# SECTION 34 11 45

# PROCUREMENT OF SPECIAL TRACKWORK SWITCH COMPONENTS

### PART 1 – GENERAL

- 1.01 SUMMARY
  - A. The Detroit People Mover (DPM) System serves the Greater Detroit Downtown business area providing convenient service to attractions including Detroit Opera House, Joe Louis Arena, Cobo Hall Convention Center, the Renaissance Center and Greek Town, along with various hotels and restaurants. The system is an aerial structure loop track as shown in Appendix 34 11 00 A Site Plan consisting of a single mainline track 2.88 miles long. The aerial structure height varies and is approximately 35 to 45 feet above street level. The aerial structure consists of numerous ancillary components to the track, such as, the running rails and fasteners for the track; two ATC cables with conduits and wall mounted Traction Power Rail System as shown in Appendix B Typical Section Through Guideway Beam.
  - B. This section includes provision of replacements for fabricated components of rail in the special trackwork switch area only in the turnout identified as the Turnout No 1 site and details of the switch in DWG NO. 21114/DPM Turnout No. 1 (LH) with Movable Point Frog on Existing Fasteners.
  - C. The Turnout No. 1 special trackwork was originally procured from Germany (Krupp Stahl AG). As shown in DWG NO. Z631-TW-98 No. 6 Turnout Switch Details it was fabricated using AREMA 115RE rail throughout the turnout but with switch rails fabricated from the EN60E1A1 (formerly Zu.1-60) asymmetrical switch point section as shown in DWG NO. 44543K/DPM. The frog design is moveable point, but at this time the frog will not be replaced. The turnout is supported by direct fixation type plate/pan fasteners with an insert resilient (rubber) pan.
  - D. Turnout No 1 is located adjacent to the Maintenance Facility Building and provides access into the building. The location is the north end of the building, south of Times Square Station and adjacent to the Detroit City Club Apartments between Grand River Avenue and Clifford Street.

- E. Related Sections
  - 1. Section 34 11 00 Rail Replacement Project
  - 2. Section 34 11 15 Dismantling of Existing Track
  - 3. Section 34 11 20 Refurbishing Existing Direct Fixation Fasteners
  - 4. Section 34 11 25 Thermite Welding of Rail
  - 5. Section 34 11 40 Reconstruction of Special Trackwork Switch Components
  - 6. Section 34 11 50 115RE Tee Rail
- 1.02 REFERENCES
  - A. American Railway Engineering & Maintenance of Way Association (AREMA)
    - 1. Manual for Railway Engineering
      - a. Chapter 4 Rail
    - 2. Portfolio of Trackwork Plans
      - a. Plan No. 221, Details for Switch Points
  - B. European Committee for Standardization
    - 1. European Standard EN 13674-2, Railway Applications track Rail Part 2: Switch and crossing rails used in conjunction with Vignole railway rails 46 kg/m and above.
  - C. American National Standards Institute (ANSI):
    - 1. ANSI B18.2.1 Square and Hex Bolts and Screws Inch Series
    - 2. ANSI B18.21.1 Lock Washers
    - 3. ANSI B18.22.1 Plain Washers
  - D. American Standards & Tests of Materials ASTM
    - 1. ASTM E19 Standard Test Method for Brinell Hardness of Metallic Metals
- 1.03 DESIGN REQUIREMENTS
  - A. Special Trackwork Rail and Materials conform to AREMA Manuals for Railway Engineering and German Federal Railways for Design and Assemblies.
  - B. Develop all required details not otherwise delineated on DWG NO. 21114/DPM Turnout No. 1 (LH) with Movable Point Frog on Existing Fasteners in accordance with these Specifications and good practice. The replacement components shall match the existing in design and quality as stated in Paragraph 2.01 A herein.

# 1.04 SUBMITTALS

- A. Submit the following for approval to be in compliance with the general requirements stipulated within the Specifications in the form of Shop Drawings and a Procurement Work Plan narrative. All final shop fabrication drawings (11 × 17 inch size) shall be submitted electronically in pdf form for future records.
- B. Submit the following special trackwork fabrication and material information:
  - 1. Shop Drawings for the details and methods of bending and machining the switch point rails, the forging details, and the process for post hardening of the forged and welded areas.
  - 2. Shop Drawings showing the counter bore drilling details for the internal rail base anchor inserts and the rail base drilling of mounting holes for switch rod connections.
  - 3. Shop Drawings of connecting 115RE transition rails extensions of the EN60E1A1 rails with appropriate transition length showing the length and nature of machining to match the switch point rail transition limits at the frog end.
  - 4. Shop Drawings for the details of the stock rails with undercut, the machining of the internal base anti-rail creep anchors and appropriate switch point rail stop mounting assemblies.
  - 5. Shop drawing of the transition rails showing length and method of planing to provide a smooth transition between the new material and the worn rails at the frog end of the turnout.
  - 6. Complete Procurement Work Plan description of the Work to be performed from initial inspection and review of component conditions of the switch area and identification marking of the components.
  - 7. Complete layout of the special trackwork switch area outlining the limits of the retrofit Work and a Bill of Material itemizing and listing the parts and quantities to be changed out.
  - 8. Submit methods of unloading and stock piling materials at a predetermined ground level storage site.
- C. Submit the following Test and Inspection Reports:
  - 1. Rail Reports from the selected rail mill providing processing information as heat numbers, strand, bloom for all the rails provided.
  - 2. Rail Test Reports or records listing mechanical properties tests, Brinell Hardness Numbers (BHN) and ultra-sonic test confirmation.

### 1.05 QUALITY ASSURANCE

A. The responsibility for all quality for this Contract lies with the Contractor.

- B. The Quality Plan details shall be included within the overall Procurement Work Plan description.
- 1.06 DELIVERY, STORAGE, HANDLING, AND EQUIPMENT
  - A. Handling of all special trackwork materials furnished by the Contractor in an appropriate manner using suitable equipment.
  - B. Contractor shall provide all materials and equipment incidental to the handling, delivery and installation of special trackwork.
- 1.07 DELIVERY LOCATION
  - A. The delivery site is in the Detroit Central Business Area as shown in Appendix 34 11 00 A Site Plan, the DPM (Detroit People Mover) Operations Center and Maintenance Building located at:

# 1250 Park Place Detroit, Michigan 48226

B. The trackwork Contractor will be informed of an appropriate stockpile site for the unloading of the special trackwork turnout rail and components.

### 1.08 CONTACT PERSON FOR DELIVERY

A. The Contractor shall contact the following person at least 40 hours with notice of the Contractor's planned schedule and 24 hours prior to actual shipment delivery at the site. Ernest Latham – Maintenance Manager,

1250 Park Place

Detroit, Michigan 48226

Phone: (313) 442 3594.

This is required to ensure adequate time is allowed for scheduling, delivery and storing the materials.

### 1.09 WARRANTY OF WORK

A. The Contractor warrants to DTC that all materials furnished under the Contract will be of the highest quality and new unless otherwise specified by DTC, free from faults and defects and in conformance with the Contract Documents. The Warranty shall be in accordance with regulations as described in Appendix C – FTA Provisions, Bonding Requirements – Warranty of the Work and Maintenance Bonds of these Specifications. PART 2 – PRODUCTS

### 2.01 CONTRACTOR – FURNISHED MATERIALS

- A. All materials shall be new
- B. Materials to be furnished shall be:
  - 1. Two switch point rails
  - 2. Two stock rails
  - 3. Four transition rails
  - 4. Two switch machine throw rods and two switch machine detector rods
- C. Switch point rails shall be of the EN60E1A1 (formerly known as Zu 1-60) section in accordance with European Standard EN 13674-2 and the following:
  - 1. Metallurgy shall be either
    - a. R350HT, as given in EN 13674-2
    - b. R350LH, as given in EN 13674-2
    - c. An AREMA metallurgy for high strength rail as defined in the AREMA Manual Chapter 4 Part 2 and specification section 34 11 50
    - d. A metallurgy having over 0.30 percent Chromium will not be accepted.
  - 2. Hardness shall be not less than 350 HBn
  - 3. Exhibit 1 presents shape, dimensions, and properties as given in EN 13674-2
- D. Stock rails and other components to be fabricated of rails shall be of 115RE as specified in the AREMA Manual Chapter 4 and specification section 34 11 50
- E. Provide two switch machine throw rods and two detector rods with accessory bolting assemblies at the switch machine and switch point rail connections as shown in DWG NO.
  82001 01402 Point Machine L710H (Switch Rod Arrangement) and DWG NO. 82001 01402 Point Machine L710H (Switch Rod Detailed Assembly)
- PART 3 EXECUTION

#### 3.01 SITE EXAMINATION

- A. Perform an existing conditions review of the turnout site, specifically the switch area and adjacent extensions, where Procurement Work will overlap and be required. The inspection shall include complete requirements of new components of the existing worn switch rods and connections for replacement.
- B. Determine the limits for the transition slope on the switch point rail and adjacent stock rail extensions based on the vertical wear at the toe of the moveable point frog rails see

DWG NO. 21125/DPM Movable Frog Point Turnout Angle 9°31'38". The transition slope shall extend more or less from beyond the heel of switch rail at approximate fastener location 19 to toe of frog at approximate fastener location 24 for a distance of approximate 12 feet providing the flatness slope within the switch rail heel and the toe of frog restrictions. The bolted joints at the toe of the frog shall be cut off with minimum 2 inch clearance beyond last joint bar hole.

C. Undertake all engineering measurements required to support the Shop Drawings for fabrication of replacement components. Key issues being the interface of internal rail anchors, matching of adjacent components and the entire assembly in a workable condition similar to the existing.

## 3.02 SWITCH RAIL FABRICATION

- A. Switch point rails shall each be approximately 30 feet long, the final length to be determined by the contractor to be sufficient to replace the existing switch rails.
- B. Hardness of wheel contact of rail head shall be not less than 350 HBN. Area of hardness shall be as described in specification section 34 11 50, 115RE Tee Rail.
- C. The switch rail will consist in part of the EN60E1A1 asymmetrical rail section and in part of 115RE rail section welded together
- D. The movable end of the switch rail shall be machined into the shape of the Detail 5100 point (also known as the Samson Point) as shown on the AREMA Portfolio Plan 221, Details for Switch Points. Reinforcing bars as shown on Plan 221 are not needed with the EN60E1A1 rail section and shall not be used.
- E. In the vicinity of the point, the bases of the switch rails shall be planed and drilled for attachment of the throw rods and detector rods at the locations shown on DWG NO. 82001 01402 Point Machine L710H.
- F. The butt end of the EN60E1A1 section shall be forged to match the 115RE rail section.
- G. The forged end of the EN60E1A1 section and the 115RE extension shall be welded together (preferably by electric flash butt welding). The location of this weld is to be based preliminarily on that shown on DWG NO. 21114/DPM Turnout No. 1 (LH) with Movable Point Frog on Existing Fasteners with the final location determined in the field, location approved by DPM.

- H. The base of the 115RE extension rail shall be planed for to provide required controlled flexing of the switch point rail for switch throw. The location and length of this planed length is to be based preliminarily on that shown on DWG NO. 21114/DPM Turnout No. 1 (LH) with Movable Point Frog on Existing Fasteners with the final location determined in the field. There shall be no sharp corners in this planed length. Planing shall be by milling or grinding. No flame cutting permitted. with undercut rail base to provide required controlled flexing of the switch point rail for switch throw
- I. Provide the 115RE rail extensions with the insert rail base anchors in the design for fastener locations 18 and 19 on both switch point.

### 3.03 STOCK RAIL FABRICATION

- A. Stock rails shall each be approximately 50 feet long, the final length to be determined by the contractor to be sufficient to replace the existing stock rails and provide the length needed to provide for forming transitions to the existing rails.
- B. Stock rails shall be 115RE in section
- C. Curved side stock rail shall be pre-curved.
- D. The straight stock rail shall be given machined voids for insert of rail base anchors for fastener locations 4, 17, and 19
- E. The curved stock rail shall be given machined voids for insert of rail base anchors for fastener locations 4, 18, and 19
- F. Stock rails shall be given stop blocks mounted to provide the lateral support of the switch point rail in the vicinity of fastener locations 13 and 15 on both left and right stock rails.

### 3.04 TRANSITION RAIL FABRICATION

- A. Transition rails shall each be approximately 12 feet long, the final length to be determined by the contractor to be sufficient to replace the existing stock rails and provide the length needed to provide for forming transitions to the existing rails.
- B. The head of the transition rail shall be planed from the full section on the switch end to the height of the worn rail at the frog end on the other.

- C. Transition rails shall be 115RE in section
- D. Two transition rails shall be straight and two transition rails shall be precurved
- E. See DWG NO. 21114 I DPM Turnout No. 1 (LH) with Movable Point Frog on Existing Fasteners for radius and direction of curvature for the curved transition rails.

## PART 4 – MEASUREMENT AND PAYMENT

### 4.01 MEASUREMENT

- A. The Measurement of Special Trackwork will be LUMP SUM. The Measurement will include the following:
  - 1. One pair of EN60E1A1 switch point rails with 115RE rail extensions and adjacent undercut 115RE stock rails consisting of a right-hand switch point rail and undercut stock rail; a left-hand switch point rail and undercut stock rail; and all appurtenances associated with these components installation, furnished and accepted.
  - 2. Four transition head machined rails for connection to frog and turnout rails.
  - 3. One set of switch point rods consisting of two drive rods and two detector rods.

### 4.02 PAYMENT

- A. The Work of this Section will be paid for at the Contract Price of LUMP SUM for the following work:
  - 1. Pay Item 34 11 45-02 Furnishing of Special Trackwork Components



EN 60E1A1 (formerly Zu 1-60) ASYMMETRICAL SWITCH RAIL

EN 13674-2:2006+A1:2010 (E)

Figure A.5 – Rail profile 60E1A1



END OF SECTION

5.50 in<sup>3</sup>

=

90.1 cm<sup>3</sup>

:

Section modulus y-y axis left

Width shoulders "B" : 52.053 mm = 2.0493 inch

# SECTION 34 11 50

# 115RE TEE RAIL

### PART 1 – GENERAL

### 1.01 SUMMARY

- A. Section includes:
  - 1. Provide 115 RE High Strength Rail to the Detroit Transportation Corporation's (DTC) The Detroit People Mover (DPM) System.
  - 2. Perform testing, shipping, delivery, unloading and placing into storage of 115 RE Rail at the Maintenance Center Yard in the Detroit downtown area.
- B. Related sections:
  - 1. Section 34 11 05 Reconstruction of Direct Fixation Track
  - 2. Section 34 11 10 Installation of Rails for Expansion Joints
  - 3. Section 34 11 40 Reconstruction of Special Trackwork Switch Components
  - 4. Section 34 11 45 Procurement of Special Trackwork Switch Components

### 1.02 REFERENCES

- A. The following Codes, Reference Standards and Specifications apply to the Work of this Section.
  - 1. American Railway Engineering and Maintenance of Way Association (AREMA)
    - a. Manual for Railway Engineering, Chapter 4, Rail
  - 2. American Society for Testing and Materials (ASTM)
    - a. ASTM E8 Test Methods for Tension testing of Metallic Materials
    - b. ASTM E10 Test Method for Brinell Hardness for Metallic Materials
    - c. ASTM A578/A578M Specification for Straight-Beam Ultrasonic Examination of Plain and Clad Steel Plates for Special Applications
- 1.03 SUBMITTALS
  - A. Submit Certified Documentation of rail fabrication for Approval in compliance with common Submittals as specified below:
    - a) Source of the rail, (Manufacturer's name and location).
      b) Description of the steel metallurgy and the identity of each rail provided.
    - 2. Description of the methods and procedures to be used to remove hydrogen from the steel.
    - 3. Description of the ultrasonic testing method and equipment together with mill test report certificates of rails tested for this order.

- 4. Description of the method and verification testing to achieve the required rail hardness together with reports indicating the actual hardness achieved.
- 5. Quality Control Program description, as outlined in Article 1.04.
- 6. Method of handling, shipping, unloading, and stacking rail from the time it is loaded onto the transportation vehicles at the rolling mill and fabrication component site until it is to be stockpiled at the Maintenance Center Yard, including:
  - a. Method of dunnage support for rails and stocking sequence for high strength special trackwork rail and transition rails.
- 7. Description of method for pre-curving stock rail.
- 8. Provide rail test records, including mechanical properties tests, hardness measurements, ultrasonic test records and all other required test documentation, for informal review during the in-plant inspection in addition to formal submittal.
- 9. In the event that on-line ultrasonic testing is not undertaken, provide Ultrasonic Inspector's qualification certification for the individuals actually conducting the testing at least 30 days before the commencement of the in-plant inspection.
- 1.04 QUALITY CONTROL
  - A. Submit the in-place Quality Control Program regulating methods, procedures and processes to ensure compliance with standards of quality required by the Contract Documents.
  - B. Within 15 days after the effective date of Notice to Proceed, submit for approval of DTC a detailed narrative explaining the Quality Control Program and procedures to be utilized for the work and a description of the organization to be used on the Contract.
    - 1. All work undertaken prior to approval of the quality control program will be at the Contractor's risk.
    - 2. DTC will review the Contractor's methods, procedures, and processes for compliance with the approved program.
  - C. Keep all records of inspection work performed by the Contractor complete and available to DTC during the performance of the Contract; and to such other agencies and for longer periods as may be specified elsewhere in the Contract.
  - D. Inspection and Testing:
    - 1. The Products and Material incorporated into the work will be subject to inspection by DTC at the Contractor's and Subcontractor's facilities, place of manufacture, the shipping point, or at the shipping destination in Detroit.

- 2. Inspection and tests by DTC will be performed in such a manner as not to unduly delay the work.
- 3. Whether or not DTC inspects or tests any Materials, the Contractor will not be relieved from any responsibility regarding defects or other failures to meet the Contract requirements, nor will such inspection or testing be considered as a guarantee of acceptance of any Material which may be delivered later.
- 4. Perform all tests and analyses specified in Chapter 4, Part 2, of the American Railway Engineering and Maintenance of Way Association (AREMA) Manual for Railway Engineering and submit the results.
- 5. Ultrasonically test all rail for internal defects in accordance with ASTM A578, as modified herein.
  - a. Construe references to "plate thickness" in ASTM A578 to mean rail depth from head to base for measurements from top of the railhead, or rail web thickness for measurements laterally through the rail web.
  - b. Replace "Acceptance Standards" in ASTM A578 by a defect in the occurrence of one of the following readings:
    - 1) Complete loss of back reflection
    - 2) A reflection from a defect (i.e. not attributable to a reflecting surface of the rail exterior) greater than 5 percent of the back reflection.
  - c. Reject any rail if a defect is detected.
  - d. Conduct ultrasonic inspection for the full length of each rail with a 1-inch diameter, 45 degree probe from the top of the railhead, directed along the length of the rail, positioned such that the rail base generates the back reflection.
  - e. Conduct ultrasonic inspection within 12 inches of each rail end with the 1 inch diameter 45 degree probe, as in Subparagraph 1.04D.5.d, and also with a 1 inch diameter, 0 degree probe from the top of the rail head, vertically, and through the rail web, laterally.
    - 1) The back reflection for the lateral measurement through the rail web is the web surface opposite the probe side.
  - f. Conduct ultrasonic inspection by a qualified technician, and provide qualification certification of each individual conducting ultrasonic inspection of the Material.
  - g. Permanently mark all indications on the railhead directly over the defect location with the percentage amplitude relative to the back reflection.
  - h. Certified mill test reports must include, at a minimum, the following information:
    - 1) Chemical composition
    - 2) Macroetch result
    - 3) Brinell Hardness Number (BHN)
    - 4) Tensile strength

- 5) Yield strength
- 6) Elongation percentage
- 6. As an alternative to the requirements of Subparagraph 1.05D.5 above, ultrasonically test all rails 100 percent in-line with a fully computerized DAPCO 200 testing unit or approved equal.
  - a. Test rails in conformance to the requirements of AREMA Manual for Railway Engineering, Chapter 4, Part 2, Section 2.1.8, Ultrasonic Testing
  - b. Use a calibration test rail of the same section as being tested with the following calibration reference standard:
    - 1) Head 3/32 inch wide  $\times 1/2$  inch long slot
    - 2) Web 1/16 inch wide
    - 3) Base 1/16 inch wide  $\times$  1/2 inch long slot
- 7. Make all rail tests and inspections at the mill prior to shipment for pre-curving or machining of the rail.
- 8. Assume full responsibility for all testing indicated.
- 9. Give DTC sufficient notice when testing in any form is proposed so they may witness the tests, and provide DTC free entry at all times to the manufacturer's mill to inspect the processing and testing of rail while work on this Contract is being performed.
- 10. Perform all tests specified herein at no additional cost.
- 11. Testing, witnessed and certified by the mills quality control manager, must include the following AREMA testing at a minimum:
  - a. Chemical composition testing of the rail steel.
  - b. Testing rail heats for hydrogen content.
  - c. Testing rail for Brinell hardness.
  - d. Testing a specimen for longitudinal tension.
  - e. Verifying that the section of the rails conforms to the design specified subject to dimensional tolerances allowed.
  - f. Testing rails ultrasonically for internal imperfections.
  - g. Macro etching all test pieces as required by AREMA.

# 1.05 PRODUCT DELIVERY, HANDLING AND STORAGE

- A. General
  - 1. Deliver the special trackwork fabricated rails to the Maintenance Center Yard.
  - 2. Load, transport, unload and stock pile special trackwork rail for storage and handle rail so as to prevent damage.

- 3. Load, unload, handle and store rail by accepted methods to prevent kinking, bending, nicking, or otherwise damaging the rail.
  - a. In unloading operations, do not drop rails, but place each length of rail with the head up and with sufficient support under the base.
  - b. Do not subject individual rails or rail bundles to excessive static loading.
  - c. Avoid sudden impact or dynamic loading, and prevent high stressing arising from point or line loading.
  - d. Spanner beams are required.
  - e. Avoid excess cantilever of the rail end beyond the slinging points in order to prevent permanent bending and excessive stressing of the rail.
  - f. Locate three slinging points at uniform lengths along the load so that the precurved rails are in a horizontal position at all times. Single point slinging of rail is prohibited.
  - g. Any rail support, handling, clamping or pinch rollers must be contoured properly to match the particular rail profile and thus avoid localized point or line contact.
- 4. Use only slings that do not cause surface damage or notching.
  - a. Terylene or nylon strapping is recommended, with an additional sleeve where the sling is in contact with the rail.
  - b. Flat profile chain link slings with a protective sleeve are also recommended.
- 5. The use of chains and wires that may cause surface damage is not allowed.
- 6. Use sufficient timber dunnage at all time and take particular care when extracting slings from around rail lifts in order to ensure they are not "ripped out."
- 7. Sort switch and stock rails and load, deliver and stock pile in a separate tier.
- 8. Sort transition rails and load; deliver and stock pile in a separate tier.
- B. Warranty
  - 1. Provide an unconditional manufacturer's warranty for the special trackwork rails, precurved rails and transition rails against defects in workmanship.
  - 2. If it should be necessary to retire these special trackwork rails, pre-curved rails or transition rails from service during the warranty period due to fracture or a defect, jointly inspect the failed rails in the presence of a DTC representative.
  - 3. If the inspection and examination establishes that cause of the failure is attributable to a defect of rail fabrication, then replace the faulty rails free of charge.
  - 4. If a delivery of substitute special trackwork rails, pre-curved rails or transition rails is difficult or cannot be executed within a reasonable period of time, compensation is payable to the DTC.
  - 5. Warranties from third-party contract will be accepted only if also accepted and endorsed in writing by the Contractor and Subcontractors.

### PART 2 – PRODUCTS

### 2.01 RAIL

- A. General:
  - 1. The rail shall be 115 RE Section High Strength Rail conforming to the requirements of the AREMA Manual for Railway Engineering, Volume I, Chapter 4 Rail except as modified by this Section:
  - 2. Rail shape shall be in accordance with Figure 4-1-1. 115 RE Rail Section
  - 3. Fabricate all rails from continuous cast blooms or hot-topped ingots.
  - 4. Use classifications, markings, brandings, and stampings conforming to AREMA specifications.
  - 5. Supply rail in nominal 80 foot lengths or cut to appropriate lengths for Turnout requirements.
  - 6. Allowable tolerances for rail lengths:
    - a. Un-drilled rails: plus or minus 2 inches
    - b. Shop curved rails shall be per calculated lengths as shown on the approved Shop Drawings plus or minus 1/2 inch.
    - c. Rails for Turnouts: plus 1 inch minus zero.
- B. Chemical, hardness, and tensile properties shall meet the requirements for High Strength Rail specified in the AREMA Manual for Railway Engineering, Chapter 4, Part 2.
- C. Head Hardening of Rail:
  - Head hardening shall conform to AREMA Manual for Railway Engineering Chapter 4, Part 2, except that the head hardening shall have a depth of effective hardening not less than 5/8 inch as measured vertically from the top of the head on centerline of rail.
  - 2. Make a hardness traverse pattern on a rail section conforming to the requirements of AREMA Manual for Railway Engineering, Chapter 4.
  - 3. Use monitoring and recording controls on all heat-treating machines to assure proper and continuous heating and quenching of rail.
    - a. Use equipment capable of making a permanent record of the heat-treating operation.
    - b. Scrap any rail involved in a machine malfunction or variation from normal heattreating operation.
  - 4. Keep an identifiable record of each rail heat treatment.
  - 5. Finish: After final treatment and acceptance, condition the rails by straightening to meet finish requirements of AREMA Specifications for Steel Rails, AREMA Manual for Railway Engineering, Chapter 4, and Part 2, Section 2.1.13.

- D. Hydrogen Content:
  - 1. Take samples for the hydrogen determination of the molten steel at the tundish to represent the first third and last third of the pour of each heat. Record both values and use the higher vale to determine conformance with the Specifications.
  - 2. Provide rails free from shatter cracks (hydrogen flaking).
- E. Ultrasonic Testing
  - 1. Prior to delivery of rail, ultrasonically test each rail over its full length to determine its interior condition in accordance with AREMA Manual for Railway Engineering, Chapter 4, and Section 2.1.8.
  - 2. A calibration test rail containing the following calibration reference standards is acceptable:
    - a. Head: 3/32 inch flat bottom hole
    - b. Web: 1/16 inch wide
    - c. Base: 1/16 inch deep by 1-1/2 inch long slot
- F. Pre-curving of Rail:
  - 1. All rails shall be straight before pre-curving.
  - 2. Uniformly curve rail, such that the deviation of the interior mid-ordinate offset from the theoretical offset is within the tolerances for straight rail using the appropriate chord distance required by the straight rail specification.
    - a. Pre-curved rail bases shall be level when laid out on a flat surface.
    - b. Distortion to laying flat in pre-curved rail base will not be acceptable.
  - 3. Identify pre-curved rail with painted identity numbering per approved Shop Drawing code at end of each rail, and paint identity numbers so that they are visible from both the top side and the side of the rails.
- G. Transition Rails
  - 1. Transition rail shall be used to compensate for vertical rail head wear at toe of frog and closure rails as shown in Appendix 34 11 45 E.
  - 2. Identify transition rail with painted identity numbering per approval of Shop Drawing code at end of each rail, and paint identity numbers so that they are visible from both sides of the rail.
  - 3. Transition slope shall be determined by vertical wear in existing frog rails and adjacent closure rails and determined length of final transition rail in place.

### PART 3 – EXECUTION

### 3.01 GENERAL

A. Manufacture, deliver, and stockpile rail in accordance with the requirements of this Section and Section 34 11 45 Procurement of Special Trackwork Components.

#### PART 4 - MEASUREMENT AND PAYMENT

### 4.01 MEASUREMENT

A. The rail procurement Work in this Section will be considered as incidental to the overall Work of Procuring Materials for Special Trackwork Turnout No. 3 Switch.

### 4.02 PAYMENT

A. The Work of this Section will be considered as incidental to the Work of Procurement Materials for Special Trackwork.

# END OF SECTION