

CONTINUOUS WELDED RAIL

****From Proctor-Middlebury STP WCRS(7)**

- xx. DESCRIPTION. This work shall consist of removing existing rails and furnishing and installing new continuous welded rail (CWR); inventorying, transporting, and stockpiling salvaged rail and Other Track Materials (OTM); scrapping of non-salvaged track materials; and de-stressing rail as required, at the locations indicated in the Plans and as directed by the Engineer.
- xx. SUBMITTAL REQUIREMENTS. Inventory of salvaged materials shall be submitted to the Engineer for review and approval.

Submit the following additional information for review and approval by the Engineer:

- (1) List of proposed equipment for use in construction. The list shall be submitted to the Engineer fifteen days prior to the start of work and shall include the name of any manufacturer of material, dimensions and weights of the equipment, and the intended use of each piece of equipment.
- (2) Proposed construction and procedures (Procedures) for rail installation. Procedures shall identify the sequence of work including distribution, installation, and pickup of materials. Procedures shall specify proposed equipment to be used, number of and classification of employees to be used, assumed hours of on-track work and off-track work, and assumed production rates. A projected schedule shall be provided for all activities.
- (3) Supervisor and/or foreman must be qualified to supervise certain track renewals as defined by FRA Track Safety Standards, Section 213.7.
- (4) Information, such as catalog cuts for bolts, spikes, insulated joints, rail anchors, and signal bonding material shall be furnished to the Engineer to verify proposed material is in conformance with specifications.

The following Other Track Material information shall be submitted to the Engineer prior to ordering materials:

- (1) Certificates of Compliance shall be provided for all materials furnished by the Contractor.
- (2) Samples of acceptable materials proposed for use prior to any construction. Any Contractor furnished materials which are installed in track and subsequently found to be defective shall be replaced by the Contractor at no additional cost to the Agency.
- (3) Fabrication Drawings of all major track material components for review and approval by the Engineer.

The following rail and joint bar information shall be submitted to the Engineer prior to ordering materials:

- (1) Manufacturer's Catalog Data. Within 30 days of receipt of the Notice to Proceed, and before installation of the materials, a complete schedule of the materials proposed for installation and the source of the material shall be submitted to the Engineer for review and approval. Information to be provided on rail shall include: rail weight, rail section, rail wear (if applicable for fit rail), drilling, typical rail length, date rolled, and the name of the mill where the rail was rolled. The design of the joint bars and compromise joint bars proposed to be furnished with each rail section shall also be provided.
- (2) Certificates of Compliance. The Contractor shall submit Manufacturer's Data and Certificates of Compliance for the following materials:
 - a. Joint Bars
 - b. Compromise Joint Bars (as required)
- (3) Fabrication Drawings of all joint bars and compromise bars to be furnished to the Engineer for review and approval.

xx. MATERIALS.

- (a) Approval of Materials. Within 20 calendar days of the Contractor's submittal of Manufacturer's Data or Certificates of Compliance, the Engineer will notify the Contractor of the materials acceptance or rejection. Rejected materials that have already been delivered to the project site shall be promptly segregated from the approved materials and removed from the premises. If materials are rejected, acceptable replacement materials shall be furnished by the Contractor at no additional cost to the Agency. Initial approval of materials will not prevent the removal and replacement of materials not meeting the requirements of these provisions or defective materials discovered during construction, inspection of the work, and routine QC/QA operations. If requested by the Contractor, the Engineer will make an off-site inspection of the rail and joint bars proposed for use in this project. The Contractor shall bear all expenses incurred for this inspection.
- (b) Rail Furnished by the Agency. Rail to be replaced outside of reconstructed grade crossings and turnouts will be furnished by the Agency. Rail to be installed at farm crossing (MP 66.92) will be furnished by the Agency. Rail is 115 RE and 131 RE, as shown on the Plans. Replacement rail will be located as indicated on the Plans.

Any rail obtained from the Agency shall be subject to inspection and acceptance by the Engineer. Rail installed shall be free of shelly spots, head checks, corrugations, bends or kinks, or any other visual defects. Rail shall be inspected prior to distribution along track. Used rail will not be used if it contains visual rail defects or if the wear exceeds the following limits from its original dimension:

Vertical head wear - 1/8 inch

Horizontal head wear - 1/4 inch
End batter - 1/8 inch
Base and web thickness - 1/16 inch
Head flow - 1/8 inch

(c) Rail Furnished by the Contractor.

- (1) Rail. CWR to be installed within the limits of reconstructed grade crossings, as indicated on the Plans, shall be furnished by the Contractor.

In reconstructed grade crossing areas, 136 RE new or relay continuous welded rail shall be used.

New head hardened rail shall conform to the Specifications in Chapter 4 of the AREMA "Manual for Railway Engineering".

It is the goal of the project to have as few welds or joints as practical. New rail shall be furnished in 78 foot sections wherever possible. In no case shall new rail be furnished in lengths of less than 39 feet unless approved by the Engineer. Rail drilling shall be approved by the Engineer. Drilling shall be uniform and match existing drillings. Rail drillings shall be as specified in AREMA, Chapter 4, Part 1. Running rail ends that are not welded shall be drilled with six holes. The rail to be field welded shall have blank ends or only the rear hole drilled. The rail to be plant welded shall have blank ends.

- (2) End Condition. Rail fishing in the joint bar area shall match the appropriate rail section.

Any necessary bolt holes shall be drilled.

Rail ends shall be square and shall be cut with an approved abrasive rail saw. Torch cut rails will not be accepted.

Chipped rail ends greater than 1/16 inch shall not be allowed. Rail chips of 1/16 inch or less shall be removed by rail end slotting per AREMA Plan No. 1005-40.

- (3) Straightness. Rail ends shall have a deviation from a lateral (horizontal) line not to exceed a maximum mid-ordinate of 0.030 inch in 3 feet or 0.023 inch at the end quarter point of a 3 foot chord.

Rails shall be straight horizontally, except that not more than 10 percent of the order may have lateral side sweep not greater than that indicated by a mid-ordinate of 1/2 inch in 30 feet.

Rails and rail ends shall be straight vertically with no upsweep or droop permissible.

(4) Relay Rail. Relay rail having any of the following defects or exceeding the following wear limits shall not be accepted:

a. Bolt hole cracks or breaks, broken base, breaks, crushed head, detail fracture, engine burn fracture, head-web separation, piped rail, horizontal split head, vertical split head, torch cut rail ends, torch cut bolt holes, and compound or transverse fissures. The presence of any of these defects in the rail render that rail as scrap.

b. Rail with wear limits greater than that specified above will be rejected. Relay jointed or CWR rail shall only have wear on one of the side of the head. Rail with wear on both sides of the head will be rejected.

(d) Joint Bars. New toeless, six-hole, 36 inch joint bars shall be used for permanent or temporary joints in new rails. Relay six-hole, 36 inch joint bars may be used for temporary joints in relay rail. Joint bars shall be of the size, shape, and punching pattern to fit the rail being joined. Joint bars shall conform to the requirements of "Specifications For High-Carbon Steel Joint Bars" or "Specifications For Quenched Carbon-Steel Joint Bars and Forged Compromise Joint Bars" specified in Chapter 4, Part 3 of the AREMA "Manual For Railway Engineering."

Compromise joint bars shall be new and of the size, shape, and punching pattern to fit the rail sizes and sections being joined. Compromise joint bars may be relay if used for temporary connections in relay rail. Compromise joint bars shall conform to the requirements of "Specifications For Quenched Carbon-Steel Joint Bars and Forged Compromise Joint Bars" found in Chapter 4, Part 3 of the AREMA "Manual For Railway Engineering." Only factory designed and produced (forged or cast) six-hole compromise joint bars shall be used to join rails of different sizes and/or sections. Compromise bars shall be manufactured to take into account the wear of the adjoining rails.

The difference in rail sections joined by compromise joint bars shall not exceed 21 pounds per yard.

Furnish Fabrication Drawings of all joint bars and compromise bars to the Engineer for review and approval.

(e) Other Track Materials Provided by the Agency. Anchors and tie plates for rail reconstruction located outside of reconstructed grade crossings and turnouts will be furnished by the Agency. Anchors and tie plates for rail reconstruction at the farm crossing (MP 66.92) will be furnished by the Agency.

(f) Other Track Materials Provided by the Contractor. Spikes shall be new and 5/8 inch by 5½ inches long. Spikes shall meet the dimensional requirements of the detail entitled: "Design of Cut Track Spikes", AREMA Manual - current edition. The material requirements of the spikes shall be in accordance with the

specification entitled: "Specifications for Soft-steel Track Spikes", AREMA manual - current edition.

Track bolts and nuts shall be new and of proper size for the rail joint and shall conform to the dimensions and specifications given in: "Design for Track Bolts and Nuts," "Rail Drilling, Bar Punching and Track Bolts," and "Specifications for Heat Treated Carbon Steel Track Bolts and Carbon Steel Nuts," all in Chapter 4, Part 3, of the AREMA Manual. Track bolts shall have oval necks.

Spring washers shall be new, 1/16 inch larger than nominal size of track bolt and shall conform to dimensions and specifications given in: "Specifications for Spring Washers," in Chapter 4, Part 3 of the AREMA Manual. A spring washer will be used with each track bolt.

Tie plates for use in reconstructed grade crossings and turnouts shall be new. Tie plates shall be made from low carbon steel. Tie plates shall conform to Chapter 5, Part 1 of the AREMA Manual. Tie plates shall be double shoulder canted. In general, plates should be at least 7½ inches X 14 inches, AREMA Plan No. 8 with B-6 punching.

Rail anchors for use in reconstructed grade crossings and turnouts shall be new and designed for the specified rail section. Rail anchors shall be supplied for manual installation. Rail anchors shall be designed in accordance with specification entitled: "Specifications for Rail Anchors", AREMA Manual - current edition.

- xx. CONSTRUCTION REQUIREMENTS. Prior to beginning the work, the Contractor shall document to the Engineer that the railway company's authorized representative (Railroad Representative) has agreed as to the force to be employed and the speed with which the work shall proceed, and shall notify the Engineer and the Railroad Representative at least five working days in advance so that adequate arrangements can be made for the prosecution of the work.

The Contractor shall provide all tools and equipment needed in connection with this work.

The Railroad Representative may be supported by additional inspectors. The instructions of the Railroad Representative or inspectors regarding the quality and type of work to be done, upon approval by the Engineer, shall be complied with at all times by the Contractor.

The Contractor shall supply the necessary supervision and labor to prosecute the work properly and in such numbers as may be required by the Railroad Representative, and as approved by the Engineer. At the request of the Railroad Representative, as approved by the Engineer, the Contractor shall remove any supervisor or employee not satisfactory to the railway company or the Engineer. The Contractor shall have a supervisor or foreman in charge of installation that is qualified to supervise certain track renewals as defined by FRA Track Safety Standards Section 213.7.

- (a) Ties. Remove sufficient ballast from cribs for adzing and anchor application. When necessary the ties must be adzed to get a full and even bearing for the tie plate. Excessive adzing must be avoided. The adzed surface shall be parallel to the top of the ties. As a tie renewal project has been completed in the area of the CWR installation, only limited adzing shall be required.

All spike holes shall be filled with chemical compound Sure Spike. All newly adzed surfaces shall be coated with an approved preservative. Spike stubs shall be driven as required.

Tie plates will be used under running rails on all tracks.

Tie plates should be free of dirt and foreign material when installed.

Care must be exercised to see that canted tie plates are applied so as to cant the rail inward.

Tie plates must be placed square with the rail and centered on the tie. Particular care must be given to see that the tie plate shoulders are never under the base of the rail and that the tie plates are well seated on the ties and the rail properly seated on the tie plate.

Ties shall be bored with a tie boring machine. Ties must be spiked with two rail-holding spikes on each rail and with additional rail-holding and plate-holding spikes as shown on the Plans.

All cut spikes shall be started and driven vertically and square with the rail and so driven as to allow 1/8 inch to 3/16 inch space between the underside of the head of the spike and the top of the base of the rail. In no case shall the spikes be overdriven, or straightened while being driven.

Spikes on gauge side of the running rail are to be placed across from each other and spikes on the field side of the running rail are to be placed across from each other. Spikes on the field side are to be placed in the hole on the north side to the plate. The pattern is to be held consistent.

- (b) Joints. Insulated joints shall be installed, as required, in accordance with the railway's instructions.

Compromise joints shall be used to connect rails of different sections and/or weight. Compromise joints shall be factory manufactured. Compromise joints shall be of proper size and dimension as determined by weight and section of each rail and wear on the rail. Compromise joints shall be of proper left hand or right hand configuration to correctly align the gauge face and top of rail of each rail section. Compromise joint bars shall not transition between rail section weights which differ by more than 21 pounds per yard. Transitions between rail section weights which differ by more the 21 pounds per yard shall be accomplished by providing intermediate lengths of rail conforming to the preceding requirement as necessary to complete the

transition. Minimum length of the intermediate rails shall be 33 feet.

- (c) Rails. When connecting to existing or new turnouts, no cutting of stock rails or frogs will be allowed. A buffer rail of 39 feet and the same weight and section as the switch shall be placed between each stock rail and frog and the installed rail. A compromise joint shall be installed as required to connect different rail sections.

Rail anchor pattern shall be spaced approximately uniformly along the rail length. To avoid tie skewing, the anchors must be applied against the same tie on opposite rails. Rail anchors when applied must have full bearing against a sound tie.

Traffic shall not be permitted upon the newly installed rail section until the track has been accepted by the Railroad Representative and the Engineer.

- (d) Cleanup. The Contractor shall remove from the railway company's property all rubbish and waste from the work and dispose of it as directed by the Engineer. After completing the work, the Contractor shall remove from the railway company's property, and from all public and privately owned property, at the Contractor's expense, all temporary structures and waste resulting from the Contractor's operations.

The Contractor shall remove joint bar bolts, spikes, rail anchors, and any other rail holding devices in a workmanlike manner which does not damage any existing materials. Flame cutting of bolts to be removed will be permitted providing the joint bars and rails are not damaged.

- xx. INSTALLATION DETAILS. When unloading rail, do not drop it on uneven surfaces or leave it unevenly supported. Place the unloaded rail so it can be laid with as little handling as possible. Rail and OTM shall be distributed along the track prior to starting installation. OTM may be placed within the center of the track.

Joints, except the insulated joints, may be placed where they come without reference to the ties.

- (a) Joint Requirements.

- (1) Six-hole joint bars must be used in CWR, including the main track throughout turnouts.
- (2) Temporary joints must have six-hole joint bars with four bolts. Bolts are not used in the two middle holes of joints to be field welded. Temporary joints must be applied except:
 - a. Where the rail cannot be joined by thermite welding prior to placing track in service.
 - b. Where permanent joints are required.

- (3) Temporary joints must be joined using the thermite welding process. This must be done as soon as possible after the rail is laid and before the joints reach a batter of 0.015 inches.

Lay rail to the correct gauge. In order to maintain correct gauge, at least every fourth tie must be gauged on tangents and every third tie on curves. Plug all spike holes properly. The gauge shall be 56½ inches, unless directed otherwise by the Railroad and the Engineer, between points 5/8 inch below the top of the rail on the two inside edges of the rail.

The use of a method to gauge track by gauging tie plates by drilling of the tie and use of gauge plugs to hold the tie plate shall be permitted.

(b) Rail Laying Procedures.

- (1) Apply joint bars before the track is spiked. The fishing surfaces of joints and bolt threads must be lubricated before the joint bars are applied.
- (2) Rail must be fully tie-plated and bolted.
- (3) Apply rail anchors immediately after rail is laid. All rail laid in a given day must be fully anchored on that same day.
- (4) Do not use a hammer, maul, or other similar tool to drive the rail into position. Instead, slide it into position with lining bars or lift it into place with rail tongs.
- (5) Do not select kinked, crooked, or surface-bent rails for laying in track.

Use a rail saw to cut any rail.

When making bolt holes in the field, all holes must be made with a rail drill.

When rail is being laid in territory equipped with track circuits, a Railroad Signals and Communications Representative will be present to ensure the proper operation of signal equipment. See SIGNALS AND COMMUNICATION of this Section for additional details.

Rail joints shall be applied so that bars are not cocked between the base and head of rail. Bars are to be properly seated in rail. Tighten bolts to the required torque, starting with the two bolts in the middle of the bar and working towards the ends. Strike both bars with a sledge hammer during the tightening process to help seat the bars properly. Do a final re-tightening of the two middle bolts. Torque bolts as required by AREMA for the respective bolt size. All bolts shall be torqued with a mechanical bolt machine and set to apply the required torque. Do not strike insulated joint bars in this manner.

Tamp all ties on which the newly laid rail does not have a full bearing. Use a mechanical tamper. Ties shall be tamped after rail is bolted and laid in tie plates and prior to gauging and spiking. No raising of track will be required or allowed.

For installation of compromise joints, space track ties under compromise bars at 18 inch centers with a tie directly under the rail end of the lighter of the two rail sections being joined. It is required that good hardwood ties be maintained under compromise joints. When using temporary compromise joints as part of rail change-out or turnout change-out programs, it is permissible to use track shims to support the joint until the shims and compromise joints are removed the next day. Tamp the ties to support any permanent compromise joints left in the track. Do not use shims to support permanent compromise joints.

After rail installation operations are completed, the ballast shall be "dressed" manually or by machine to restore the original ballast section. There shall be no ballast material left on the base of the rails, tie plates, or top of the ties. Switches and other appliances shall be dressed and swept and cribs dressed so that the ballast does not interfere with the motion of the switch, switch point derail, and/or derail.

When necessary to make a temporary connection for the passage of a train, the union shall be made with a rail of the section being renewed. The closure rail shall not be less than 14 feet long, and shall be connected to the new rail by a compromise joint if the rails are of different sections. The connection rail shall have a full number of bolts and spikes. At the completion of a day's work, a short section of new rail not less than 18 feet long shall be used in making the closure and shall be connected to the old rail with a compromise joint.

- (c) Mismatched Rail Joints. The rail match at any joint must be that any dimension of one rail must match the corresponding dimension of the other rail, to a tolerance of 1/8 inch. This applies anywhere within the area of possible wheel contact.

The rail mismatch must be measured once standard or compromise joints have been applied and tightened. If mismatched rail ends have already been battered (the larger rail has been struck by wheels), the amount of battering must be taken into account when calculating the mismatch.

If the rail mismatch is more than the 1/8 inch tolerance, the mismatch will be corrected by grinding the higher rail to match. The length of ramp required for this procedure is calculated as the ramp slope, which must not be more than .010 inch per inch of length.

- (d) Temperature Requirements. CWR should be laid within the preferred rail laying temperature (PRLT) range, as indicated on the Plans.

Laying and adjusting procedures for CWR are dependent on the maximum and minimum rail temperatures expected.

If CWR is laid at temperatures above the maximum rail laying temperature, the CWR must be adjusted prior to November 30th of year installed.

If CWR is laid at air temperatures below the minimum preferred rail laying temperature, rail heaters will be used to bring rail temperature within range of PRLT.

The rail temperature of any CWR string laid must be measured with an accurate thermometer placed on the base of the rail near the web. The thermometer designed for measurement of rail temperature must be away from the wind and out of direct sunlight.

- (e) Rail Expansion. CWR rails must be laid without expansion gaps.

To lay CWR which is below the minimum preferred rail laying temperature, the rail must be heated to the preferred laying temperature with a propane rail heater. The rail heater is operated directly behind the rail-laying crane or rail vibrator. The temperature of the rail determines the amount of heat required.

On the base of the rail next to a secure tie plate which has been gauged, mark the exact distance the rail must expand based on the difference between the rail temperature and the PRLT. This should be done at each quarter point and the end.

To ensure proper rail movement occurs, the rail must be vibrated by a mechanical vibrator.

Do not under any circumstances use spike mauls, sledge hammers, or other types of hammers or tools to vibrate the rail by striking it.

Equipment such as hydraulic rail pullers may also be used to expand the rail to the proper PRLT equivalent length.

- (f) Use of Anchors. Rail anchors must be applied immediately after CWR is laid. All rails laid in a day must be fully anchored before the end of the day.

Trains must not be allowed to pass over the unanchored CWR except in an emergency. Then, they must not go faster than five miles per hour.

Use following procedures when anchoring CWR:

- (1) For the first and last 200 feet of each string, including connections as noted on the Plans, apply and box rail anchors at every tie in both directions, including where joints are to be thermite welded. For the remainder of the string, apply and box anchors at every second tie for restraint in both directions.

- (2) Where CWR joins conventional jointed rail, all rail, except those supporting the rail joint, should be box anchored for 200 feet in each direction.
- (3) If joints have been eliminated by thermite welding, it is permissible to remove anchors on every second tie.
- (4) For welded rail over 90 feet long but less than 400 feet long, apply and box rail anchors at every tie in both directions.
- (5) Where continuous welded strings are connected to jointed rails, apply and box anchors at every third tie on the jointed rail.
- (6) Where CWR connects to bolted rail, anchor the first six bolted rails at every third tie in both directions.
- (7) Through turnouts and other special trackwork connected to CWR, anchor rails in accordance with the following;
 - a. Every tie in each track of the turnout shall be box anchored wherever possible, i.e. when anchors are applied to one rail, anchors are also required on the opposite rail of the same track. Rail anchors should be applied on the gauge side of the rail except where insufficient clearance restricts the use of the anchor or application tool, in which case anchors may be applied from the field side of the rail where clearance permits.
 - b. In addition to the mainline, the diverging track shall be anchored a sufficient distance to prevent rail movement from disturbing the switch point and frog.
 - c. Every cross tie shall be box anchored for 200 feet ahead of the head block and 200 feet behind the frog on each track on each side of the turnout.

A minimum 12 foot stagger should be maintained between welds and bolted joints.

Every tie must be box anchored for a distance of at least 300 feet back from the abutment at either end of bridges.

Bolted joints, including temporary jointed, in connecting strings of continuous welded rail must not be located on bridges. Also, they must not be located on roadbed approaches within 300 feet of the ballast walls at either end of the bridge.

Anchor decks laid with CWR to open deck bridges as follows:

Anchor every third tie to the bridge spans. All anchors must use two fasteners, each equivalent to a 3/4 inch diameter bolt. Railroad to install fasteners prior to CWR installation.

A record of all CWR strings laid must be maintained and given to the Engineer. The record must indicate the date, the string number, the weight of the rail, the manufacturer, the year, the temperature at which the rail was laid, the mileage location, and whether the string was north or south rail. Each rail string shall be marked with a permanent method that identifies each rail. Markings shall be on each end of the rail. The method of marking rails shall be submitted to the Engineer for approval.

xx. REMOVAL, SALVAGE, AND DISPOSITION OF MATERIALS.

(a) Salvage. The following materials shall be salvaged for later use by the Agency:

(1) All 105# rail.

(2) All OTM with the exception of used spikes, nuts, bolts, and washers.

(b) Inventory of Track Materials. The Contractor shall keep a detailed inventory of excess and salvaged track materials stockpiled for the Agency.

Detailed inventory shall be recorded and submitted to the Engineer in an appropriate format acceptable to the Engineer. Payment under this Section shall be contingent upon the Engineer's acceptance of the inventory.

(c) Transport and Stack Excess and Salvaged Materials. Excess and salvaged materials which are not used in track repair work shall be stacked at a site as indicated on the Plans and designated by the Engineer.

(d) Stacking of Rails.

(1) Rails shall be stacked on approved sills a minimum of 6 inches above the ground.

(2) Rails shall be stacked with the heads up and with the ends even.

(3) Each layer shall be separated by at least three (3) 2 inch X 4 inch wood strips evenly spaced along the length of the rail.

(4) Rail shall be grouped by weight, section, drilling, condition, length, and amount of wear.

(5) The weight, section, drilling, and length shall be marked on one (1) of the rails near the mid-height of the stack.

(6) These markings shall be painted neatly near one (1) end of the rail.

(e) Stacking of Joint Bars, Gauge Rods, and Tie Plates.

- (1) Joint bars, gauge rods, and tie plates shall be sorted by section, punching, and condition and shall be stacked on pallets.
 - (2) Each pallet stack shall be steel banded for forklift handling.
 - (3) The maximum weight on any pallet shall be 1,500 pounds.
 - (4) Compromise joint bars shall be wired together in pairs and stacked on pallets, separate from other bars.
- (f) Containers.
- (1) Rail anchors shall be sorted by type and size and placed in kegs, steel drums, or other approved containers.
 - (2) Containers shall be labeled with the rail weight and section.
- (g) Material to be Scrapped. All 100# rail, used spikes, nuts, bolts, and washers shall be scrapped and shall become the property of the Contractor and shall be removed from the project site.
- (h) Quarry Track Siding Turnout. The existing quarry track siding turnout shall be removed and salvaged in accordance with BALLASTED TURNOUTS of Section 900.

xx. SIGNALS AND COMMUNICATION.

- (a) Insulated Rail Joints. Furnish and install joints and insulated joints on all tracks. Insulated joints shall be new non-bonded encapsulated joints.

The location of insulated joints shall be coordinated by the Contractor with the Railroad Representative and the Engineer as required.

The Contractor shall protect in place all existing rail highway crossing warning system equipment, e.g. flashers, signs, equipment cases, cables, and associated equipment during installation of rail and related track work installation and during operational field testing of the crossing system.

- (b) Rail-Highway Crossing Active Warning Systems. This work shall consist of furnishing, installing, material, hardware, and all necessary appurtenances specified or required to replace rail in area with existing safe and operating Automatic Highway Crossing Warning (AHCW) System(s) as described in these provisions and as indicated on the Plans.

Quality Assurance - 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 Federal Railroad Administration (FRA) Highway Railroad Grade Crossing Rules and

Regulations Governing Testing Maintenance and Inspection, effective August 1997.

Unless otherwise specified herein, all items furnished and/or installed shall be in accordance with applicable Agency, AREMA, Institute of Electrical and Electronic Engineers IEEE, NEMA, FRA Part 236 and the operating railroad standards, practices, and recommendations. In cases of conflict the priority shall be:

- (1) Federal, State, and local laws and regulations.
- (2) Permits.
- (3) Contract Specifications.
- (4) Contract Drawings.
- (5) Agency Standards.
- (6) Railroad Standards.
- (7) AREMA Signal Standards, practices, and recommendations.
- (8) IEEE Standards.
- (9) NEMA Standards.
- (10) Manual on Uniform Traffic Control Devices (MUTCD).

The Contractor shall submit the following for approval:

- (1) Catalog cuts and descriptive literature for all material as specified herein.
 - (2) Complete performance data of the type AHCW system equipment proposed to be furnished and installed.
- (c) Rail Bonds. Non-insulated rail joints shall all be double bonded with a Welded Web Bond installed around all rail joints with the gauge side bond threaded through the joint bar and welded to the rail web and a head bond on the field side of the joint bars.

Welded Web Bonds shall be installed in accordance with AREMA Signal Manual Part 8.1.32 and AREMA Drawing Number 8.1.32, Figure 1.

Rail joints shall be double bonded with a Rail Head Bond installed on the field side of the rails in addition to the welded web bond above. Rail Head Bonds shall be furnished and installed in accordance with AREMA Signal Manual Part 8.1.20 and Part 8.1.30 and AREMA Drawing Number 8.1.31.

Bonds shall be manufactured for use in welded web bond installation. Bonds shall be 5/16 inch tab style, 7 inch nominal length.

- (d) Insulated Joints and Associated Material. Each insulated joint shall consist of two joint bars of the same general hole configuration as standard joint bars conforming to the dimensional requirements of the existing rail section. Each insulated joint bar shall consist of a rolled, heat-treated steel core surrounded by a uniform, single pour, polymeric insulation material and designed for use in installations requiring insulated signal joints.

Bar, end post, and bushing insulation material shall be impervious to oil, grease, and water, and shall have electrical resistance characteristics equal to or greater than fiber insulation meeting the requirements of the AREMA Signal Manual Part 14.5.1. Insulated joints shall be highly resistant to abrading, cracking, cutting, spalling, and fatigue failure under impact loads, and shall exhibit deflection characteristics comparable to standard steel rail joints.

All insulated joints shall be furnished complete with bars, end posts, bushings, and washer plates.

Bolts, spring washers, and nuts shall be furnished.

Fasteners shall be swaged type fasteners. Bolts and swage collars shall be of wide flange design. Bolts shall be Grade 5 or higher. Bolts shall be of proper diameter to fit joints.

Tie plates for insulated joint support shall be polymer, insulated steel plates, or approved equal.

- (e) Insulated Joint Installation. Insulated joints, where required, shall be furnished by the Contractor in accordance with INSULATED JOINTS of Section 900.

- (f) Rail Bonding Installation. All non-insulated joint bars in the crossing circuited territory shall be double bonded with one 48 inch long welded web bond and one 60 inch plug type web bond.

Track switch, frog fouling bonds, and track circuit connections shall be exothermically welded bonds.

- (1) Welded Bonds. 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.

The Contractor shall ensure that each bond connection is thoroughly welded to the rail. The Engineer 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 Engineer is reasonable.

The Contractor shall demonstrate that the bonding is in accordance with the requirements of this Section and as specified in AREMA Signal Manual Part 8.1.32 and AREMA Drawing Number 8.1.25 Figure 1 (type 2 plug).

- (2) Plug-Type Rail Web Bonds. Plug-type web 60 inch bonds shall be installed in accordance with AREMA Signal Manual Part 8.1.25 and AREMA Drawing number 8.1.25 Figure 1 (type 2 plug).

Rail shall be drilled in accordance with AREMA 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) Track Circuit Connections. New track circuit connectors shall be furnished and installed in accordance with AREMA Signal Manual, Part 8.1.32 and meet the requirements of AREMA Signal Manual, Part 8.1.33. Connectors shall have a tab end that fits squarely to the rails. 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.

Track circuit connectors shall be furnished and installed with insulated bond strand cable. The bond strand shall have a nominal diameter of 0.200 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 hosing to prevent damage from ballast and frost in the ground.

Prior to installation of the new rail, existing track circuit connectors and track circuit cable shall be exposed, if required, and protected in place during the installation of the new rail.

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.

A twenty-four inch piece of Cordura hose shall be located beneath the rail base and sealed with sealing compound, in a manner approved by the Engineer.

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 the Agency.

Care shall be taken to avoid excessive slack in the bond conductor to prevent vandalism.

Any bond, weld, or connection installed by the Contractor which is found to be defective prior to acceptance, shall be removed and a new bond shall be installed as part of the work at no additional cost to the Agency.

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, are required then the Contractor shall correct any such deficient existing rail bonding at no cost to the Agency in accordance with these provisions, or as directed by the Engineer.

- (4) Quality Assurance Testing Procedures. All test procedures and inspection procedures shall be subject to the approval of the Engineer and Railroad and shall comply with all FRA rules and regulations.

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.

The Engineer and the Railroad shall have the right to witness any or all field tests conducted. The Engineer and the Railroad 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 an authorized representative of the Agency and the Railroad being present and witnessing the in-service tests, unless otherwise agreed by the Engineer.

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.

In the event that the system does not meet the requirements of these provisions, 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 Agency.

- (5) Field Test Procedures. 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.

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 these provisions. These tests shall be performed prior to any operational testing of systems or subsystems.

The Contractor's test procedures shall consist of pre-printed data sheets or inspection sheets for each test. The Contractor shall submit test results on a form(s) approved by the Engineer. When completed by the field test personnel and checked for accuracy and completeness, this form(s) shall be submitted as the test report.

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.

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 Engineer.

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 Agency or Railroad inspector.

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.

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 Engineer. 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 Engineer and the Railroad.

The Engineer and the Railroad 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.

Any changes made after completion of test procedure shall be retested in accordance with the applicable test procedure.

(6) Field Tests and Inspection.

- a. General Field Tests. General field tests shall include, but not be limited to, the following:
 1. Ground verification test.
 2. Operating tests.
 3. 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 provisions.
- b. Circuit Continuity Tests. 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.
- c. Circuit Wiring Verification. 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.
- d. AHCW Operational System Tests. A test train shall be used to verify that any AHCW predictor equipment installed under this Contract has the specified warning time at each highway grade crossing.

Tests of the AHCW systems shall be performed in both directions at various speeds to the satisfaction of the Engineer.

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 Railroad. Any such alternate procedure proposed shall be accompanied with verification documentation of such field tests performed by the Contractor for similar AHCW installation projects.

- xx. OPERATIONS AND REQUIREMENTS OF CONTRACTOR SUPERVISION. The work shall be supervised at all times by a Contractor superintendent and a foreman in charge of field operations who are well experienced in track construction and fully qualified to direct and supervise the installation of ballasted trackwork on railroad systems.
- xx. METHOD OF MEASUREMENT. The quantities of Special Provision (Continuous Welded Rail) and Special Provision (Removal and Replacement of Relay Continuous Welded Rail) to be measured for payment will be the number of meters (linear feet) of rail (measured as track feet) installed in the complete and accepted work.
- xx. BASIS OF PAYMENT. The accepted quantities of Special Provision (Continuous Welded Rail) and Special Provision (Removal and Replacement of Relay Continuous Welded Rail) will be paid for at the Contract unit price per meter (linear foot). Payment will be full compensation for removing existing rails; furnishing and installing new continuous welded rail (CWR); inventorying, transporting, and stockpiling salvaged rail and Other Track Materials (OTM); scrapping of non-salvaged track materials; de-stressing rail as required; performing related signal and communications work; and for furnishing all labor, tools, equipment, and incidentals necessary to complete the work.

Partial payments will be made as follows:

75% of the Contract unit price will be paid upon accepted installation of the rail.

The remaining 25% of the Contract unit price will be paid upon acceptance of the inventory of salvaged material by the Engineer and the transport and stockpiling of salvaged material.

Removal and salvage of the quarry track siding turnout will not be measured and paid separately, but will be considered incidental to the work under this Section.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
900.640 Special Provision (Continuous Welded Rail)	Meter (Linear Foot)
900.640 Special Provision (Removal and Replacement of Relay Continuous Welded Rail)	Meter (Linear Foot)