUTHORITY PRIOR TO OVERRIDE”.

9. The labels “Test” on the left, “Normal” in the middle and “Override” on the right shall be installed to correspond to switch operation positions.

10. The wire terminations on the switch within the MC Box shall be identified with tags, as specified. These tags shall indicate the nomenclature of the wire.

L. FOUNDATIONS

1. Precast Concrete Foundations shall be made of concrete of average compressive strength of 5000 p.s.i. and be in accordance with the applicable drawing section of Part 14 of the AREMA Signal Manual for the type of precast foundation required. Precast concrete foundations shall be steel reinforced. Reinforcing steel shall be placed not less than one inch from any outside surface.

2. Bolts, Nuts, and Hardware

   a. Bolts, nuts, and washers shall be galvanized. Nuts and threads shall be in accordance with AREMA Specifications for Bolts, Nuts and Threads, Signal Manual, Part 14.6.20.

b. Plain washers shall be in accordance with AREMA Specifications for Plain and Spring Lock Washers, Signal Manual, Part 14.6.21. Steel shall be in accordance with AREMA Specifications for Various Types of Steel, Signal Manual, Part 15.1.4, Section 1.

3. Finish and Curing of Precast Foundations - Proper control of the water-cement ratio, high frequency vibration and controlled curing shall be used. An air entraining agent shall be used to increase the resistance to weathering. All outside surfaces shall present a smooth and finished appearance.

M. MISCELLANEOUS PRODUCTS AND COMPONENTS

1. Signal Terminal Connectors

   a. Signal system terminal connectors shall be in accordance with the applicable requirements of AREMA Signal Manual Part 14.1.15.

2. Signal Terminal Binding Posts

   a. AHCW system terminal board binding posts, required for supervisory control circuits, shall be in accordance with AREMA Signal Manual Part 14.1.10.

3. Terminal Post Insulators

   a. All terminal posts, located on terminal boards in the SIH or Instrument Case used to terminate 55, or greater, ac or dc volt circuits shall be provided with a protective insulator.

   b. The type of insulator shall be individual for each terminal post and shall be fire-resistant.

   c. Insulated test links shall be Type 0255-101 as manufactured by Western-Cullen-Hayes, Inc. or approved equal.

4. Lightning Arresters and Equalizers

   a. Lightning arresters and equalizers shall be mounted on three post porcelain or approved type base and shall be in accordance with AREMA Signal Manual Part 14.1.7.

5. Terminals for Wires and Cables

   a. All solderless terminals shall be in accordance with AREMA Signal Manual Part 14.1.1, or as specified herein.

   b. Terminals shall be of the solder-less crimp-on type. Samples of all solderless terminals shall be submitted for approval.

   c. All stranded copper wire shall be fitted with an approved type of terminal at all points where the wires are to be terminated on terminal binding posts.

   d. The terminating means shall be of five types:

      1) a lug for terminating heavy wires or signal power wires;

2) a solder-less insulated terminal as manufactured by AMP, Inc. under the trade name of "Ring Tongue Plasti-Bond," similar to Catalog No. 35628, or approved equal, for terminating No. 16 and No. 14 AWG stranded wires;

3) a solderless insulated terminal similar to AMP Catalog No. 35627, or approved equal, for terminating insulated wires Nos. 12-10;

4) a solderless insulated terminal similar to AMP Catalog No. 324108 for terminating other stranded vital circuit insulated wires Nos. 20-16 AWG having a maximum diameter of 0.200 inches;

5) a solderless insulated terminal, AMP Catalog No. 320554, or approved equal, shall be furnished for No. 8 studs and AMP Catalog No. 320571, or approved equal, shall be furnished for 1/4 inch studs for non-vital circuit insulated stranded wires Nos. 22-16 AWG having a maximum diameter of 0.125 inches.

e. Where flag-type terminals are required, they shall be similar to AMP Catalog No. 322313, or approved equal, for terminating No. 16 and No. 14 AWG stranded wires. Other pre-insulated terminals shall be similar to those shown in AMP Product Bulletin No. 109-1.

f. The terminals shall be for attaching to the ends of the conductor in such a manner that the flexibility of the conductor will not be destroyed and the possibility of breakage at the terminal will be reduced to a minimum.

g. Terminals shall be for attaching to the wire with a tool made by the manufacturer of the terminal and recommended by the manufacturer for the terminals being furnished.

h. The tool shall be equipped with a ratchet device to ensure proper indentation of the terminal and which will not release until proper indentation is complete.

6. Tagging for Cables, Wire, and Equipment

a. Except as otherwise specified in this Section, both ends of each cable and each cable wire and all single wires that terminate in the cases, junction boxes, gate mechanisms, instrument housings on entrance racks, and any equipment of the AHCW system outside of such locations shall be permanently identified with a tag. Tags shall not obscure connecting links used between terminal binding posts. Tags shall be installed so that they may be read with a minimum of disturbance of the tags and wiring. Each conductor of the cable shall be rung out and identified before applying the tag.

b. Tags for wire and cable identification and for identification of transformers, resistors, reactors, and other components shall meet the following requirements and shall be subject to the approval of the EIC:

1) Sleeve Type Tags

a) Tags for identification of individual cable conductors and field-installed wires within instrument housings, base of signal junction boxes, and similar applications shall be the sleeve type as manufactured by Raychem Corporation, Thermo-fit Marker System (TMS), W. H. Brady Co., Brady-sleeve (XB-321, -322, -323), or approved equal. The application of the conductor nomenclature shall be in accordance with the

manufacturer's instructions and shall result in a permanently bonded and legible identification.

2) Flat Plastic Tags

a) Tags for identification of vital relay plug boards, individual transformers, resistors, reactors, terminals, and other miscellaneous components within the cases or SIH shall be the flat plastic laminated type.

b) These tags shall be 1½ inches long by 3/4 inch wide with one, 5/16 inch hold located in the center of the width. The distance from the edge of the tag to the hole shall be approximately 9/32 of an inch. The untreated tag shall be milk white "vinylite," or approved equal.

c) The identifying nomenclature space shall allow for three rows of lettering, and the tag material shall be capable of receiving typed-on characters by conventional means. The height of the lettering shall be not less than 1/8 inch.

d) After lettering, both the face and back side of the tag shall be covered with a clear plastic coating, "vinylite," or approved equal, of at least 0.01 of an inch thick.

e) The nomenclature applied to tags to go on entrance racks and boards shall show the terminal post identification on the top line. The functional nomenclature shall appear on the bottom line, or, if required, on the middle and bottom lines. The terminal posts shall be identified by geometry coordinates, such as rack, row, and post number.

3) Wrap Around Tags

a) Tags for identification of the individual wires of plug-in relays, within the SIH or Instrument Case and the wayside cases, shall be the wrap around, self-adhesive type.

4) Flag Marker Tags

a) Tags for identification of individual wires of shelf-mounted relays, and wires and conductors in junction boxes, shall be flag marker tags of the miniature locking type.

5) Pressure-Sensitive Labels

a) The rows and columns on entrance racks shall be identified by pressure-sensitive labels bearing the geometric coordinates.

b) Wires on plug-in vital relays shall be identified by the contact to which they are applied. These tags shall be wrap-around self-adhesive type.

7. Hardware

a. All mounting hardware exposed to the elements and used for signal equipment, cases, conduit, hangers, brackets, clamps, etc., shall be hot-dip galvanized, except as otherwise approved by the EIC.

1) Galvanizing

a) The hot dip process of galvanizing shall be used. All parts shall be pickled so that all scale and adhering impurities will be removed. The zinc coating shall be of commercially pure zinc and shall be continuous and thorough. It shall not scale or blister or be removable by any of the processes of handling or installation. The finished surface shall be free from fine line cracks, holes, or other indications of faulty galvanizing. It shall be smooth and free from adhering flux and other impurities. The edges and ends of parts shall be free from lumps and globules. Parts shall be coated with at least 2 ounces of zinc per square foot of galvanized surface, after all bending, cutting, drilling, and final fabrication.

b) In order to avoid destruction of resilience encountered in the hot dip process of galvanizing, all lock-washers shall be cadmium plated.

c) All galvanized mounting hardware nicked during construction shall be painted aluminum and coated when dry with a non-oxide grease to prevent corrosion.

2) Cadmium Plating.

a) All nuts, bolts, and washers used for the mounting of equipment within finished enclosures shall be cadmium plated or stainless steel. As an alternate, the Contractor may submit another type of plating or non-corroding metal for the EIC's approval.

b) Cadmium plating shall be an impervious, dense, hard, fine grained, continuous, closely adhering coating of commercially pure cadmium, free from capillaries and shall completely cover the surface of the part in a smooth, bright layer. Plating on raised or prominent portions shall show no evidence of blackness or loose crystalline structure. It shall have a minimum thickness of 0.0006 of an inch and shall withstand the salt spray test for at least 1,000 hours or an equivalent test approved by the EIC.

8. Padlocks and Keys

a. Signal padlocks and keys shall be furnished and installed for all housing or case doors and covers of signal equipment installed under this Contract. Switch padlocks shall be furnished and installed for manual control boxes requiring access by train crews. The Contractor shall obtain from the JAXPORT the proper ordering references for the JAXPORT's signal and switch padlocks.

9. Sealing Compound

a. Sealing compound for use in sealing cable entrances shall be in accordance with AREMA Signal Manual Part 15.2.15.

10. Cable Entrance Pipes

a. Cable entrance pipes for ground-mounted AHCW instrument housing shall be 6 inch schedule 40 PVC pipe, 3 feet long with bell housing on one end, unless otherwise approved by the EIC.

11. Paint and Finish

a. All paint and painting procedures shall be in accordance with applicable requirements given in AREMA Signal Manual Part 1.5.10 where the AREMA requirements do not conflict with any requirements of the specifications.

12. Ground Rods, Welds, and Wire

a. Ground rods shall be copper-clad steel, of the non-rusting type, as manufactured by Copperweld Corporation or approved equal. The rod shall be at least 10 feet in length and at least 5/8 inch diameter.

b. All ground wire connections to ground rods shall be of exothermic weld type as manufactured by Erico Corporation or approved equal. No mechanical connections are permitted.

c. Internal ground wire from the equipment to the ground bus shall be insulated No. 6 or 10 AWG stranded copper wire. Insulated ground wire shall be colored green.

d. A grounding bus of nickel-plated hard-drawn pure copper shall be provided in each crossing house or case. The minimum dimensions of the bus shall be 8 inches by 8 inches by 1/2 inch thick. A minimum of twelve 3/8 inch holes shall be drilled and taped in the bus and twelve (12), 3/8 inch by 1/2 inch long hex head nickel plated bronze studs with one washer each shall be installed.

13. Signal Transformers

a. Signal transformers shall be in accordance with the latest revision of AREMA Signal Manual Part 14.2.10 for single-phase transformers, where the requirements do not conflict with any requirements specified in this Section.

1) General Signal Transformers

a) General signal transformers shall be provided with sufficient primary and secondary voltage taps to adjust between 85 and 110 percent for varying feeder voltages. All transformers shall be rated to carry 125 percent of the total load continuously.

b) The primary and secondary taps shall be brought to terminals mounted inside the transformer case, and a connection for each secondary tap and at least two connections for the primary winding shall be brought out of the transformer to AREMA terminals, or other approved bushings and terminals. All terminals shall be identified.

2) Signal Lighting Transformers

a) Signal lighting transformers shall be equipped with taps to provide output voltage adjustment in one volt steps, from 6 to 15 volts. The primary excitation voltage shall be 120 volts ac at 60 Hz.

N. CONDUIT

1. Contractor shall install two (2) four-inch (4”) Schedule 80 PVC conduit parallel with the track and one (1) four inch (4”) galvanized rigid steel (GRS) conduit perpendicular to the track at each at-grade crossing location for signal cables use per the Contract Plans and, or as directed by JAXPORT. PVC conduit shall be ten (10) feet from the edge of the roadway on both sides and

parallel to the track and the GRS conduit shall be located ten (10) feet off the crossing surface edge and perpendicular with the track and or as directed by the EIC. A two feet minimum distance between roadway and track conduits shall be provided to accommodate bending radius of cables. A minimum of three feet of cable shall be looped at cable transition between conduits.

2. Contractor shall submit proposed end of conduit location finders, i.e. stakes, ribbons, etc., for review and approval. Contractor shall mark ends of the conduit with approved marking devices.

    a. Rigid

        1) Rigid conduit shall be used at locations as specified herein and as shown on the Contract Drawings, specifically steel conduits shall be used for cable installation under tracks. The types of rigid conduit to be used for the various applications shall be as follows:

            a) Steel conduit shall be made of the best grade standard weight steel pipe protected inside and outside by a coat of hot dip galvanizing. Where elbows are used, they shall be long radius type. Steel conduits shall be protected in shipping and handling by approved thread protectors.

            b) Contractor shall size conduit in accordance with National Electric Code (NEC). Submit fill calculations utilizing one or more trade size 4" conduits for review by the EIC.

    b. Schedule 80 PVC

        1) Schedule 80 PVC conduit shall be used at locations as specified herein and as shown on the Contract Drawings, specifically PVC conduit shall be used for cable installations under the roadway. The types of PVC conduit to be used for the various applications shall be as follows:

            a) Four inch diameter, thick-wall polyvinyl-chloride conduit, High Impact Schedule 80, herein referred to as PVC conduit.

            b) The top of conduits placed under existing grade or paving other than track shall generally be 30 inches minimum below top of final grade.

    c. Flexible Conduit and Hose

        1) Hose for track circuit leads installation shall be Valuflex/GS as manufactured by HBD Thermoid Inc. and shall be made of multiple plies of rubber spiral polyester fiber and EPDM tube or approved equal.

        2) Metallic Flexible Conduit. Where the EIC permits, the use of metallic flexible conduit shall be Type UA or approved equal.

    d. Fittings

        1) Approved PVC fittings shall be used for PVC conduit. All fittings for rigid steel conduit shall be of cast malleable iron and shall be protected by hot-dip galvanizing.

        2) Expansion joints for PVC conduit, if required, shall be EIC-approved.

O. BATTERY TRAYS

1. The Contractor shall furnish battery trays for installing batteries inside signal instrument enclosure in accordance with Contract Documents in accordance with batteries proposed by the Contractor. Alternative designs of polyethylene may be submitted for consideration.

P. BATTERY CHARGING EQUIPMENT

1. Design Requirements

   a. Two battery banks and charging equipment shall be provided. One bank shall be used for crossing control circuits and another bank shall be used for wayside signal equipment. A separate battery bank shall be used for electronic track circuits if required.

   b. Battery charging equipment shall be a microprocessor-based design for continuous operation, shall provide constant current and constant voltage charge and shall meet the requirements of AREMA Signal Manual, Part 9.2.5.

   c. Battery charging equipment shall be designed to deliver rated outputs with an input voltage of 100 to 130 volts ac at 60 Hz, single phase, two-wire input.

   d. Battery charging equipment shall have a reserve capacity at least 25 percent above the calculated requirements.

   e. Each charger shall be provided with an adjustment device to change the rate of output current.

   f. Terminal markings for ac and dc terminals shall be permanent.

2. Track Battery Chargers.

   a. Track battery chargers shall provide constant current and constant voltage charge and shall meet the requirements of AREMA Signal Manual, Part 9.2.5. Chargers shall have a selectable float voltage to match supplied battery manufacturers requirements, as manufactured by National Railway Supply ERBC 5/5, or approved equal.

3. Battery Bank Chargers

   a. Battery bank chargers shall be fully adjustable rectifiers as manufactured by Cragg Type ETC, National Railway Supply Type ERBC, LaMarche Type A75 or approved equal.

   b. The Contractor shall furnish battery bank chargers for operating all equipment required to operate the connected equipment.

   c. The charger shall provide a stabilized output voltage, with output current limiting. The capacity of the battery charger shall be determined by the Contractor and approved by the EIC. The charger shall adjust its output current automatically according to the load and to the demand on the battery.

Q. STORAGE BATTERIES

1. The Contractor shall furnish storage batteries for all applications except as otherwise approved by the EIC.

    a. Batteries shall be maintenance-free, sealed JAXPORT signal batteries, designed for JAXPORT use as a standby source of power for highway crossing warning devices, signal control systems, and other similar uses as manufactured by EnerSys PowerSafe DDr 50 or approved equal.

    b. Battery must operate, with a high degree of reliability, -40ºF to +160ºF in a harsh environment, enclosed only in a relay house or raised concrete battery box.

    c. The battery shall not be capable of explosion under any condition, including a short circuit discharge.

    d. Batteries shall meet the requirements of AREMA Signal Manual Part 9.1.3, where the requirements of the Signal Manual do not conflict with any requirements specified in this Section.

    e. Battery Size and Application

        1) The following is a guide to minimum storage battery size. The Contractor shall calculate the loads based upon the equipment that the Contractor proposes to furnish. All batteries shall be sized for a minimum 24-hour standby capacity at an ambient temperature of 40°F.

            a) 80 AMP-Hour (minimum) - DC steady energy track circuit battery;

            b) 472 AMP-Hour (minimum) - XB12 battery for wayside equipment;

            c) 264 AMP-Hour (minimum) - Local MB12 battery.

    f. Physical Construction:

        1) Polypropylene container and cover.

        2) Projected design life of 20 years at 80 percent rated capacity.

        3) Individual cells (multiple cell groups or modules not allowed).

R. SIGNAL CABLES

1. General

    a. Vital signal cable furnished for this Contract shall meet AREMA C&S Manual Part 10.3.17, Recommended Design Criteria for Signal Cable, Armored and shall be of the highest quality, assuring durability for minimum life expectancy of 40 years. These cables shall be suitable for use in the environment to be encountered on a JAXPORT signal system and shall be certified for continuous operation at 75°C in wet or dry locations with no conductor failing in continuity or with loss of insulation to cross or ground less than one meg-ohm.

    b. Actual conductor size shall be calculated to suit distances and loads. Detail conductor sizes and cable makeup for application of Contractor’s final design. Submit voltage drop calculations and size conductors to provide minimum voltages specified in the AREMA

Communications & Signal Manual of Recommended Practices 3.2.15 (gates), 3.2.35 (flasher assemblies), and 3.2.61 (electronic bell) under maximum calculated load conditions. Sizing for conductors in remaining circuits shall allow no more than a five percent voltage drop between power source and load under maximum calculated load conditions.

c. Multi-conductor distribution cable containing more than two conductors shall contain a minimum of 10 percent spare conductors or two spare conductors, whichever is greater, except that two conductor cables will not require spare conductors.

2. Pre-qualification.

a. All cable manufacturers supplying cable for this Contract must be pre-qualified by the EIC. The Contractor shall provide all of the data required for the EIC's evaluation and shall make the arrangements for any required demonstrations and tests.

b. Qualifications shall be based on the following criteria:

1) Past Performance and Experience. The cable manufacturer(s) must demonstrate previous successful experience in supplying cable to the railway industry for use as vital signal control cables. A list of such installations shall be provided for each cable manufacturer to be considered.

2) Quality Assurance Program. The manufacturer of cables in accordance with the requirements of this specification shall be accomplished in compliance with a Quality Assurance Program that meets the intent of the ASQC Standard CI-1985; General Requirements for a Quality Program. Such compliance shall promote a thoroughly tested cable which will render the 40 year service life to the user. Prime concern must be focused on the necessary formal assurance requirements to ensure that cable failure cannot be attributed to actions or lack of actions by the manufacturer.

3) Technical Data. The Contractor shall provide full technical data which demonstrates compliance with the requirements of this specification for each specified cable type the Contractor plans to supply.

4) The manufacturer shall certify compliance with the following warranty prior to selection:

a) The manufacturer warrants that the design, material, and workmanship incorporated in each item of cable shall be of the highest grade and consistent with the established and generally accepted standards for aerial and underground cable for vital JAXPORT signal, communication, and power circuits; and that each such item and every part and component thereof shall comply with this specification.

b) The manufacturer agrees that this warranty shall commence with the acceptance of each item of the cable, whether the defect is patent or latent, and shall continue for a period of two years after initial satisfactory operation of the item or four years after acceptance of the item, whichever is shorter.

c) The warranty covering any length of cable that shall be replaced by the manufacturer under the above conditions shall be reinstated for a period of two years, effective as of the day when said replacement is affected. If the failure is found to be of major importance and affects any other item of cable, the reinstatement of the warranty shall

then be extended to cover the item so affected as well and shall start as of the date of such replacement. The warranty reinstatement provided herein shall apply only to the first replacement or repair of any such item and, in the case of failure of major importance, to the first extension of the said warranty to said affected items.

d) The foregoing warranties are exclusive and in lieu of all other warranties, written, oral, implied, or statutory (except as to title and freedom from lien). In no event shall the manufacturer be liable by reason of breach of warranty for special or consequential damages.

3. Quality Assurance.

a. The Contractor shall submit the following to the EIC for approval prior to shipment of the cable:

1) List of the cable manufacturer's railway signal installations.

2) Each cable manufacturer's Quality Assurance Program.

3) Full technical data for each type of cable which the cable manufacturer intends to supply.

4) The Contractor shall submit two certified copies of the following to the EIC for approval:

a) Cable test reports for all factory tests.

b) Test reports of cable tests conducted in the field in accordance with the approved testing procedures.

c) Certification that each cable supplied complies with the requirements of these specifications.

d) Information to be supplied by certified cable test reports shall include the following:

1. Report Number.

2. Date and location of test.

3. Description of test and test conditions.

4. Complete cable or wire description.

5. Lot, batch, or reel identification number.

6. Quantitative test results.

7. Summary of test results.

8. Information on the components of the cable tested, to include batch numbers and physical and electrical properties.

4. Trench Marker Tape.

a. The Contractor shall furnish trench marker tape for signal cable: bright red, six (6) inches wide, and continuously coded in black lettering with the following legend:

CAUTION CAUTION CAUTION

BURIED SIGNAL CABLE

5. Site Test Equipment and Materials.

a. All test instruments and equipment necessary to conduct the tests specified herein shall be available and ready-for-use not less than 48 hours in advance of test need. Ready-for-use shall mean properly matched for test parameters, properly calibrated, and supplied with leads, probes, adapters, stands, etc. necessary to conduct a particular test in accordance with FRA requirements.

b. All temporary or interim test related materials, special tools, connections, jumpers, etc. shall be furnished and available in advance of the test.

S. SIGNAL INSTRUMENT ENCLOSURE

1. The Contractor shall design, furnish, install, test and placed in service a complete factory-wired JAXPORT type signal instrument enclosure complete with all equipment necessary to provide train detection and control of AHCW equipment. Instrument enclosure shall include, but not limited to the following equipment:

- Utility power equipment.
- Meter enclosure on the side of the housing.
- Motion-based train detection and AHCW control equipment.
- Two (2) battery banks.
- Two (2) battery chargers.
- Power off indication LED light on each side of enclosure.
- Manual Control Box (test and cut-out switch)
- Fan with thermostat mounted to the enclosure side
- All other equipment and facilities required for safe and reliable operation of AHCW system.

2. The enclosure shall be as manufactured by PTMW or approved equal. The Contractor shall submit the following to the EIC for approval:

a. Shop drawings showing components, layout, and construction of wayside enclosures.

b. Site specific installation layouts, mounting and grounding arrangement of each enclosure.

c. Factory and Field Inspection Procedure.

3. The enclosure design shall prevent air penetration and shall be equipped with front and back doors. Doors shall be provided with handle and a three-point locking device to ensure that the door cannot be locked until it is completely closed. Provisions shall be made for locking with an approved standard hex keyed padlock.

4. Doors shall be provided with means for being secured in the 90-degree open position.

5. Each door shall be equipped with a plan holder of sufficient size to hold all record plans for the location.

6. The hinges for both doors shall be on the same side of the housing and shall be so designed that when the door is closed and locked, wear due to vibration shall be prevented. Hinges shall be separate castings, securely fastened to the housing and door. The hinges shall be equipped with bronze hinge pins, and fittings to allow lubrication. The manufacturer shall lubricate the hinges before the enclosure is shipped.

7. Instrument enclosure provided under this Contract shall be furnished complete with ratchet-style adjustable foundations, terminal board, power off LED lights, battery trays, cable entrance pipes, power equipment, grounding equipment and all miscellaneous parts and material required to provide a fully functional instrument enclosureto control the grade crossing warning equipment.

8. The Contractor shall inspect wayside enclosure after shipment prior to installation for defects and damage and after installation. Any deficiency found shall be reported to the EIC. The Contractor is responsible for replacing of any material or equipment that is damaged, lost, or stolen during the transport and installation of the wayside enclosure at no additional cost to the Contact.

9. Wayside enclosure shall be of 12-gauge sheet steel construction with a steel floor. The top and sides of the enclosure shall be lined with five resistant insulating materials complying with a flame spread of 0-20 and a fire rating of 7 in accordance with ASTM-E-84. Each wayside enclosure shall have knockout(s) for both aerial and underground cable entrance and shall be provided with fire-resistant ventilated openings in each side, lined with heat and cold insulating material and constructed to prevent sweating.

10. The Contractor shall submit for approval design, materials, and proposed methods of instrument enclosure installation, including proposed equipment layout.

11. Wayside enclosure shall be provided with a convenience outlet, switched porcelain base lamp holders, and 60 watts equivalent LED lights rated at 120 VAC located on both track and field sides. Convenience Outlet (Receptacles) shall be provided with a Ground Fault Circuit Interrupter (GFCI).

12. A three-eighths inch high tensile strength, silicon manganese bronze stud bolt for externally grounding the enclosure shall be provided. Perforations of sheet steel cases will not be permitted.

13. The exterior of the signal instrument house shall be painted in accordance with requirements of AREMA C&S MANUAL PART 1.5.10. The finish color shall be as directed by the EIC. The bottom of the signal instrument house shall be treated with a corrosion resistant undercoating. All paint shall be fire retardant.

14. Each enclosure shall be mounted on foundations level and plumb and fastened with the hardware provided. Trackside doors in the open position shall clear center line of the nearest running track by 8'-6" minimum and top of foundation level with top of rail unless otherwise approved by the EIC.

15. All grounding material shall be provided and submitted for approval.

16. Pipes for underground cable entrances shall be installed in the knockout holes provided in the rear of each enclosure. These pipes shall be secured to each enclosure by locknuts and insulating bushings.

17. Cables entering the instrument enclosure shall be dressed, pot headed, tagged, and terminated. All cable entrance pipes shall be sealed with approved sealing compound.

18. AC Power Supply:

    a. The Contractor shall design and furnish a new metered power service to the Signal Instrument Enclosure. The new service will be located on a new pole adjacent to the crossing instrument enclosure. The Contractor shall obtain all permits, licenses and agreements with the supplying Utility Company and is responsible for all coordination.

    b. Peak load calculation for meter service shall be provided by the Contractor. Actual power conductor size shall be calculated to suit distances and loads. Sizing for conductors shall allow no more than a five percent voltage drop between power source and load under maximum calculated load conditions.

    c. All power service materials and equipment installed shall conform to all applicable state and local ordinances pertaining to electrical power installations and the latest edition of the MEC.

    d. The Contractor shall provide and install cable for connection of the 120VAC, three wire feed from the meter to the utility tapping point. A sufficient cable slack shall be provided for the use by Utility Company. The meter and connections to the power line shall be provided by Utility company. Coordinate with the Power Company for any additional requirements.

19. Relay and Component Mounting

    a. Relay Plug-boards shall be designed for insertion of removable type contacts. The method of attaching the wires to the removable contacts shall be solderless connections. Unless otherwise approved by the EIC, or proven by type acceptance testing, the plug-board shall be designed so that the removable contact will have a direct connection with the contact and coil prongs.

    b. The plug-boards shall be in accordance with the applicable Sections of AREMA Signal Manual Part 6.2.2. All wires shall be of sufficient length to permit them to be moved to any contact on the same relay. The plug-boards for vital relays shall be equipped with a registration plate to prevent relays of the wrong type, contact arrangement, or operating characteristics from being inserted.

20. Identification

    a. There shall be an identifying nameplate for each relay, or other instrument mounted in the enclosure.

b. The relay plug-boards shall be equipped with a tag as specified herein. This tag shall indicate the nomenclature of the relay.

c. The contact numbering system shall be uniform for each type of relay used.

d. The wiring to each removable contact shall be identified with a wraparound tag as specified herein. This tag shall indicate the relay contact number assigned to the wire.

e. Wire and cable conductor identification tags for terminal board mounting shall be as specified herein.

f. External identification of the MCS shall be provided.

g. Provisions shall be made to locate spare wire conductors on dedicated terminal posts or lightning arresters, in line with the working conductors of any one cable.

h. Wire-wound resistors shall be spaced with 1/2 inch minimum clearance between adjacent resistors.

21. Cable Entrance Pipes

    a. Cable entrance pipes shall be provided.

22. Grounding

    a. A 3/8 inch high tensile strength, silicon manganese bronze stud bolt for externally grounding the enclosure shall be provided. Perforations of the enclosure will not be permitted.

    b. Internal ground bus arrangement shall be as specified herein.

23. Wiring

    a. Internal wiring for vital circuits shall be in accordance with applicable AREMA Signal Manual Parts, unless otherwise specified herein. No. 16 AWG 19 strand flexible wire shall be used for all circuits, except for No. 10 AWG, or larger, flexible stranded shall be used for signal lighting, track connections to the main terminal board and battery and rectifier bus circuits. Solderless terminals, for stranded wire, shall be in accordance with these specifications. Wiring for lights, switch and convenience outlets shall be insulated No. 12 AWG, flexible, THHN wire installed in EMT. Solid terminal connectors shall be used for all short terminal jumpers.

24. Wiring Raceway

    a. All internal enclosure wiring shall be contained within surface mounted plastic raceway. Raceway shall be of a polycarbonate, low smoke type with a solid snap-on cover and flexible side walls. The side walls shall be of “finger” type construction allowing for insertion and removal of wire runs with terminations attached. Sizes shall be determined by the manufacturer. Fill capacity shall not exceed 40%.

PART 3 – EXECUTION

3.1 GENERAL

A. SITE CONDITIONS

1. The Contractor shall properly notify "Dig Safe" at 1-888-344-7233 prior to any excavation or subsurface work.

2. The Contractor shall contact the JAXPORT in order to obtain written permission to enter the right-of-way to work on signals at the crossing. The Contractor shall coordinate times when crossing will be taken out of service for proposed work.

3. All work shall be accomplished in a manner that will protect the crossing throughout the prosecution of work.

B. EXCAVATION AND BACKFILL

1. General. It is the responsibility of the Contractor to obtain from the utility companies and others the location of all underground facilities prior to beginning any excavation. Any damage to an existing facility shall be repaired by the Contractor at the Contractor's expense.

   a. Unless otherwise indicated in the Plans or in the special provisions, the Contractor shall perform all excavation, backfilling, and resurfacing work, including removal and replacement of curbs, sidewalks, paved surfaces, and any other materials necessary to complete the work in accordance with the Plans and specifications or as ordered by the EIC

   b. In making excavations in paved surfaces, such as for the installation of signal conduit, cuts shall be made with a concrete saw to a minimum depth of 2 inches along the neat lines of the area to be removed.

   c. All landscaping and underground utility systems that have been disturbed by the construction shall be restored to their original condition by the Contractor at the Contractor's expense upon completion of the work.

2. Excavation for Conduit and Buried Cable

   a. Trenches necessary for placing conduit and buried cable shall be excavated at the location shown on the Plans or as directed by the EIC, and the bottom of conduit trench graded to a pitch of not less than 3 inches per 100 feet.

3. Excavation for Foundations

   a. Excavation for foundations shall be made at the locations shown on the Plans or as directed by the EIC.

4. Backfill

   a. Backfill of suitable material shall be placed and compacted as directed by the EIC. The fill material around cables shall be free of sharp objects that might damage cable. Excess materials shall be disposed of in a manner satisfactory to the EIC.

b. All buried cable shall be marked with 6-inch red, plastic marking tape in the backfill, 12 inches below finished grade.

C. INSTALLATION

1. General

a. AHCW wayside equipment shall be installed in accordance with the approved installation plans, recommendations of regulatory agencies specified herein or as directed by the EIC.

b. AHCW control system equipment shall be mounted in such a manner as to provide for easy access to test points, indicators, and adjustments.

c. Track circuits termination diodes and shunts shall be installed in accordance with the manufacturer's standard and at locations shown on the approved plans.

2. Foundations and Cribbing

a. At all locations where pre-cast concrete foundations are installed, a crushed stone base shall be placed and compacted on the accepted subgrade to a total depth of not less than 4 inches after compaction.

b. When placing foundations, the Contractor shall exercise care to ensure that anchor bolts are not bent, or threads damaged. All anchor bolt threads, washers, and nuts shall be protected by applying friction tape, or other approved method satisfactory to the EIC, until such time as the unit to be supported is installed. Anchor bolts requiring leveling nuts shall be of sufficient length.

c. Foundations and pads shall be installed level and plumb.

d. If the surfaces of all foundations exposed to view do not present a uniformly clean surface of even texture and appearance, the surface shall be treated and rubbed to obtain a satisfactory finish, subject to approval by the EIC.

e. After backfilling foundations, the Contractor shall ensure that the foundation is plumb and level. Top of foundation to be at the same elevation as the crown of the roadway and no more than 4 inches above the final top of grade. If a crib support wall is required, the top of final grade in relation to the top of foundation shall be as approved by the EIC.

f. Each tier of timber cribbing shall be drift bolted to the one upon which it rests with 3/4 inch galvanized drift bolts in sufficient length to extend through two tiers and not less than 4 inches into the third tier. Concrete or steel cribbing shall be installed in accordance with the manufacturer's instructions.

g. The filling of the interior of the crib shall follow closely the erection of the successive tiers and at no time shall the cribbing be laid up higher than 3 feet above the backfilled portion.

h. The cribbing shall be installed to have a minimum perimeter walkway around the enclosure, or signal, of 6 feet.

3. Flashing Light Signal Installation

   a. The flashing light signal mast shall be securely fastened within the split base in a manner such as the distance between the split halves of the base shall be equal. The heads of the bolts in the base assembly shall be squared with each other and facing oncoming highway traffic.

   b. The base shall be securely fastened to the concrete foundation with the hardware provided for that purpose. The mast shall be plumb when the base assembly is fastened to the foundation. Shims, spacers, or other filler devices shall not be used to level and plumb flashing light signal equipment.

   c. A hole shall be factory-drilled in the mast for the bottom cross-arm. The center line of the hole shall be located so that, when the cross-arm with light units is attached thereto, the lowest part of the light assembly shall be between 7'-6" and 9'-6" above the crown of the roadway. Holes for additional cross-arms, when required, shall be located, and drilled in the field after the bottom cross-arm has been secured to the mast. The centerline of the additional light units shall be 23 inches above the centerline of the lower light unit.

   d. Electronic bell(s) shall be installed on the top of the mast of the flashing light unit as shown on the Contract Drawings.

   e. Underground cables shall be installed within the mast and terminated in the base junction box. No.10 wire shall be run to the cross-arm junction box in a manner as specified in AREMA Signal Manual Part 10.4.1.

      1) Wiring for the flashing light units and the bell shall be 37 strand, No. 10 AWG in accordance with the requirements of the AREMA Signal Manual.

      2) Where additional light units are used, wiring for these units shall multiple off the wiring in the next lowest cross-arm junction box.

      3) Wiring for bells shall go directly from the bottom cross-arm junction box to the bell.

      4) Terminations for flasher unit and bell wiring shall be solderless compression type terminals as specified herein.

   f. With ac power off and standby battery in a fully charged condition, the lamp voltage shall be adjusted to 9½ volts for LED lights (measured at the lamp) by varying the resistor for the flasher unit.

   g. The front lights of the flashing light unit shall be focused to provide maximum visibility for oncoming highway traffic. The back lights of the flashing light unit shall be focused to provide close visibility for oncoming highway traffic from the opposite direction.

4. Cable Installation

   a. General

      1) The installation of wire and cable shall conform to Parts 10.4.1 of the AREMA Signal Manual, except as modified herein.

2) Prior to the installation of underground cables, a sand bed compacted to a depth of not less than 3 inches shall be placed on the accepted subgrade. Following the installation of the cables, sand backfill shall be placed and compacted with hand tools around and over the cables in 4 to 6 inch layers, to a uniform depth not less than 8 inches without damage to the cables.

3) The Contractor shall provide sufficient slack in cable conductors at all terminating posts to enable three re-terminations of the conductor due to broken eyelets without re-servicing or re-pot heading the cable.

4) Cables shall not be bent to a radius less than 10 times the diameter of the cable during installation, or as finally installed.

5) All cable runs shall be continuous without splices between cable terminating locations.

6) Tags to identify cables shall be of plastic material. Tags shall be lettered to correspond with the cable destination and number of conductors in the cable. The type of tag to be used shall be as described in these specifications.

7) All cables shall be terminated in conductor order. Individual cable conductors shall be identified at each cable termination with plastic tags as specified herein. All spare conductors in each cable shall be terminated and identified.

8) All cable entrance openings in equipment houses and junction boxes shall be sealed with a pliable sealing compound after the cable is in place. Sealing compound shall be used to seal the area around cable where the cable emerges from the end of a conduit, pipe, or duct bank. All spare conduits shall be sealed or plugged in an approved manner.

9) A suitable lubricating medium, non-injurious to the cable insulation, shall be used when pulling cables into conduit or pipe.

10) Wherever multiple conductor cables are terminated, the outer sheath of the cable shall be carefully removed to the point of cable entrance. At the end of the cable sheath or covering, two layers of plastic electrical tape shall be applied.

11) When direct buried parallel the tracks, cable shall be buried a minimum depth of 30 inches below finished earth or ballast. Cable shall be laid loosely in the trench with a sand bed and backfill as specified. When passing under tracks, cable that is not protected in conduit shall be buried a minimum depth of 48 inches below top of tie.

12) Upon request, and only under extreme circumstances and because of installation hardship, will installation of a cable be allowed to a depth of less than 30 inches, subject to the EIC's approval. The cable shall be protected in a manner as approved by the EIC.

13) Restoration of backfill and ballast shall be subject to the approval of the EIC.

14) Whenever any signal cable is to pass under roadway or tracks, if existing conduit is not provided, the cable shall be installed in a 4-inch galvanized steel conduit and the conduit shall extend 20 feet beyond the edges of the pavement. It shall be the Contractor's responsibility to restore the pavement or roadway to its original condition, subject to the approval of the EIC.

15) Where cable leaves the ground at other than buildings or in foundations, it shall be protected by a bootleg or other covering extending above the ground line. Top of such protective coverings shall be filled with a sealing compound.

16) The Contractor shall install polyethylene cable marking tape at a depth of approximately 12 inches below final grade while backfilling each cable trench. This tape shall be as specified herein.

17) The pot-heading of buried cabled shall be applied whenever cable is terminated in signal equipment and such termination is within 2 feet of the grade level. This neoprene end seal pothead shall be installed in accordance with the manufacturer's instructions.

5. Rail Bonding Installation

a. All non-insulated joint bars in the crossing circuited territory shall be bonded with one bond installed on the field side of the joint bars.

b. Exothermically Welded Rail Head

1) The surfaces of the rails where the bond is to be applied shall be ground clean with a reinforced grinding wheel, of a type as recommended by the bonding material manufacturer. The use of vitrified grinding wheels will not be allowed. After grinding, the surface shall be cleaned with an approved non-toxic solvent to remove all traces of grease and dirt. After the surface has been ground and cleaned, it shall be heated to drive out any moisture. The bond wire shall then be welded to the rail in a manner to ensure a thorough mechanical and electrical connection.

2) The Contractor shall ensure that each bond connection is thoroughly welded to the rail. The EIC reserves the right to require a test of each weld by hammer and striker, or in any other manner that in the opinion of the EIC is reasonable.

3) The Contractor shall demonstrate that the bonding is in accordance with the requirements of this Section and as specified in AREMA Communications & Signal Manual Parts 8.1.20, 8.1.30, and 8.6.40.

c. Plug-Type Rail Web Track Circuit Connections

1) Track circuit connectors shall be furnished and installed in accordance with AREMA Communications & Signal Manual Parts 8.1.20 and 8.1.25 (Type 2 plugs). The opposite end of the connectors shall have a 7 inch length of turned bond strand with a compression sleeve installed for connection to bond strand wires.

2) Rail shall be drilled in accordance with AREMA Communications & Signal Manual Part 8.6.25. Rail shall be drilled with an approved 3/8 inch bonding drill bit and drill normally used for this purpose to permit the application of the bond to the rail web.

3) No hole shall be drilled through the rail brand. Holes shall be drilled within plus or minus 3/16" of the neutral axis of the rail. All holes shall be clean and deburred. Bond wires shall be installed on the same day as the hole is drilled. In the event that bond wires cannot be installed on the same day, the bond hole shall be protected against the elements with a suitable plug.

4) Plugs shall be driven with a hammer of approximately three pounds in weight, and when in-place shall be tight to provide the best possible contact throughout the web of the rail.

5) Track circuit connectors shall be furnished and installed with insulated bond strand cable. The bond strand shall have a nominal diameter of 0.200 of an inch and be jacketed with 3/32 inch rubber compound. The bond strand shall be connected to the solid #6 insulated twisted track wire with compression sleeves and taped and insulated to prevent corrosion. The connection between track wire and bond strand shall be housed in rubber water hose to prevent damage from ballast and frost in the ground. Bond strand shall be fastened to the rail base using approved rail clips.

6) The underground cable shall be stripped back a sufficient distance for the exposed conductor to be fully inserted into the compression sleeve. The sleeve shall then be compressed with the type of compression tool designed for that purpose. The sleeve shall then be covered with two layers of vinyl plastic electrical tape.

7) A 24 inch piece of approved rubber hose shall be placed beneath the rail base to house track circuit cable and shall be sealed with approved sealing compound in a manner approved by the EIC.

8) Any track circuit connection installed by the Contractor that is found to be defective prior to acceptance shall be removed and a new track circuit connection installed at no additional cost to JAXPORT.

9) Care shall be taken to avoid excessive slack in the bond conductor to prevent vandalism.

d. Plug-Type Rail Web Bonding

1) Bonding connectors shall be furnished and installed in accordance with AREMA Communications & Signal Manual Parts 8.1.20 and 8.1.25 (Type 2 plugs).

2) Rail shall be drilled in accordance with AREMA Communications & Signal Manual Part 8.6.25. Rail shall be drilled with an approved 3/8 inch bonding drill bit and drill normally used for this purpose to permit the application of the bond to the rail web.

3) No hole shall be drilled through the rail brand. Holes shall be drilled within plus or minus 3/16” of the neutral axis of the rail. All holes shall be clean and deburred. Bond wires shall be installed on the same day as the hole is drilled. In the event that bond wires cannot be installed on the same day, the bond hole shall be protected against the elements with a suitable plug.

4) Plugs shall be driven with a hammer of approximately three pounds in weight, and when in-place shall be tight to provide the best possible contact throughout the web of the rail.

5) The fouling wires shall be installed to allow for the plug end of the one wire to be placed on the outside of the far rail and the other end of the inside of the opposite far rail. The second wire installation shall be the reverse of the first wire.

6) Fouling wire shall be stapled to separate ties, 1-1/2” below the top of tie, opposite each other in the same tie bay. The fouling wires shall be installed to avoid touching the tie plates. Fouling wires shall be left exposed to allow visual inspection.

7) Any bond, weld, or connection installed by the Contractor that is found to be defective prior to acceptance shall be removed and a new bond installed as part of the work at no additional cost to the Contract.

e. Existing Bonding

1) If existing rail bonding is in place on the approach circuits, then the Contractor shall inspect and verify that all such bonding, including track switches, is in accordance with these specifications. If additional rail bonding, or rail bonding corrections, is required then the Contractor shall correct any such deficient existing rail bonding at no cost to JAXPORT in accordance with these specifications, or as directed by the EIC. Final determination of bonding requirements will be made by the JAXPORT.

6. Retirement and Disposal of Existing Equipment

a. All retired existing AHCW equipment or passive crossing warning devices shall be removed by the Contractor and transported to a site designated by the EIC.

7. Following the date of in-service operation, all JAXPORT flagging and related crossing protection expense, during periods that the warning system fails to operate as intended by this specification, shall be borne by the Contractor until the system is accepted by JAXPORT

SECTION 344266 - SIGNAL DRAWINGS AND RECORD PLANS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section include This Section specifies the production and furnishing of drawings for the signal system. It describes the general format of drawings, types of drawings and the manner in which information shall be displayed on such drawings.

B. Related Requirements:

1. 344200 General Signal Requirements
2. 344252 Commercial Metered Power Services
3. 344258 Signal System Testing
4. 344264 Automatic Highway Crossing Warning System

1.3 DESCRIPTION OF WORK

A. This Section specifies the production and furnishing of drawings and describes the general format of drawings, types of drawings, and the manner in which information shall be displayed. The Contractor shall use the Contract Drawings as the base for preparation of drawings specified herein as required to suit the proposed system, product, manufacturing process or installation method.

The information on the Contract Drawings describing the existing facilities pertinent to this Contract is accurate insofar as it is shown. The Owner does not, however, guarantee or represent that the existing conditions conform to the Contract Drawings. It shall be understood that conditions may exist which are different from the conditions indicated by the Contract Drawings based on existing plans and that the Contractor assumes all risks regarding the cost or quantity of the work to be done because of any use which he may make of them.

B. Drawings required under this Contract shall be as follows:

1. Shop Drawings - Drawings displaying systems, subsystems, products, arrangements, layouts, etc. as designed and manufactured by the Contractor and proposed for installation. This includes existing drawings revised to depict proposed modifications to existing systems required under this Contract.

   The Contractor shall submit proposed modifications to the existing systems record drawings for each location using "X" for removal and "O" for additions or any other method previously approved by the EIC. Shop drawings shall be prepared in accordance with the requirements of this specification and shall be a prototype of the Record Drawings. All drawings shall be prepared using MicroStation CAD software in accordance with this specification. All drawings shall be prepared using the latest drawing border and AREMA signal symbols.

2. Working Drawings – Shop Drawings will become Working Drawings after they have been submitted and approved for manufacturing and installation. Working drawings shall be updated to include all revisions to shop drawings required after EIC's review and factory testing.

3. As-Built Drawings – Working drawings will become As-Built Drawings after they were updated following installation, field testing and cut-over of any part of Work. A complete set of as-built drawings pertinent to the location that was tested and placed in service shall be left inside instrument housing with all mark-ups made during field testing. As-built drawings shall have all information identifying final location of wayside equipment and facilities including, but not limited to locations of underground facilities such as cable trenches, raceway entrances, utility power tabs and all other system elements provided under the Contract.

4. Within seven (7) calendar days of placing in service any part of Work, the Contractor shall revise As-Built drawings to include all modifications made during field testing and submit them for approval without the use of "X" and "O" symbols or any other revision method. Once approved, these drawings will become Record Drawings.

5. Record Drawings are intended to convey all information required to maintain signal system provided under this Contract and shall show the actual completed state of each location and the entire Project. Record Drawings shall be provided for all new work and for all modifications to existing plans. Quantities of plans for the final Record Drawing submittal shall be as specified herein.

C. Unless the effective date and identification number to be inscribed on the final Record Drawings is furnished by the EIC all existing drawings revised or redrawn shall have revision notation stating the revision description, sequential number, and the date of cut-over. Any new drawing shall have the date and description of work placed in service. The Contractor shall be responsible for the accuracy of all drawings including, but not limited to existing field conditions, signal equipment location assignments, circuit drawings and modifications thereof.

1.4 TYPES OF DRAWINGS

A. Drawings to be delivered by the Contractor shall be comply with these specifications and shall be a prototype of final Record Drawings. They shall have border, shall list previous revisions listed on the current as-in-service (AIS) drawings. Drawing set for each location shall include, but shall not be limited to the following:

1. Cover Sheet that shall bear the name of the submittal package and the name and location of the plan book in two inch high letters, mile post and AAR-DOT number shall be included;

2. Index Sheet that includes the drawings arrangement order, title and description including a list of relay coils and major components used on a particular sheet and future revision number. The final arrangement of drawings shall be based on a logical progression of the circuit's sequence of operations. The drawings order and index sheet shall be approved by the EIC. Index sheets shall reflect all the existing as well as all of the new drawings being provided so as to constitute a complete package of all the signal system drawings for each location that are part of the Project.

3. Symbol Sheet that identifies the meaning or function of all the symbols used on the drawings.

4. Nomenclature Sheet that identifies the meaning of all abbreviations and designations used in the drawings to describe wires, relays, devices, tracks, wayside equipment, and any other items.

5. Track and Cable Plan showing the track configuration, length of approaches to crossing, final location of all wayside equipment and structures pertinent to the work performed under this Contract, cable runs between points of termination, cable make-up and wire sizes, cable raceway types and sizes. Location of the conduits installed by the Contractor shall be identified.

6. Circuit Drawings showing control and indication circuits of a particular function(s) that shall be identified in the drawing title. These drawings shall identify all equipment, cable, and wire termination points, contact assignments, equipment location within the instrument housing, and all other information pertinent to equipment shown.

   Circuit drawings shall contain circuit nomenclature, terminal identification, fuse and resistor sizes, relay contacts identified by number and by the location of the relay on the instrument rack, usage of each relay contact, input/output points, plug connectors and wiring details. Information, such as time settings of timers, shall be shown on the circuit plans beneath the corresponding time element symbol. New and existing equipment identification, manufacturer's name, part numbers and ratings shall be shown on the Record Drawings.

7. Detail Drawings showing the arrangement of terminal boards, instruments, or components inside instrument housing or room, rack, junction box, cabinet, or module.

   The contact arrangement including both the working and spare contacts of vital and non-vital relays shall be shown on these plans. The circuit plan numbers where the contacts, components, or relay are used shall be identified.

8. Installation Layout Drawings showing all details, dimensions, and complete bill of material with part numbers of wayside equipment, equipment housing, dimensions relative to adjacent equipment or structures, tracks, and roadway, mounting details with sizes of utilized fasteners, brackets, and other elements of the layout.

9. Product Drawings showing the dimensions and internal mechanical and electrical details of particular pieces of equipment or assemblies shall bear the title of the particular piece or type of equipment shown;

10. Power Distribution Drawings showing schematic of energy distribution of systems and subsystems required under this Contract. These schematics shall be included as part of the Circuit Drawings.

11. Temporary Drawings showing required temporary work, that will not remain as a part of the completed work.

12. Wiring Diagrams showing the details of electrical connections for various parts of system equipment including junction boxes and other termination points shall bear the title of the particular piece of equipment;

13. Track Circuit Drawings showing a double line track layout with all related equipment, polarities, relay (receiver) and transformer (transmitter) ends, bonding connections, jumpers, and other equipment and connections related to track circuits.

14. Instrument Housing Layout shall be a scaled set of drawings showing instrument and entrance rack layout, location of equipment inside the housing on racks and housing walls, cable entrance details, cable distribution tray layout, HVAC ducts, housing lighting and furniture as well as equipment and terminal arrangements on cable entrance racks, equipment racks, and housing walls.

15. Material Reference Sheet showing description, nomenclature, part numbers and ratings for all materials and equipment provided.

16. All other drawings that are required to illustrate all proposed and/or completed work as specified herein or requested by the EIC.

1.5 QUALITY ASSURANCE

A. All drawings submitted by the Contractor shall be in accordance with the industry standards for AHCW circuit and detail design. Approval of the Drawings shall be at the discretion of the EIC. Prior to submittal, verify that the drawings conform to the Contract requirements specifically addressing the following:

1. Use of AREMA Standard Symbols and nomenclature.

2. Conformance to the Specifications.

3. Logical grouping and arrangement of subject matter.

4. Accuracy.

5. Legibility.

6. Neatness.

7. Line quality.

8. Lettering quality.

9. Reproduction quality.

10. Lack of clutter and minimum of crossed lines.

11. Inclusion of interfaces with related contracts.

B. During the review of submitted drawings the EIC will consider the points enumerated above, with the basic criteria for obtaining approval being that drawings are easy to read, understand and use.

1.6 DRAWINGS SUBMITTALS

A. Drawings shall be submitted in accordance with requirements of Submittals Section of these specifications. Prior to production of plans submit a sample of project drawings 11x17 inch size with the JAXPORT border and title block provided by the EIC.

B. All drawings germane to the product, subsystem, or location shall be grouped together and submitted at the same time. This logical grouping of drawings shall be referred to as a submittal package.

C. Modifications to existing facilities and proposed temporary work marked with "O" and "X" or other approved method shall be submitted four (4) weeks prior to the scheduled date of implementing work.

D. When recording work in progress use green color to show conditions that are acceptable, brown for contacts verified, red for circuit changes to be added, and yellow for circuit changes to be removed.

The Contractor's approved signal EIC shall sign and date all circuit testing and changes. As revisions are made, they shall be copied to all prints at each location.

E. As-Built Drawings with all revisions clearly marked shall be left inside each pertinent instrument housing (SIH, Case, JB, etc.) after placing in service any portion of the work, unless otherwise directed by the EIC. One paper copy shall be left at the Project office and one shall be submitted to the EIC for approval.

F. After approval of as-built drawings and completion of all "punch list" items the Contractor shall submit a complete set of final Record Drawings as specified herein. Record Drawings shall incorporate all modifications made during final cut-over of each part of every phase of the implementation of the Contract. Record Drawings shall have no "X" and "O" symbols or other means of drawing modifications.

G. Record Drawings shall be provided by the Contractor to the EIC within seven (7) days after the work is complete and in-service. Record Drawings shall also be furnished by the Contractor to the EIC in MicroStation CAD format and PDF format for use on a Windows based PC.

H. Within 7 days of completing punch-list items the Contractor shall submit the Record set of drawings that shows the final configuration of the AHCW system at each location. Record drawings shall be provided as follows:

1. One printed set 11"x17" of plans shall be delivered to each signal location and placed inside the instrument housing.

2. Two (2) sets 11"x17" of all Record Drawings bound in a protective covering shall be delivered to the JAXPORT Project office.

3. MicroStation CAD files and PDF files for use on a Windows based PC shall be delivered to JAXPORT or as directed by the EIC.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Electronic files of all drawings shall be in the most recent release of MicroStation available. The Contractor shall maintain an electronic copy of the Project CAD files for a period of not less than five years at his facility.

B. Supply a matrix of layer names and colors for all drawings. Review plotting procedures with JAXPORT's CAD personnel and ensure all drawings can be plotted satisfactorily using JAXPORT owned equipment.

C. CAD Standards used for creating and plotting drawings such as pen weights, text heights, colors, etc. shall be obtained by the Contractor from the EIC. No x-ref files shall be utilized.

D. All copies of plan books and submittal drawings shall be bound with a protective cover and backing as manufactured by Wilson & Jones or approved equal.

PART 3 – EXECUTION

3.1 BASIC FORMAT REQUIREMENTS FOR DRAWINGS

A. Drawings shall not be crowded or cluttered and shall be arranged to be easily readable. Circuitry shall be presented on the drawing with a minimum of crossed or offset lines. Where applicable, a schematic track diagram shall be included to show the area of work.

B. Complete circuits shall be shown on each drawing insofar as practicable. Circuit continuations shall be kept to a minimum. When circuit continuations are used, they shall be clear and specific and shall include the identity of circuit, reference letter and continuation sheet, even when continuation is on the same sheet.

C. New drawings requiring continuation of, or match lines to, existing drawings shall match the existing drawings in format, relative placement of equipment, cables, tracks, and other items depicted on the drawings.

D. When circuit continuation is required, the reference to continuation shall have a circuit nomenclature, circle with a letter at the end of the line depicting wire, and sheet number where continuation is shown.

E. Local or equivalent circuits shall be drawn with relay coils, timers, motors, or other operated devices shown near the right or left border of the drawing wherever practical. Where there is a choice the right border shall be favored. Contacts in circuits shall be laid out in geographical succession insofar as possible and practical.

F. Relay nomenclature shall be printed in three lines, as follows:

Top – Coordinate	(3A2)	(15B6)
Middle - Name Identification:	10-2N	10-3
Bottom - Function Description:	AS	NWCP

G. Relay nomenclature shall appear above top of coil or contact.

H. Stick contacts shall line up under the coil of the controlling relay. Relay contacts shall line up with the controlling coil and other contacts of the same relay insofar as practicable. Different relay contacts and coils shall not line up.

I. A minimum distance of 0.40 inch shall be maintained between lines representing circuit wiring. Lettering or printing shall be at least 0.10 inches high. All spacing shall be in multiples of tenths of inches.

J. All track and cable drawings shall show the survey stations for all wayside equipment, junction boxes, signal instrument housings and related structures.

K. All circuits shall reflect the actual wiring indicating all contact and terminal numbers. When the final circuit is wired differently from the Contractor's drawing, revise the drawings to indicate the actual wiring before preparation of As-Built drawings.

L. The arrangement of circuitry shall be in such a manner that no more than two wires shall be shown connected to a single terminal or contact pin. A uniform method shall be used to indicate the actual

location of double wire connections when it is not desirable to show both wires at the point of termination. Wires shall be shown at the actual point of termination.

M. Use symbols and nomenclature as shown on the Contract Drawings and specified herein, unless otherwise directed by the EIC.

N. All modifications to existing plans shall be prepared by reproducing the original existing drawings in CAD and then adding all proposed revisions. The modified existing plans shall be submitted for approval as all project drawings and shall be approved by the EIC prior to implementing proposed modifications to existing system.

O. Unless otherwise directed by the EIC, all CAD drawings prepared by the Contractor shall be as follows:

1. DRAWING REQUIREMENTS:

   a. Drawing Lines shall be continuous from start to finish.

   b. Any filling shall be solid no hatched fills.

   c. All track circuits shall be shown with the track layout.

   d. The Contractor shall have their Logo in revision box.

2. WORKING UNITS

   a. The working units' settings are as follows:

      1) Unit Names:

      2) Master Units: IN

      3) Sub Units: TH

      4) Resolution: 10 TH Per IN, 1000 Pos Units Per TH

      5) Working Area: 429496 IN

3. GRID SETTINGS

   a. The grid has been set as follows:

      1) Master/Grid: 0:1.0000

      2) Reference Grid: 10

      3) Configuration: Orthonal

      4) Aspect Ratio (x/y): 1.0000

4. LOCK TOGGLES

   a. The gridlock toggle shall be on whenever possible.

b. The unit lock toggle shall be on for all element placements. Unit lock Distances (UR) have been set in the seed file for 0:0.5000 between grid marks.

c. The snap toggle shall be on.

d. The remaining locks shall be turned off.

5. GLOBAL ORIGIN

a. The (GO) control is where the X, Y=0,0 point is located with respect to the design plane.

b. The Global origin has been set to the lower left border of the drawing inner borderline.

6. LEVEL SYMBOLOGY

a. The level symbology shall be turned on at all times.

7. TEXT

a. EICing Font #3 shall be used for all text.

8. TEXT SIZE

a. The following sizes shall be used for all text:

1) General Text, Notes, Equipment Description and Line Tagging.

a)	Height	0.1000
b)	Width	0.1000
c)	Line Spacing	0.5000
d)	Line Length	255
e)	Interchar Spacing	0.0000
f)	Slant	0.0

2) Headings and Title Block Information:

a)	Height	0.2000
b)	Width	0.2000
c)	Line Spacing	0.5000
d)	Line Length	255
e)	Interchar Spacing	0.0000
f)	Slant	0.0

9. TEXT PLACEMENT

   a. All text shall be placed with the unit locks on. Line tag text shall be centered 0.500 tenths above the line. "Data Fields" shall be used where provided in accordance with the cell library.

10. TEXT JUSTIFICATION

    a. The preferred justification settings are:

       TXJ= LC, CC or RC

       TNX=LC, CC or RC

11. CELLS

    a. Cells used in drawings shall not be "Dropped Status" and rearranged.

    b. Cells and Drawings that require filled in areas will be solid fills and not hatched fills.

12. VIEW ATTRIBUTES

    a. The following view attributes shall be adhered to. View #1 shall be displayed on the main screen and view #7 displayed on the other screen if equipped. (See Attached View Attributes Chart).

13. PLOTTING

    a. View #7 is standard plotting view.

    b. All plots shall be 11"x 17" size unless otherwise requested by the EIC.

    c. All plots shall be clear and legible.

    d. Plots shall be plotted in black and white.

    e. Level Symbology and Line weights turned on.