Technical Requirements

Track Renewal & Grade Crossing Upgrade Project

For the
Central Florida Rail Corridor

Florida Department of Transportation

District 5

B. QUALIFICATIONS FOR CFRC ENGINEERING DEPARTMENT 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.

3. The Chief Engineer will maintain a record of each person who qualifies as Welder. 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.

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 CFRC Welder.

2. Class room training directed by a Welding Instructor or Manager–Welding.

3. Commercial Trade School

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 Chief Engineer a general knowledge of its contents.

2. A person must obtain a copy of the *CFRC MofW Field Manual* and demonstrate to the Chief Engineer, or designee, a general knowledge of the rules.

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

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 Maximo 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 Chief Engineer 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 and vertical positions for track appliance. For structural welding, the person will be required to have vertical and overhead weld samples.

4. The Welding Instructor or Chief Engineer 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 Chief Engineer will specify the welding positions.

5. The Welding Instructor or Chief Engineer 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 Chief Engineer 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 Chief Engineer 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 Chief Engineer 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 Chief Engineer 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.

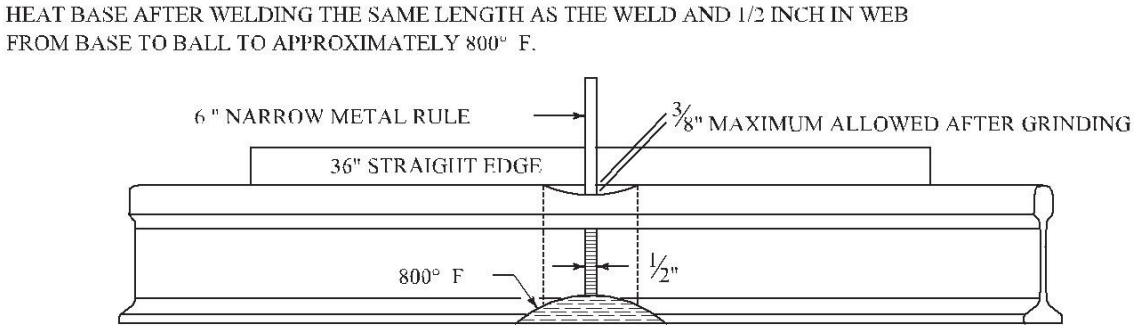
5. Grind out all damaged metal down to sound, clean parent metal. The removal shall not be accomplished through the use of a torch. Special care must be used to remove enough metal to eliminate all shatter cracks.

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



ENGINE BURN REPAIR SKETCH
DEPTH MEASUREMENT AND HEATING PATTERN

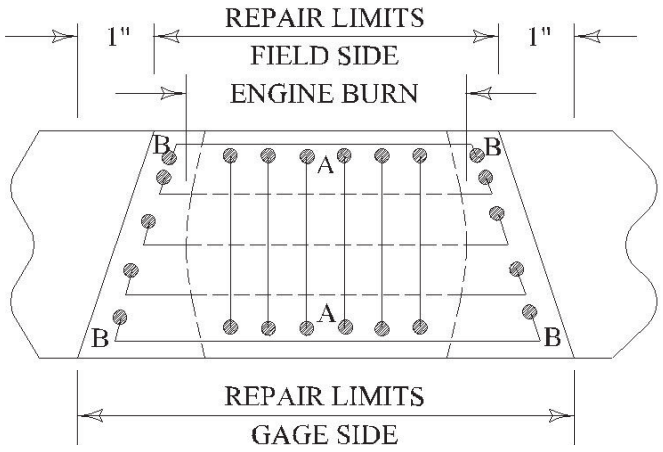
Sketch C-1

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.

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.



ARC WELDING ENGINE BURNS

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.

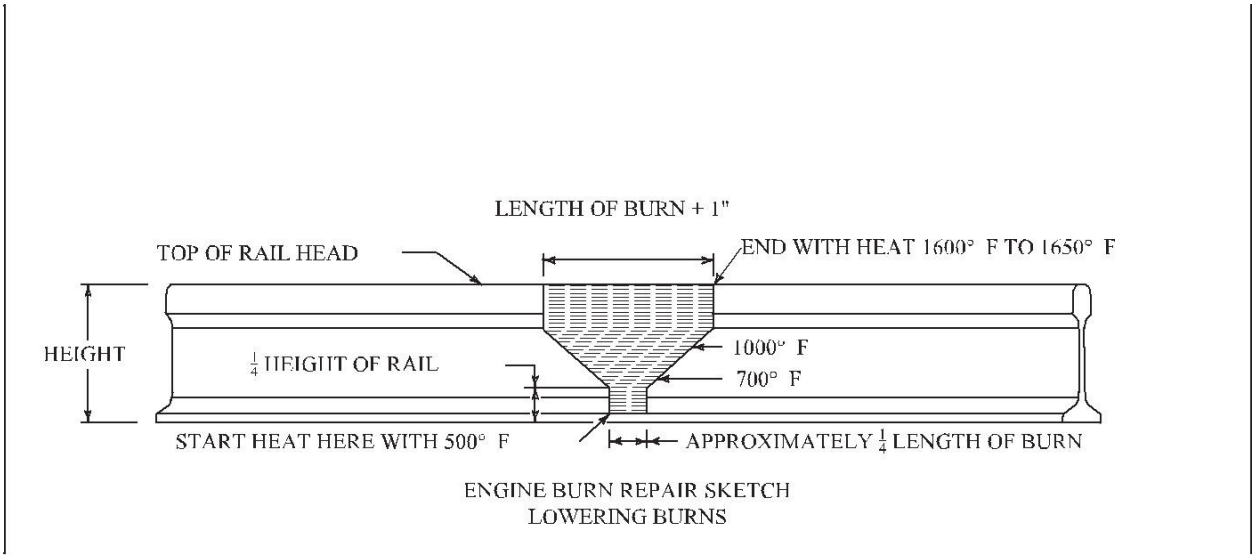
13. Use the surface grinding attachment to grind the weld area to a smooth surface and true rail contour.

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).

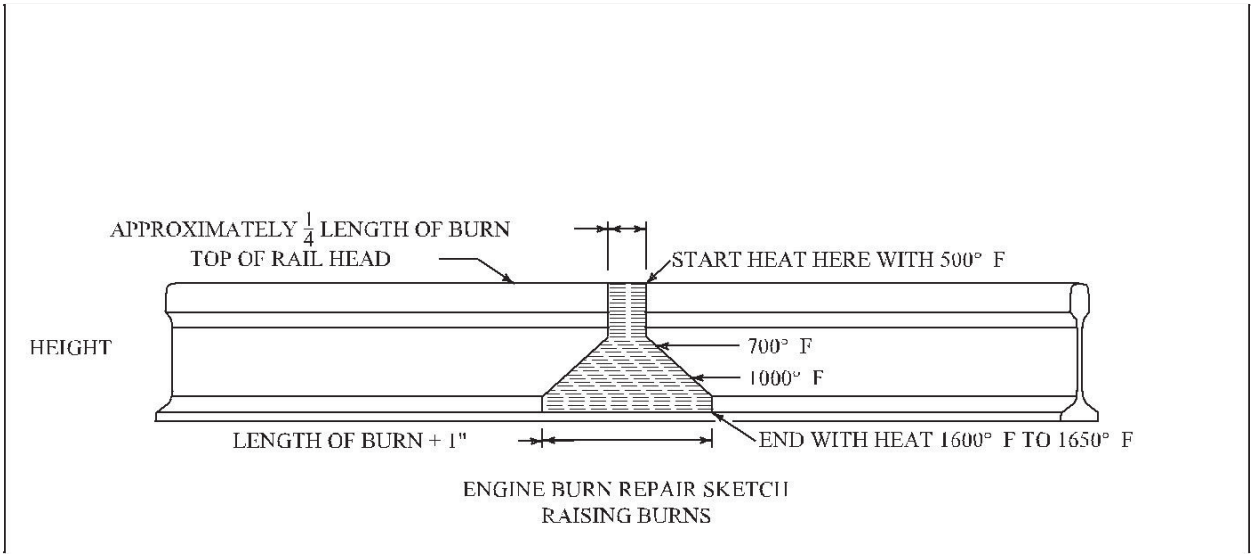
15. Remove shims from one tie and tamp that tie before removing the shims from the next tie. Replace any rail anchors that were removed.

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.

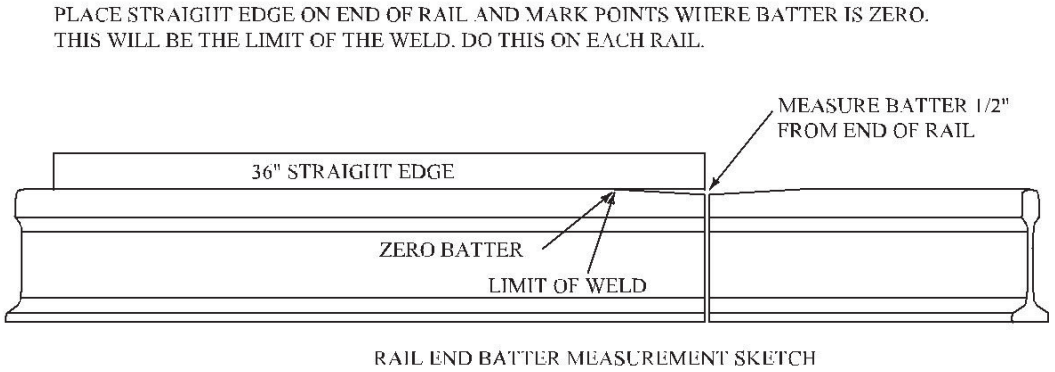
2. Rail ends that have been repaired by welding will not be thermite welded until the rail end has been cropped to remove the entire previously repaired area.

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:

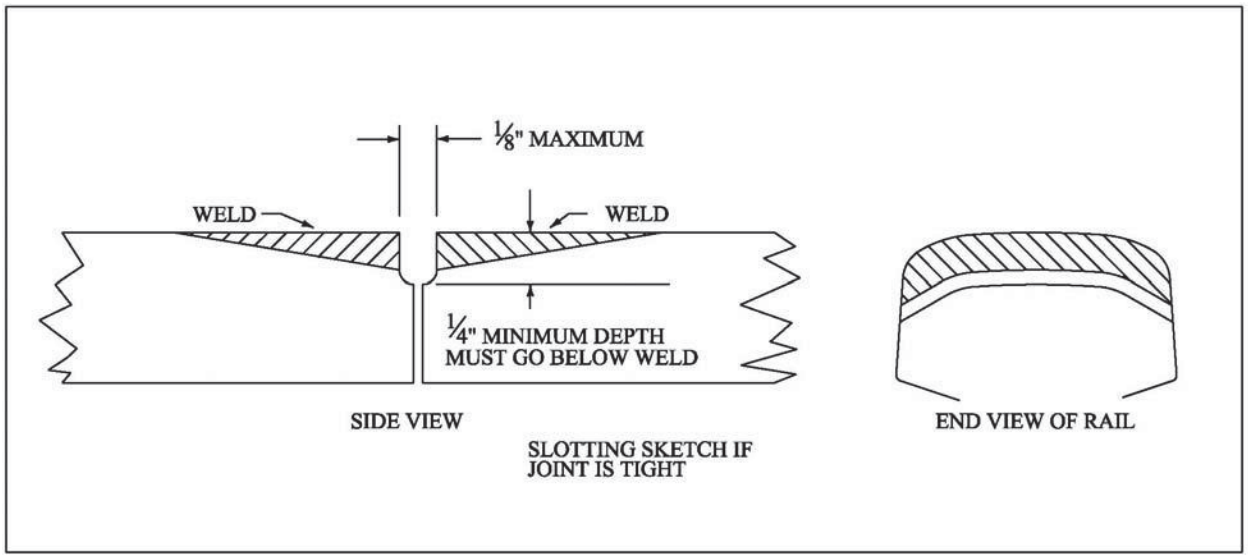
   1/8 inch (0.125”) where freight train speed exceeds 60 MPH
   1/4 inch (0.250”) where freight train speed exceeds 40 MPH
   3/8 inch (0.375”) where freight train speed exceeds 10 MPH
   1/2 inch (0.500”) where freight train speed is 10 MPH or on excepted track.

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.

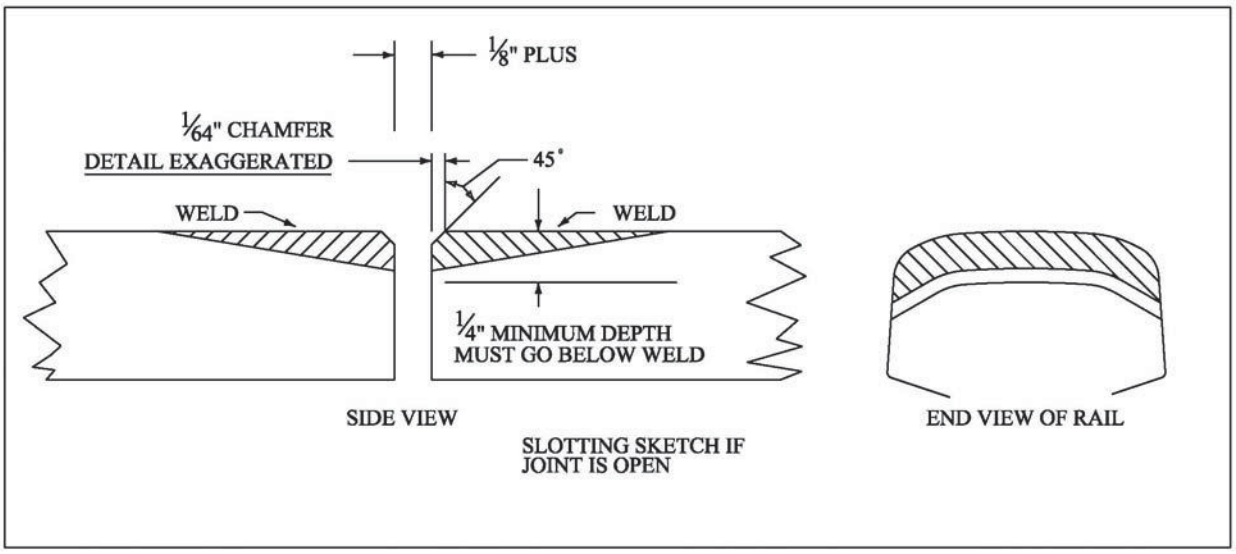


Sketch D-1

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:

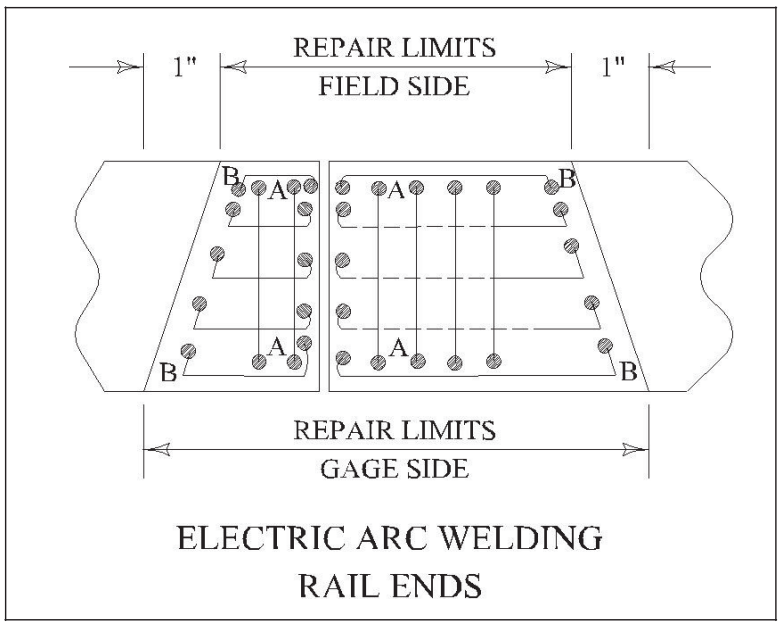
ELECTRIC ARC PROCESS

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. 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

5. 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.

6. 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.

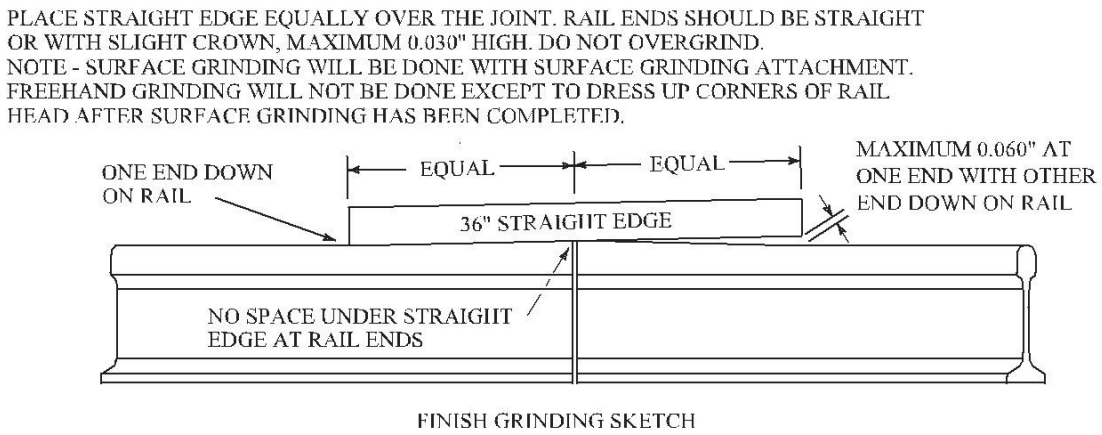
7. With fully heat treated and head hardened rails, post-heat the welded area to approximately 800°F immediately after the welding operations. After post-heating, it is most important that the rail cool slowly to 200°F. It may be necessary to protect the weld area with insulation, such as an insulated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

8. **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.

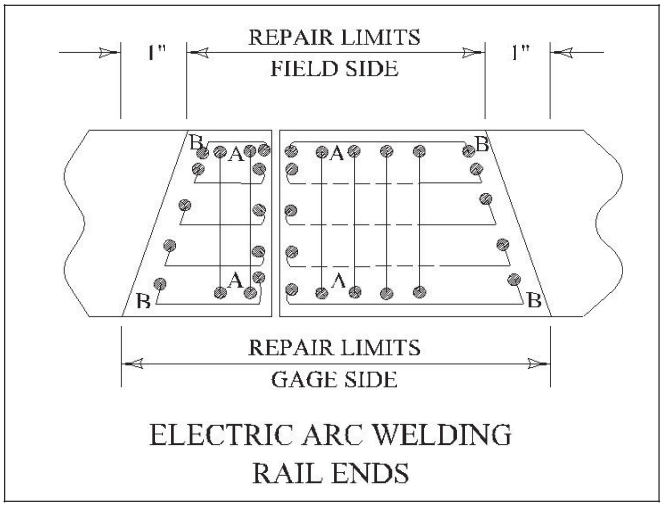
4. The area to be repaired should be welded in multiple layers. Each welding bead must be peened and enough time allowed between beads to keep the rail end within the allowable

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.

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. Weld the switch point in the open position, starting at the point and working toward the heel. A copper plate (1/8" thickness or 1/4" thickness) may be placed between the point and stock rail to help protect against overflow. This copper backing plate 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.

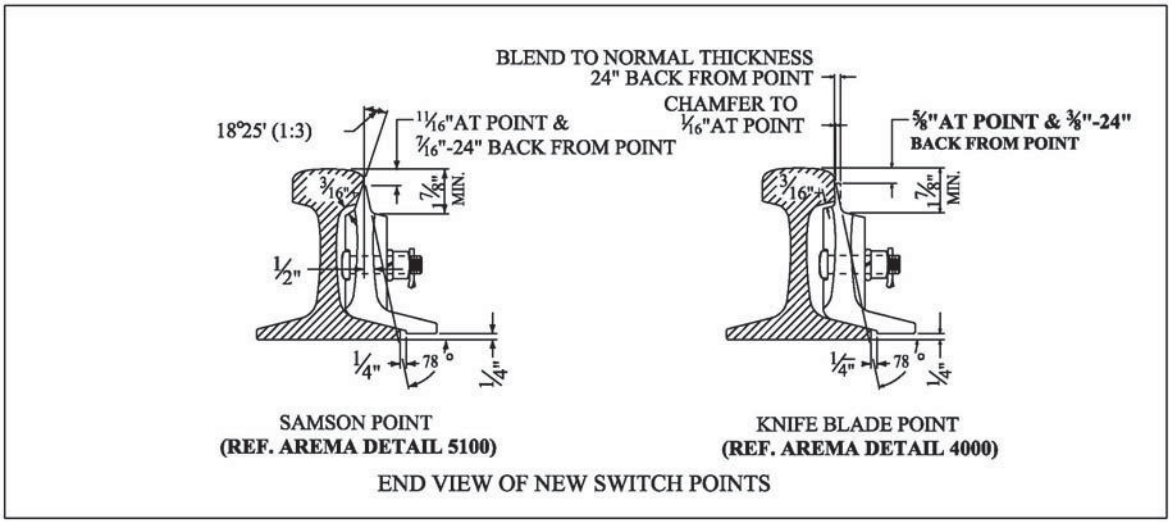
   Exception: Do not post heat switch points with manganese steel tip inserts.

5. Grinding procedures.

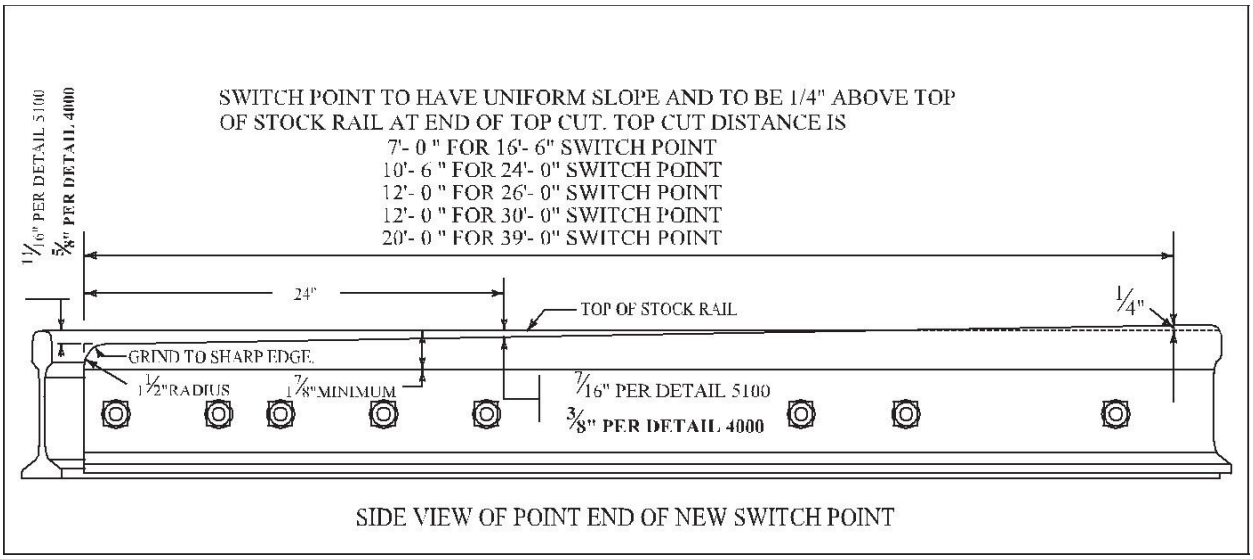
   a. First, grind the back side of the point. Check with a 36" straightedge after grinding. Check for proper fit with the stock rail by throwing the switch.
   b. Second, grind the gage face of the point. Check with a 36" straightedge after grinding.
   c. Third, grind the top of the point. Check with 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 one end of a 36" straightedge on the gage face of the switch point at the end of the welding and the other end on the stock rail ahead of the point. Check to see that the point is not sticking out into the flangeway.

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.

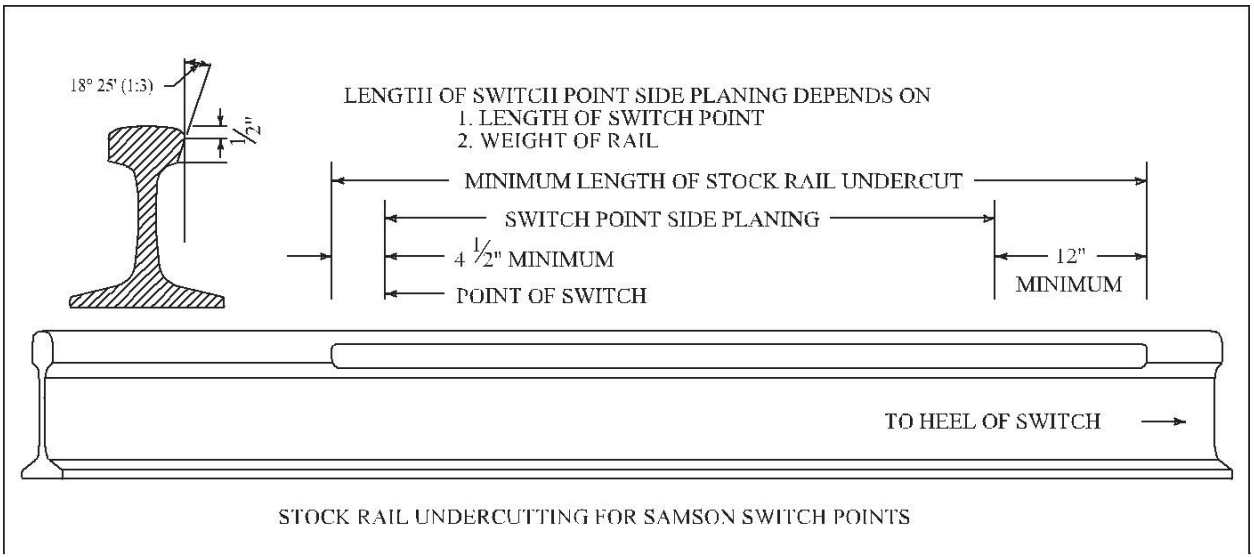


Sketch F-1



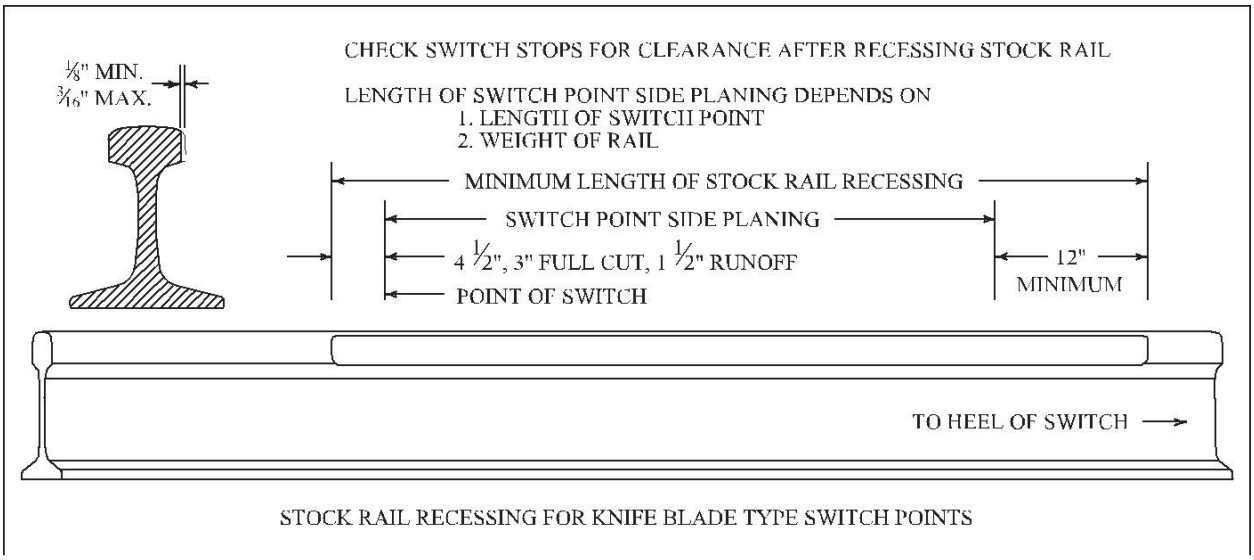
SIDE VIEW OF POINT END OF NEW SWITCH POINT

Sketch F-2

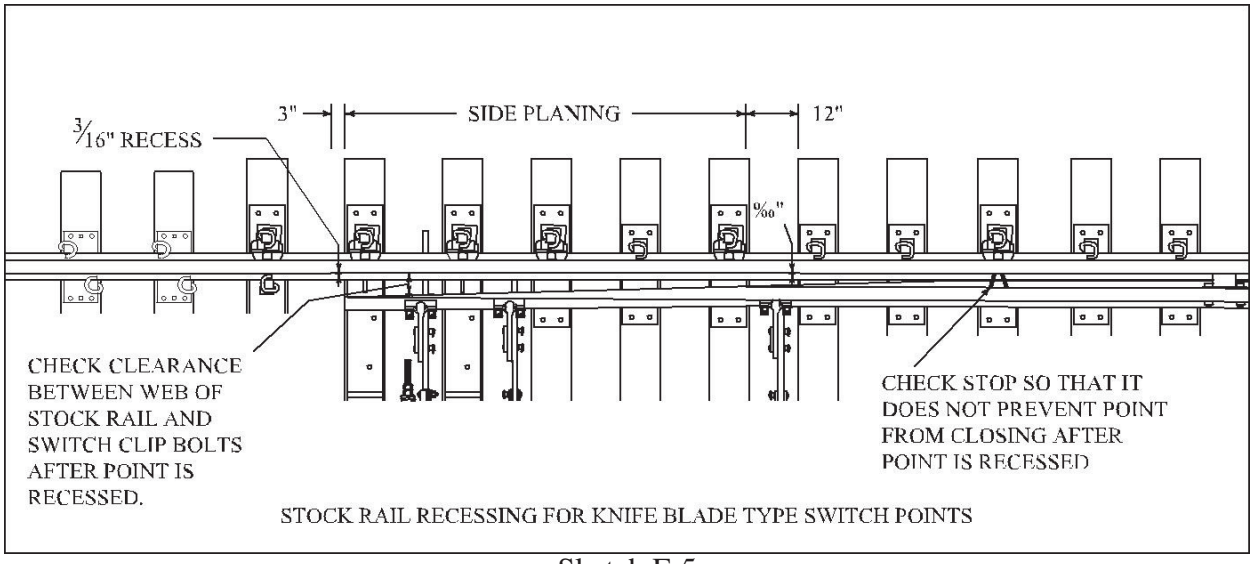


STOCK RAIL UNDERCUTTING FOR SAMSON SWITCH POINTS

Sketch F-3



Sketch F-4



Sketch F-5

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G. REPAIR 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 some frogs, crossings, and other track components may need grinding or welding shortly after installation.

4. New manganese track components should be inspected frequently in the first few months after installation. When the bead 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. 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, 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.
    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. 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)

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 (WBM) 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. They are not interchangeable.

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. Frogs will be marked with a "hash mark" on the top of heel end of the wing rail of frog, each time it is repaired by welding.

14. 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. 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 ¾" 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.

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 or a conformal frog gauge 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 amperage, as required by the work being done and the size and type of 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. The wider the bead, the slower the welding travel speed. The slower the travel speed, the hotter the casting gets. Travel as fast as possible and skip weld whenever possible.

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

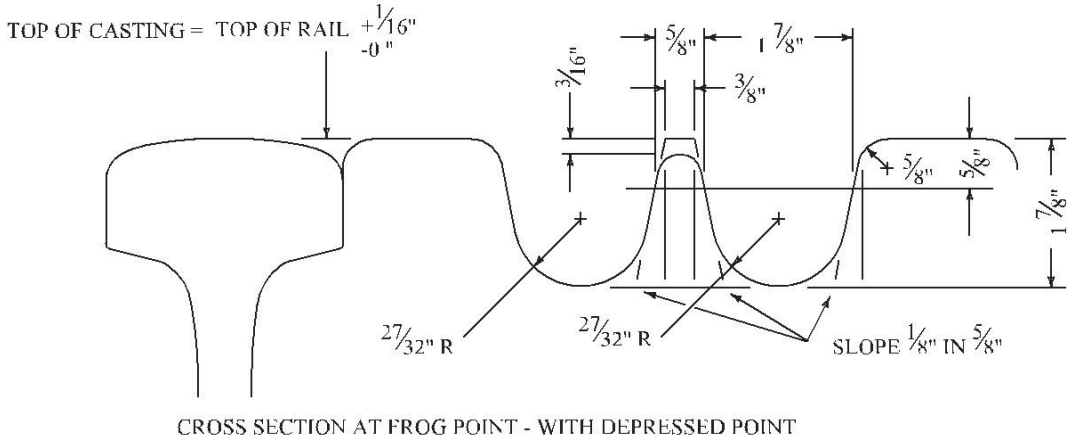
8. Every bead must be cleaned and peened to relieve stresses before depositing the next bead. NOTE: Weld beads making up the stainless buffer pad should NOT be peened.

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 often during grinding to check openings

and radii.

11. After grinding, 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. Ramped diamonds should be built up as shown in Sketch G-3. The flangeway will conform with the flangeway gauge, as shown on Sketch G-4.

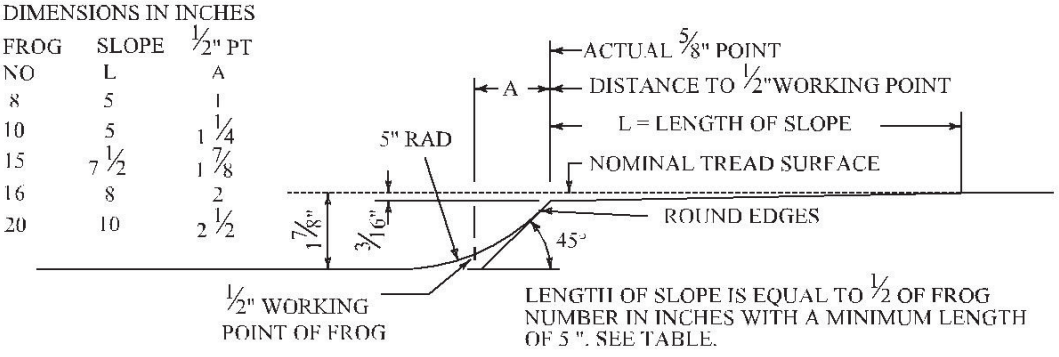


CROSS SECTION AT FROG POINT - WITH DEPRESSED POINT

Sketch G-1

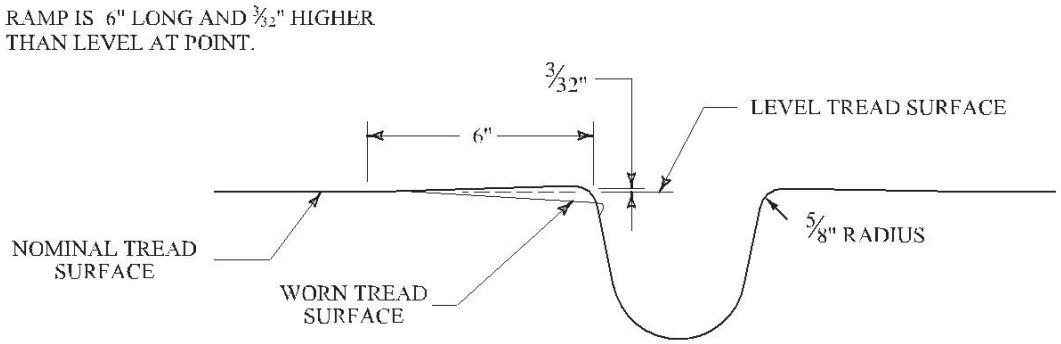
DIMENSIONS IN INCHES

FROG NO	SLOPE L	1/2" PT A
8	5	1
10	5	1 1/4
15	7 1/2	1 7/8
16	8	2
20	10	2 1/2



SIDE VIEW OF FROG POINT WITH DEPRESSED POINT

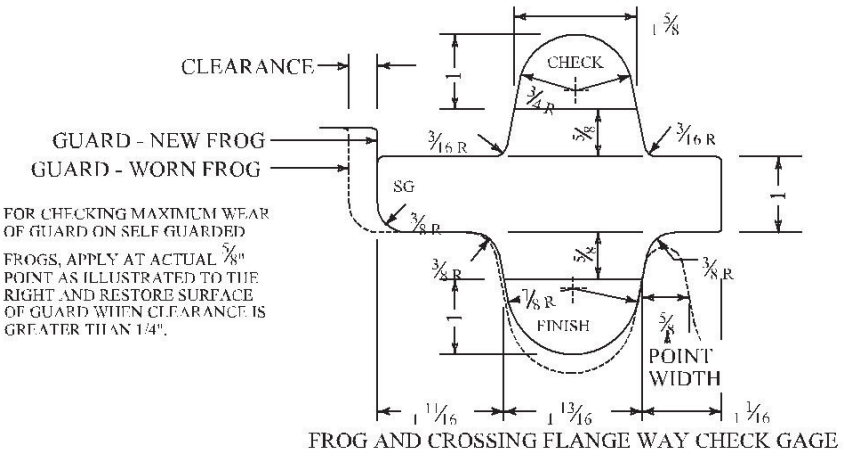
Sketch G-2



RE-ESTABLISHING RAMP AT FROG POINT ON RAILROAD CROSSING DIAMONDS

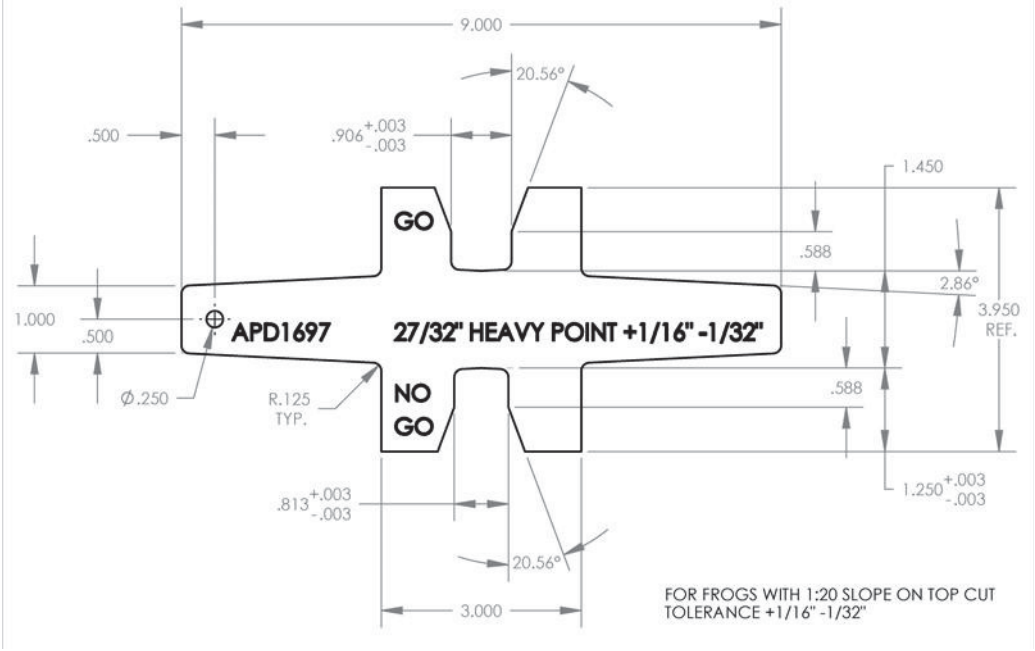
Sketch G-3

GAGE DIMENSIONS IN INCHES



FROG AND CROSSING FLANGE WAY CHECK GAGE

Sketch G-4A

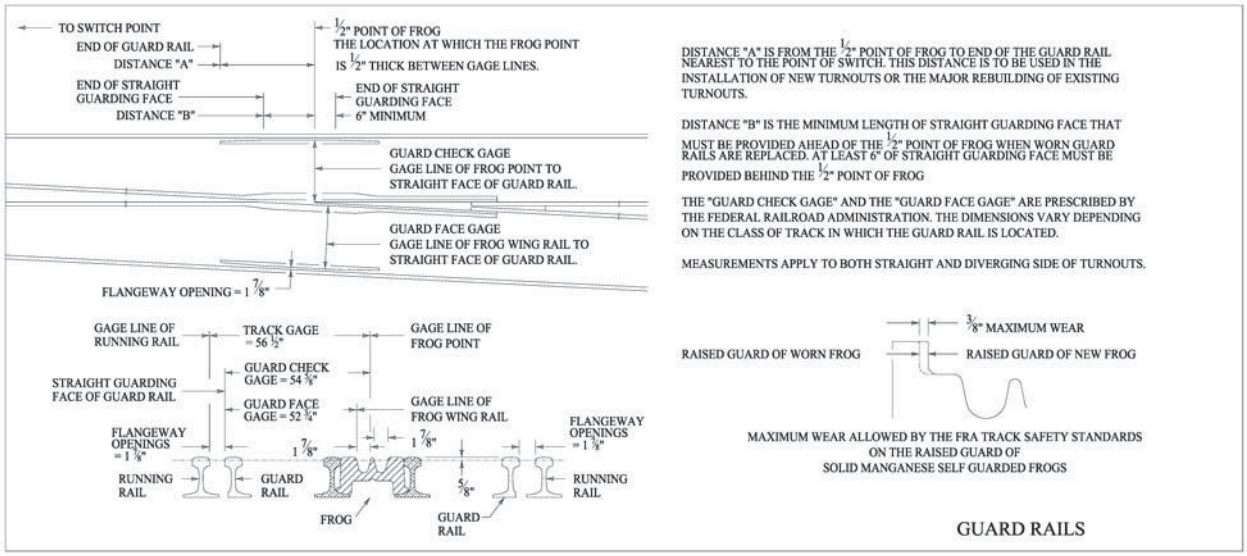


Sketch G4-B

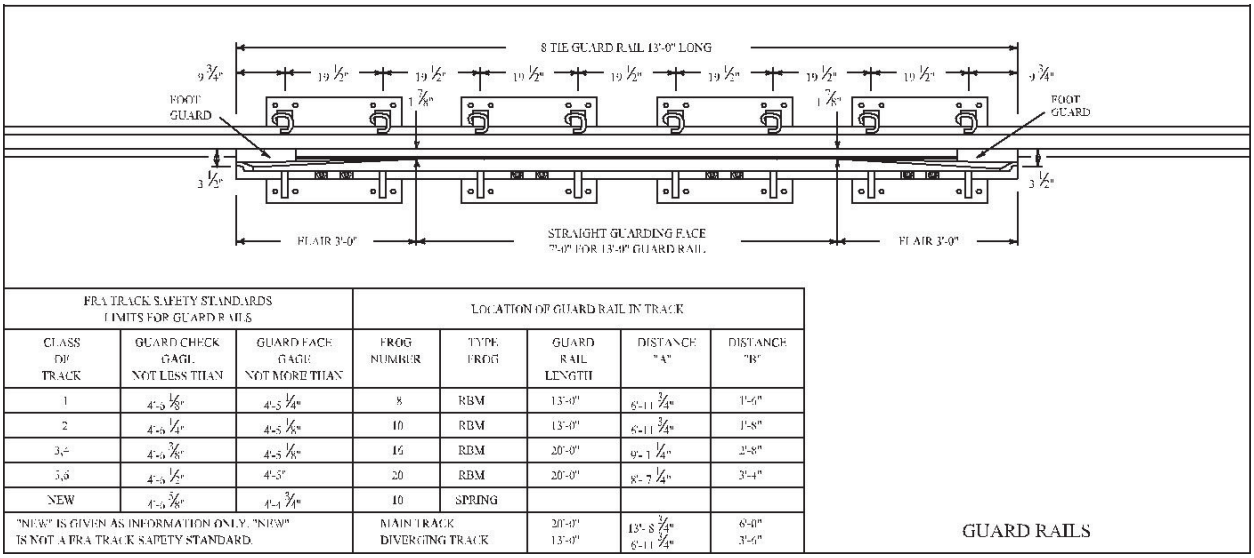
12. The junction between the castings and rail components will be slotted 1/8” wide and ¼” deep to prevent chipping and spalling of the metal.

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-5 and G-6).

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.



Sketch G-5



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'-5 ⅛"	4'-5 ¼"	8	RBM	13'-0"	6'-11 ¾"	1'-6"
2	4'-5 ¼"	4'-5 ⅜"	10	RBM	13'-0"	6'-11 ¾"	1'-8"
3,4	4'-5 ⅜"	4'-5 ½"	16	RBM	20'-0"	9'- 7 ¼"	2'-8"
5,6	4'-5 ½"	4'-5"	20	RBM	20'-0"	8'- 7 ¼"	3'-4"
NEW	4'-5 ⅝"	4'-4 ¾"	10	SPRING			
"NEW" IS GIVEN AS INFORMATION ONLY. "NEW" IS NOT A FRA TRACK SAFETY STANDARD.			MAIN TRACK DIVERGING TRACK		20'-0" 13'-0"	13'- 8 ¾" 6'-11 ¾"	6'-0" 3'-0"

GUARD RAILS

Sketch G-6

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 Inspection 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-4).

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

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-1 and G-2.

This section addresses the maintenance and repair of conformal frogs with wrap rails and boltless (WBM) frogs. The weld repair of a Boltless Conformal (WBM) frog is the same as for the conformal frogs with wrap rails, however do not use the same gauges for a wrap rail conformal frog on the boltless conformal frog.

Photo G-1

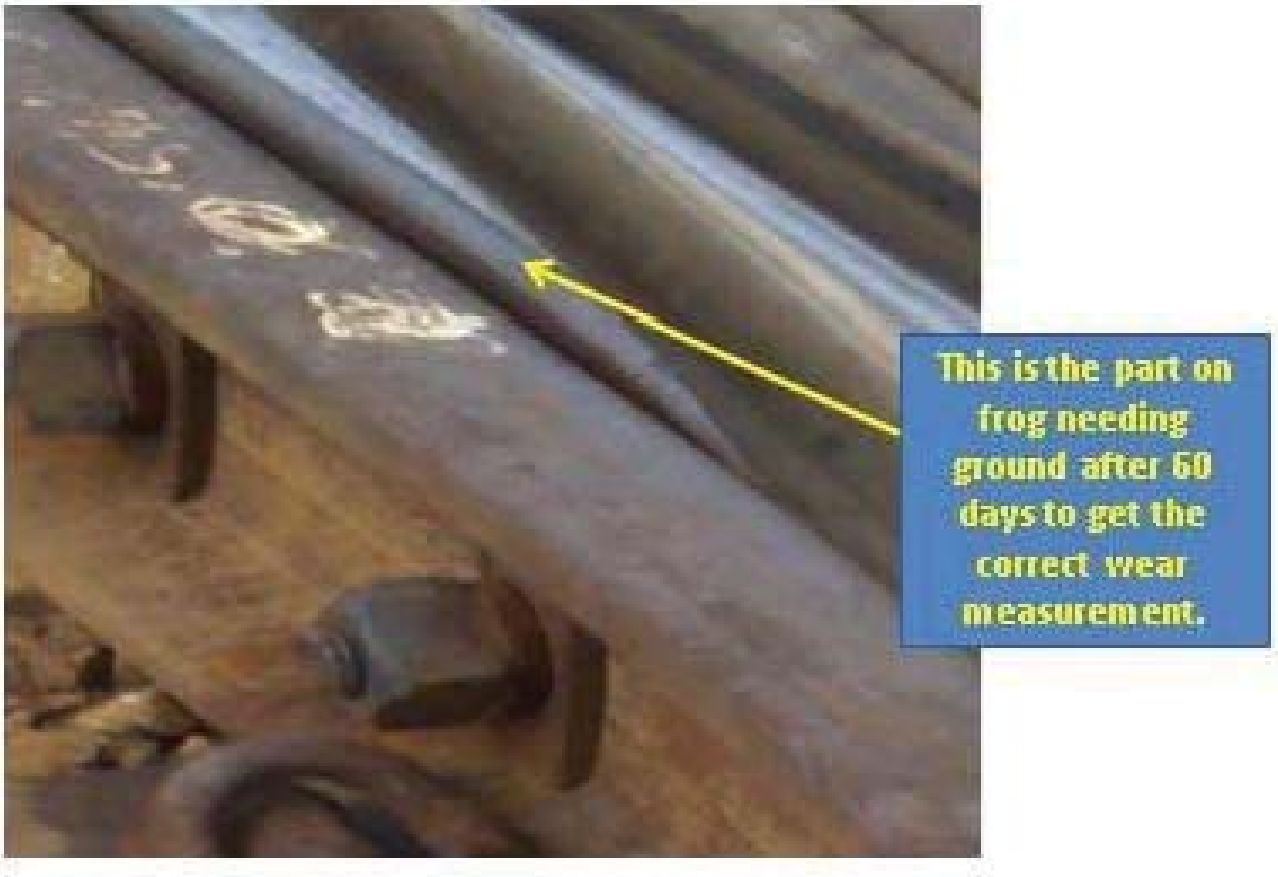
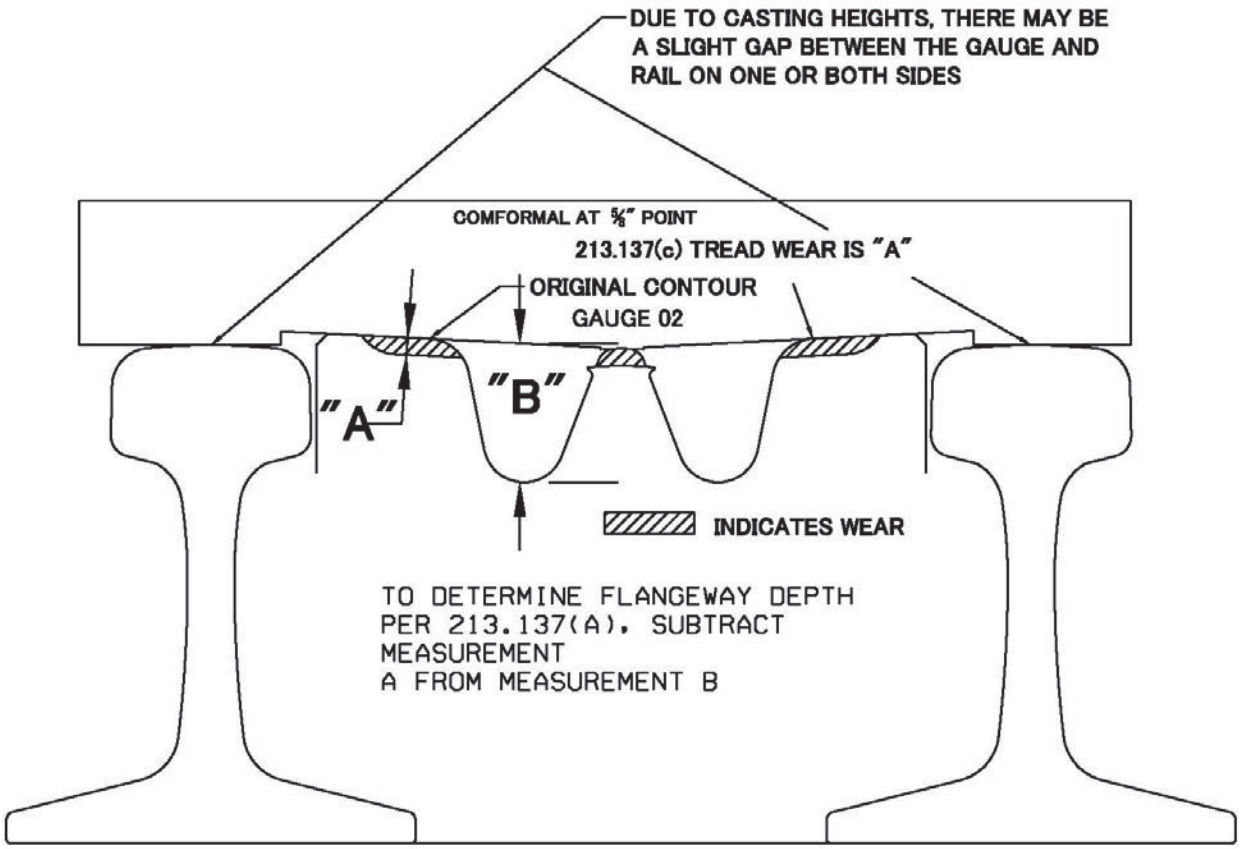


Photo G-2

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 on page 6 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 #02 along the top of the wrap rail. See Sketch G-7 below on the following page. For boltless conformal frogs, use gauge #1. If the tread wear exceeds 3/8” below wrap rail height, the wing tread must be repaired or slow order to 10 mph.

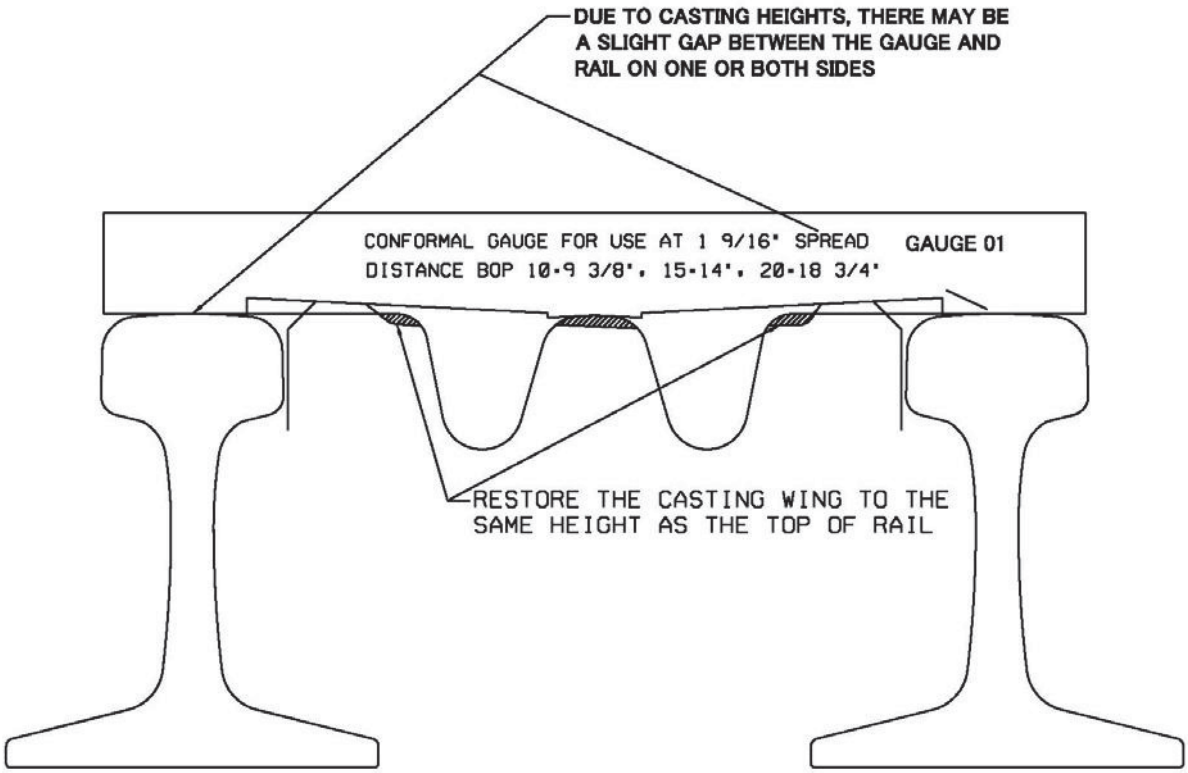


CONFORMAL GAUGE FOR CHECKING TREAD WEAR AND FLANGEWAY DEPTH AT POINT

Sketch G-7

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 #01.

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-8 below on the next page. The repair must be checked using a conformal frog gauge #01 for frogs with wrap rails and #2 for boltless frogs and taper gauge



CONFORMAL GAUGE FOR WELD REPAIR OF THE WING AND POINT AT 1 $\frac{9}{16}$" SPREAD

Sketch G-8

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 #01 conformal frog gauge from the 5/8" frog point (actual point) for frogs with wrap rails. Table 2 provides the proper distance to place the #02 conformal frog gauge from the 5/8" frog point for boltless frogs. No weld repair will be made beyond the location of the second gauge on the wing tread.

Frog No.	Distance from #01 gauge
10	9 - 3/8"
15	14 - 0"
20	18 - 3/4"

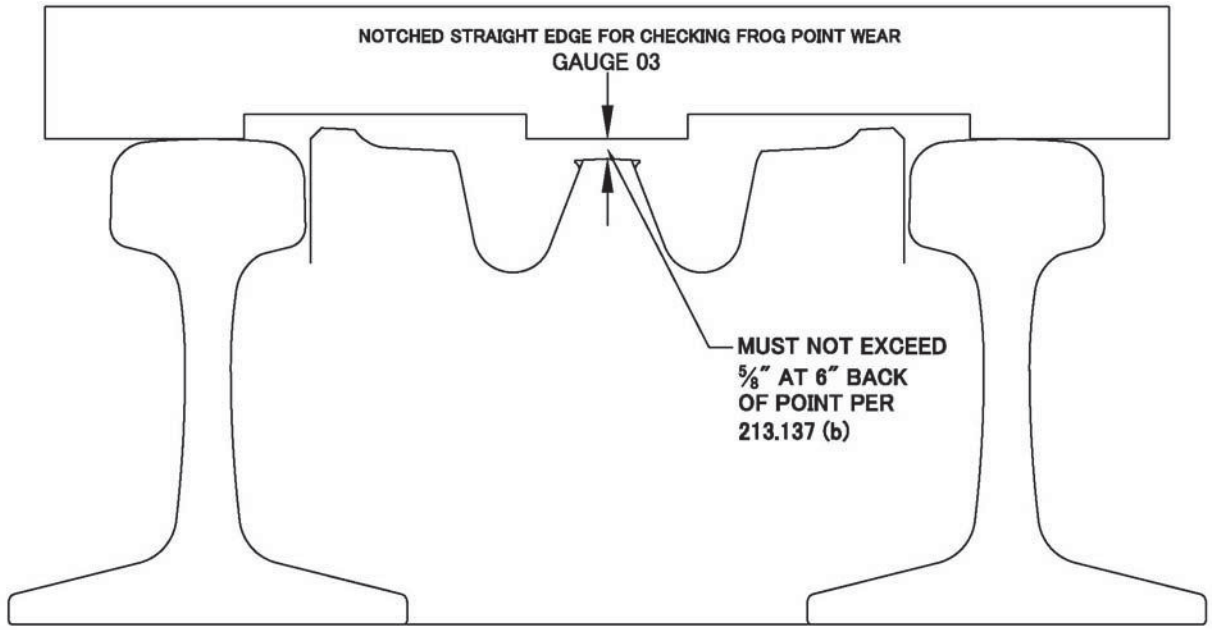
Table 1 – For Conformal frogs with wrap rails

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

Table 2 – For Boltless Conformal frogs

To check the frog point, use the notched straight edge (gauge #03) for frogs with wrap rails. For boltless conformal frogs, use gauge #01. 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-9. Photo G-3 provides an example of the boltless conformal frog gauges on a #20 frog.

Photo G-3

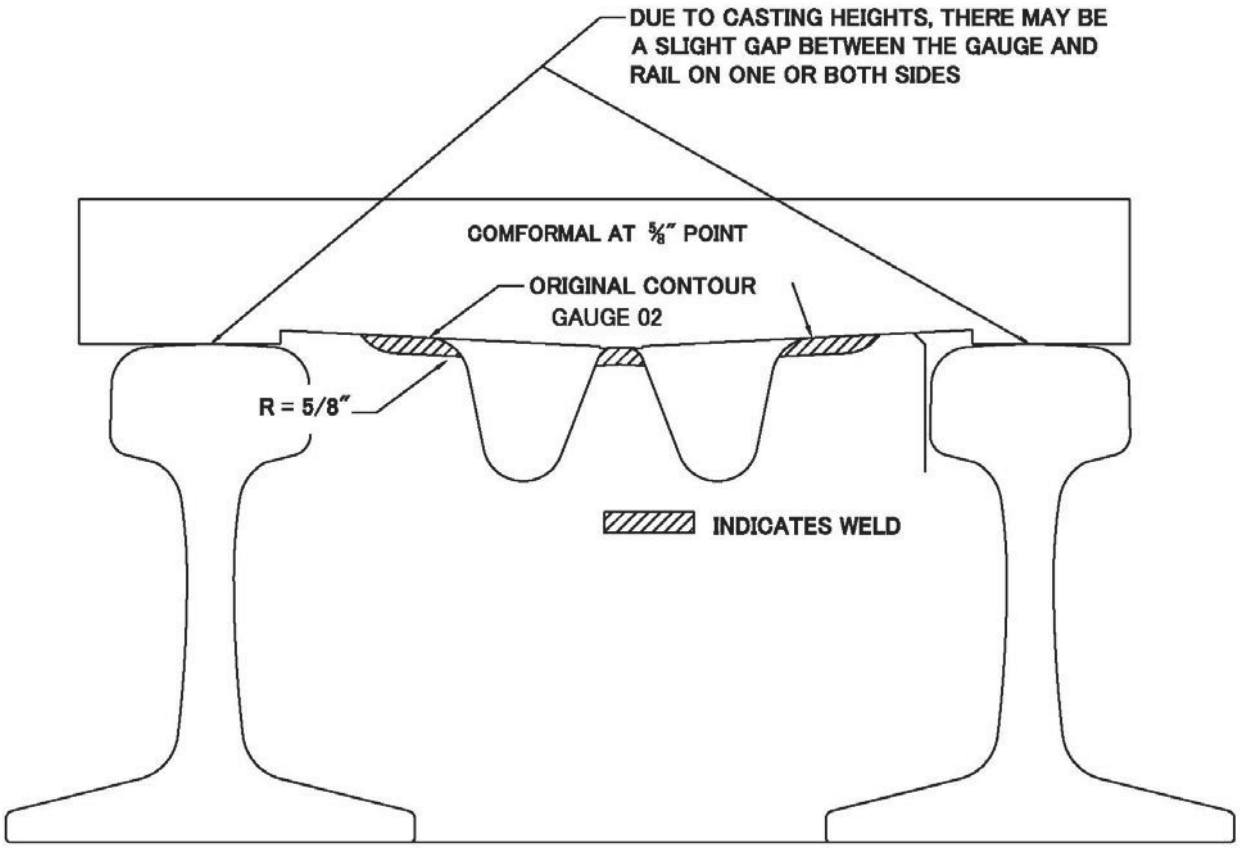


GAUGE TO CHECK 5/8″ POINT WEAR ON CONFORMAL FROGS

Sketch G-9

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.



CONFORMAL GAUGE FOR WELD REPAIR OF WING AND POINT.

Sketch G-10

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-10. 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.

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 Chief Engineer 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 CFRC. 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 CFRC Welding Manual.

20. Clean work area.

21. Fill out track disturbance record online.

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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 equipment required includes a stopwatch and a taper gauge that must be used during the welding process.

3. 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. 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 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 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).

4. 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.

5. 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 700ºF.
   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.

6. 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.

7. 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.

8. 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.

9. 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.

10. 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.

11. 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.

12. 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).

13. 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.

14. 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.

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

    a. An O&M firm representative, will randomly test thermite welds on their territory to ensure the weld quality.

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.

16. All thermite welds will be identified with the following paint stick markings on the web of the rail:
    a. Specific Mile Post Designation
    b. Date of weld (MM/DD/YY).
    c. Thermite weld batch/serial numbers will be recorded in Maximo.
    d. Welder's initials or Team number.
    e. Number of weld, by welder, for year.
    f. Rail temperature (°F).
    g. Amount of rail added or removed. (+ or -)
    h. Additional information as may be required, such as **TC** for torch cut rail, **C** for closure weld, **P** if rail puller is used, and on track class 6 and above the **date the weld is tested** and the **testers initials**.

17. The welder will submit a Welding Report on Maximo 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.

18. 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.

    Standard Track Safety Pan
    Bridge Safety Pan

19. 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 feet unless snow on track, then 30 feet). In particular, vehicles shall be located far enough away from the work to ensure that they cannot be showered by the sparks.

20. 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. See MWI 1704 and Standard Drawing CFRC 2906 for complete details of the use of jumper wires for Maintenance of Way purposes.

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:

<table>
<tr><td rowspan="2">Rail Temperature</td><td colspan="2">Weather Conditions</td></tr>
<tr><td>Clear</td><td>Wind, light rain, or snow</td></tr>
<tr><td>40°F or greater</td><td>Air Cool

Weld Cooling Cover is not required</td><td>Apply Weld Cooling Cover immediately after shearing.
Leave cover in place until weld is cooled below 800°F (about 35 minutes).</td></tr>
<tr><td>Between 40°F and 0°F</td><td colspan="2">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).</td></tr>
<tr><td>0°F and less</td><td colspan="2">Welding is not recommended</td></tr>
</table>

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 CFRC. 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 has greater than 6 feet in width for a walkway or a working platform on the outside rail, the employee must use personal fall arrest. When the walkway or working platform is 6 feet or less, the following will be met:

- The employee working on the outside of the hydraulic rail puller must have a walkway or a working platform meeting FRA regulation § 214.109 part 3, "Top edge height of toprails, or equivalent guardrail system member, shall be 42 inches, plus or minus three inches. Supports shall be at intervals not to exceed eight feet. Toeboards shall be a minimum of four inches in height".

STRIPPED JOINTS

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.

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

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

Before operating puller, be in compliance with CFRC 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. Remove anchors where puller is to set on rail and knock down any high spikes.

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. If grease or moisture is

present, burn off with torch and grind the web of the rail 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. WHEN USING PULLER AROUND SWITCHES, CAUTION SHOULD BE USED TO KEEP FROM MISSALIGNING. A 200-FOOT DISTANCE OR OUT OF SOLID ANCHORS, IS A GOOD RULE TO FOLLOW.

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. CHECK WELD TEMPERATURE.

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 CFRC 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.

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 under rail if available or wedges. Remove anchors where puller is to set on rail and knock down any high spikes.

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 inches before clamping to the rail.

10. If grease or moisture is present, burn off with torch and grind the web of the rail where puller jaws will make contact. (Roughly 3 feet to the open end and 4 feet 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 till 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 – 21 and 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 MISSALIGHNING. A 200-FOOT DISTANCE OR OUT OF SOLID ANCHORS, IS A GOOD RULE TO A FOLLOW.

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. **CHECK WELD TEMPERATURE**.

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 PRESURE 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 CFRC 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.

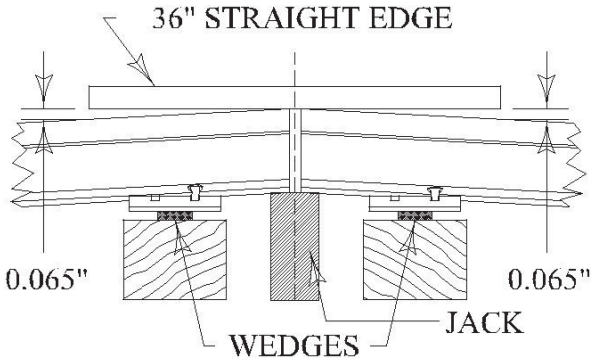
e. **Ensure that the correct gap is obtained**. The correct gap for all rail sections is 1" with a tolerance of 1/16" (1" to 1 1/16" permitted). The gap will be measured on both sides of the head and web (4 measurements) to confirm the proper gap has been established.

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.



Sketch I-1

j. If necessary, use gage rods, 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" (015.0003178.1) 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 ¼" is permitted. If the rail height difference is greater than ¼", the weld will be made with the running surfaces of the rails mismatched and no more than a ¼" 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 ¼” 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 plexiglass 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 ten (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.

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

Victor or Smith 5 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”) 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 5 minute 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.

j. 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 fifteen (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 five minutes after the pour.

c. After five 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 ½" 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.

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 pre-heater 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.

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

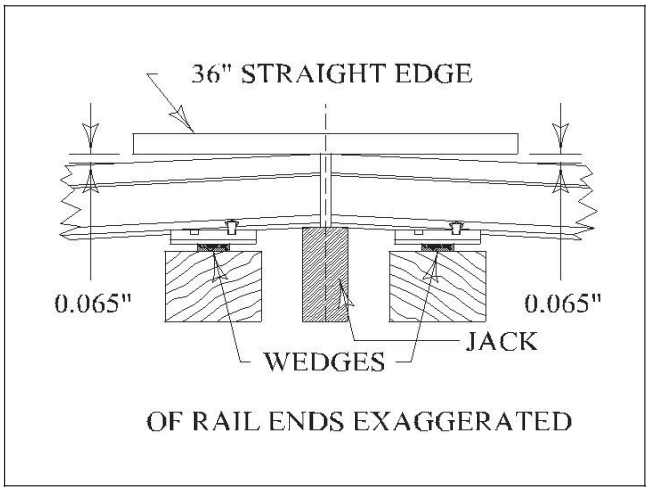
f. If the gap between rail ends is too small, the ends may be cut to give the proper gap.

g. All rails should be eye aligned 40 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, 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 ¼" is permitted. If the rail height difference is greater than ¼", 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 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.

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.

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 ten (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.

e. The proper preheat working pressures are:

Smith, Victor or Hessa Equipment

Propane:	15 PSI
Oxygen:	65 PSI
Burner Hgt.:	1 1/2"

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 one (1") gap in the rail. Make certain that it is also aligned in the center across the head and the burner tip is 1 ½" 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 stopwatch is the easiest and most accurate way 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. 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.

j. 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 fifteen (15) seconds after the preheating burner has been removed.

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 ½". 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 feet 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 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. 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 five 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. Six (6) minutes after the finish of the pour, score the mold on both sides 1 ½" 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 may also 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.

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.

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.

g. The wedges and weld base plate may be removed after 20 minutes.

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

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 (451.1100250.1) should be all that is required to reach the desired crown and alignment.

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 ¾" 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.

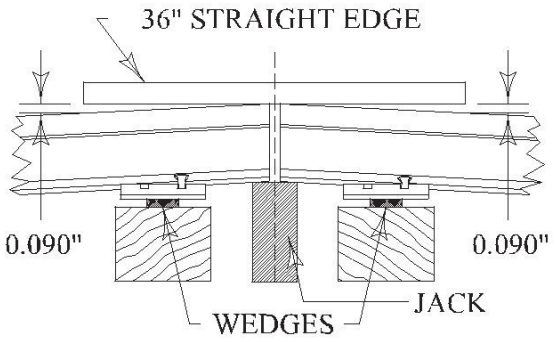
f. If the gap between rail ends is too small, the ends may be trimmed with a saw to give the proper gap.

g. All rails should be eye aligned 40 feet 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, 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.

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 ten (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	Hessa	Smith
Model	HD310C	U. S. Thread	WH200
Preheating Burner 22 Orifice			
Manufacturer	Victor	Hessa	Smith
Model	TWN-5	SKV-5	VNG-15674

Preheating Operating Pressures at the Torch Handle

Propane:	15 PSI
Oxygen:	60 PSI

Preheating Time

All rail sections: 6 1/2 minutes

Inline Test 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 fifteen (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 feet (30 feet 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 six 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°. 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.

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 Maximo 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 in TIMRS.

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

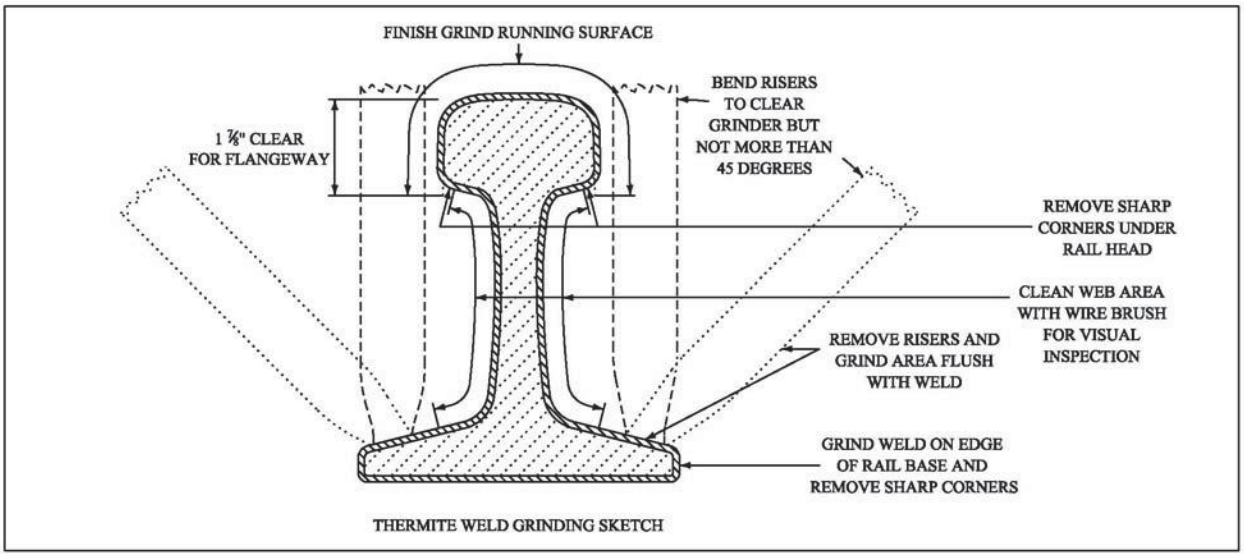
a. All thermite welds must be ground before the heat leaves the weld. Do not re-introduce heat into the sides of the weld where it will be ground. **Do not finish grind the rail head freehand.**

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 800°F, or about 0.015" high if finish grinding is done at 500°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 and wire brushing, a visual inspection must be made on every weld for hairline cracks and other visible defects. 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 Templestik or a digital thermometer before allowing a train to pass over.

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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 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 Chief Engineer 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. Previously approved mechanical tachometers may be used until they require replacement.

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.
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 CFRC 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. 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 O&M management. 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:

Electrode Size :	3/16"	1/4" and greater
Recommended Amp.	300	400

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.

OPERATION OF SLICE TORCH

CAUTION: Don't 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 inches 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 CFRC equipment making the weld.
        2) Holland Co.= HW
        3) CFRC Plasser = PW
        4) CFRC Truck = TW
        5) The equipment number of the machine/truck making the weld.
        6) Was this a closure weld?
            a. If it was, insert a "C" before the sequence number.
            b. If not, leave blank.
        7) The weld sequence number.
        8) 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 5/8" upset required.