HARDFACE TECHNOLOGIES
by POSTLE INDUSTRIES

Railroad Track Maintenance Procedures

POSTALLOY

POSTLE INDUSTRIES, INC.

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Recommended Postle Products

Electrodes for Manganese Frogs and Crossings

Postalloy® FrogTuff

Deposits quickly become tougher and harder under load, and will not spall or mushroom.

AC or DC Reverse Polarity 10 lb. Box	Tensile Strength Yield Strength Hardness as Deposited Work-hardens to Deposit Thickness	125,000 psi 80,000 psi 15-22 Rc 55 Rc As Required

POSTALLOY® 301

High strength, ductile, crack resistant stainless alloy designed for crack repair.

AC or DC Reverse Polarity 10 lb. Box	Tensile Strength	Up to 120,000 psi

Self-Shielded Flux Cored Wire for Manganese Frogs and Crossings

Postalloy® FrogTuff-FCO

High alloy austenitic manganese steel welding wire that produces high-strengh, crack resistant deposits that are tough, ductile and work-harden rapidly.

DC Reverse Polarity 25 lb. Spool	Tensile Strength Yield Strength Hardness as Deposited Work-hardens to Deposit Thickness	135,000 psi 90,000 psi 20 Rc 50-55 Rc As Required

Electrodes for Carbon Steel Rail Ends

Postalloy® RailTuff

A build-up electrode that provides wear resistance far superior to low, medium, and low alloy carbon steels. Deposits are extremely tough and have a high resistance to impact and deformation. Not subject to spalling or roll-over. In addition, deposits are dense, crack-free and porosity-free.

AC or DC Reverse Polarity 10 lb. Box	Hardness Deposit Thickness	32-38 Rc As Required

Self-Shielded Flux Cored Wire for Carbon Steel Rail Ends

Postalloy® RailTuff-FCO

Strong, tough, low alloy build-up wire. It can be applied to carbon and low alloy steels. Weld deposits are exceptionally sound and dense, and heavy build-ups are possible without danger of cracking.

DC Reverse Polarity 25 lb. Spool	Hardness Deposit Thickness	30-35 Rc As Required

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Manganese Steel Track Castings
General Information

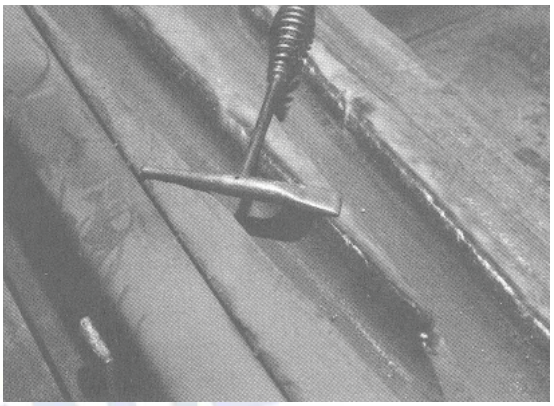
The purpose of this section is to supply accurate information about materials and procedures for reclamation (by welding) of manganese steel track castings - data which has aided many railroads in reducing maintenance and operating costs. Each frog or crossing may be considered an individual job with its own peculiar characteristics and problems. The general comments and instructions, however, apply to all manganese steel track castings.
Some of the factors in sound manganese steel reclamation procedures include:

1. Adherence to proper grinding practice.
2. Preparation of the castings for welding.
3. Proper use of flangeway gauges.
4. Use of Tempilsticks for heat control.
5. Skip-welding methods used in manganese steel welding.
6. Welding techniques and finish grinding.

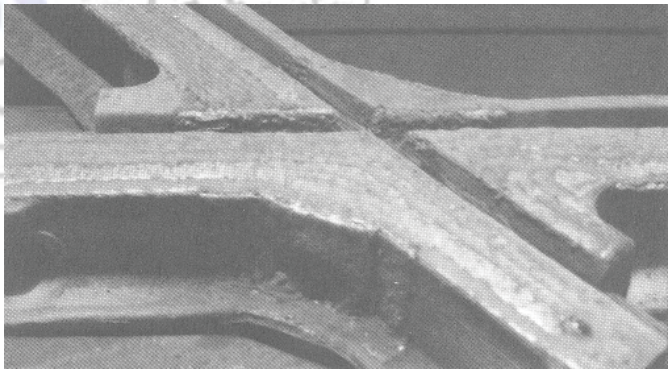
NOTE: Some manganese steel frogs and crossings can be repaired without any welding at all. Many times it is necessary only to grind away the roll-over along the flangeway and bring it back to gauge. But if the flangeways are to close, the wheel flanges may start breaking the metal out in passing through and result in expensive repairs.

General Information

Manganese steel castings are reclaimed by weld repairing cracks and defects and building up worn areas. The areas of most wear on a frog casting are: the nose or point, the wings adjacent to the point, the ends of the frog at rail joint, and the guard on solid self-guarded frogs. The areas of most wear on crossing castings are points and ends of castings at rail joints. The casting's running surface usually isn't worn to any great extent in some areas. By employing a straightedge in these areas, low spots can be identified, as well as the amount of weld metal required for repair. The entire running surface of the casting should be lightly ground and inspected for cracks. More grinding will be required at points of greatest impact (the frog point, the wings adjacent to point, and the ends of the frog at rail joints). Manganese steel hardens under impact.
The work-hardened metal should be removed and cracks V'eed out the full length and depth of the crack before welding. A quick means of determining when work hardened metal has been sufficiently removed is with the use of a homemade tool such as a center punch rounded off at the end to a small ball, then hardened (See Pg 2). A sharp hammer rap on the punch on a non-hardened casting area, such as the bottom of the flangeway, and again on the running surface being ground will determine when sufficient metal has been removed. Grinding should be continued until the center punch impressions are the same diameter as on work hardened surfaces. A grinding depth of 3/16" (4.8mm) is usually sufficient. In extreme cases, it may be necessary to remove as much as 1/4" (6.5mm) below the surface of areas that receive greatest impact. Sharp edges along the flangeway should be rounded slightly before welding. Special grinding wheels are not required, however some grinding wheels are more desirable than others. Resinoid bond wheels will allow higher speeds than vitreous bond wheels, and are safer and more efficient.



Rebuilt in a frog shop using 5/64" (2.0mm) Postalloy® FrogTuff-FCO semi-automatic. By using a welding jig and rotating positioner, flangeway side walls and running surfaces can be welded in a downhand position.



Manganese Steel Crossing rebuilt with two layers of Postalloy® FrogTuff-FCO. Note uniformity of bead appearance, width, and the minimum of weld bead craters.

Grinding wheels should have a grain size of 16 or 20. Contact your grinding wheel supplier for recommendations. These suggestions also apply to the preparation of manganese steel crossing castings. In frog shop welding, warping of castings may be minimized by clamping castings to jig as described on page 4. Place a 5/8" (16mm) thick plate under the frog and clamp at the heel and toe of frog, then tighten until the frog is bowed. Rail bound frogs brought into a shop for repairs require additional preparation. A frog should be stripped and examined for cracks. The cold flow along the outside edges of castings should be removed. Any cracks in the casting should be cut out and prepared for welding. It is recommended that the "V" be no wider than necessary but wide enough to allow welder to properly manipulate the electrode. New running rails are now fitted and assembled and the casting is ready to be placed in jig for welding.

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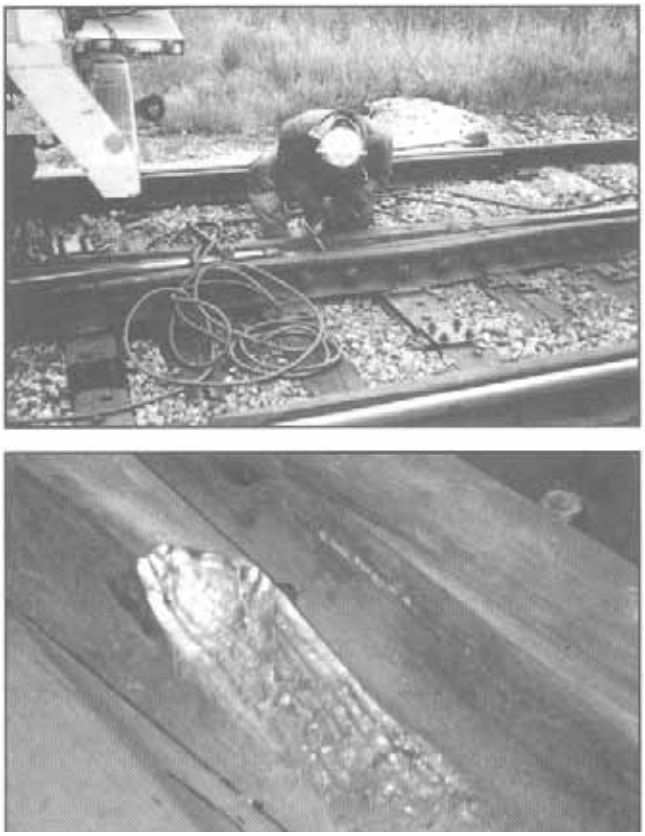
Manganese Steel Track Castings

Inspection and Preparation

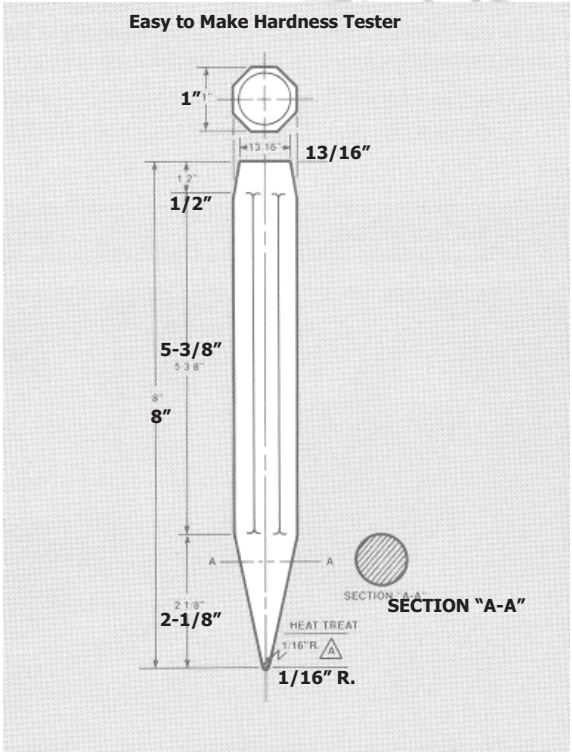
1. Inspect castings for cracks and defects. If required, use dye penetrant to locate cracks.
2. Grind or gouge out detected cracks. (Do not use a cutting torch)
3. Remove all work hardened surfaces before welding by arc airing or grinding approximately 3/16" (4.8mm) deep.
4. Remove all batter and roll-over.
5. Use a flangeway gauge to check flangeway opening.
6. Grind and "round" the edges along the wing rails (sharp edges can result in cracking).
7. Never preheat manganese steel unless below 32°F (0°C) and then simply take the chill out of the casting.
8. Use Air Arc Gouging if at all possible when removing defects or cracks. Air Arc Gouging will put less heat into the casting than when gouging electrodes are used.
9. Weld with high enough current to ensure proper weld penetration and bead wetting.
10. During welding never make a bead wider than 5/8" (16mm). Remember this important rule: The wider the bead, the slower the welding travel speed - and the slower the travel speed, the higher the heat input into the casting.
11. Always travel as fast as possible.
12. To prevent overheating make frequent tests with a 500°F (260°C) Tempilstick. Welding should be stopped in any one area when temperature goes above 500°F (260°C). Welding can continue in another area that has cooled down.
13. Skip-weld whenever possible.
14. Reverse direction of weld beads to minimize build-up of stresses.
15. Beads should not be started or stopped at edge of castings.



TOP: Air Arc Gouging of cracked frog point prior to welding. Welding equipment and air compressor mounted on welding truck.

BOTTOM: Air Arc Gouged cracked frog wing. Note clean surface doesn't have to be ground prior to welding.

Easy to Make Hardness Tester



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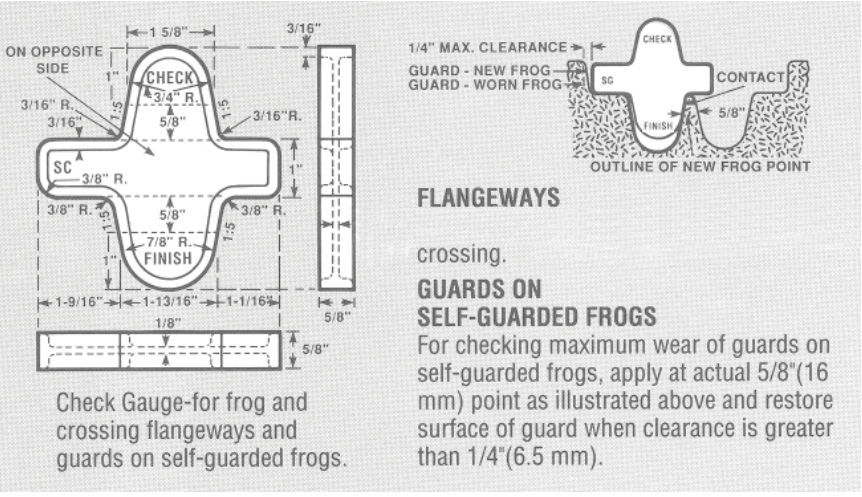
Manganese Steel Track Castings
Inspection and Preparation (cont.)

16. Peening is usually not required when building up surface of worn areas; however, it is essential that weld deposits be peened in severely stressed areas such as cross cracks and areas where deep defects have been removed.
17. Carefully grind to contour and gauge after welding.
18. Slot grind.
19. Make final inspection.
20. Before repairing a crack, bevel with Air Arc Gouging or a grinding wheel.
21. The welding in a beveled crack should be done by applying a series of welds approximately 3" (76mm) long. Do not deposit beads the full length of crack.
22. Control heat very closely to prevent overheating.
23. In general, the gun should be held at about a 20 - 25 degree angle in the direction of the weld bead travel.
24. Guard face on self-guarding frogs must be restored when wear exceeds 1/4" (6.5mm).
25. Points on turnout frogs should be ground 3/16" (4.8mm) lower on the extreme end and tapered back according to size of frog. For example:
    8" taper for No. 8 frogs, 10" taper for No. 10 frogs, 14" taper for No. 14 frogs, 20" taper for both No. 20 and 24 frogs.
    At end of taper the level of the point should conform to the level of the wing rails.
26. Crossing frogs should be ground 3/16" (4.8mm) below running surface at tip of point and taper to level where frog point is 2½" (65mm) wide.
27. A radius from 3/8" (9.5mm) to 5/8" (16mm) should be ground on the top edges of the points and wings.
28. Mating surfaces between manganese castings and binder rail should be slotted with a 3/16" (4.8mm) slotting wheel. This is to prevent spalling of the manganese which will cold flow under impact.

Rebuilding a frog point using Postalloy® FrogTuff-FCO wire. Use flangeway carbon (graphite) blocks inserted in flangeway opening to facilitate the build up of the point and wings. This practice is used to minimize the grinding of the flangeway side walls.

Build up of edges of flangeway point. To minimize heat buildup, narrow (stringer) beads are used. Note the Tempilsticks to check casting temperature.

Use of Flangeway Gauges (Instructions)



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Manganese Steel Track Castings
Welding Jigs

To minimize distortion during welding, railroad frogs are placed in a jig with the running surface up. Pressure is applied on each end with jacks. With long frogs, castings can be bowed slightly and the contraction of the weld metal as it cools will straighten the frog. Jigs can also be designed to rotate self-guarded frogs to maintain downhand position for welding. This type of jig cuts down on welding time and makes work easier. Jigs can also be constructed from carbon steel rails by welding them back-to-back and side-by-side, then welding those three or four sections on cross rails.

The adjacent picture shows an outdoor jig mounted on a concrete slab. If a considerable amount of welding must be done on a frog placed in a jig, the pressure of the jack should be relieved gradually to prevent build up of excessive stresses. Too much stress build up could result in ultimate cracking under traffic.

Welding Jig Application

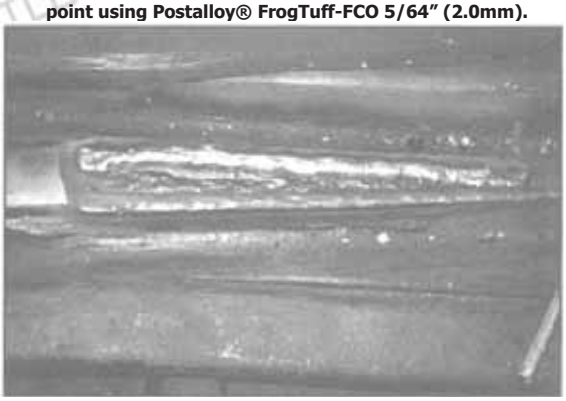
Manganese Steel Track Castings
Procedures Used to Weld Manganese Steel

Manganese steel castings should be welded with the electric arc process only. Because of its greater speed, there is less danger of overheating and destroying the properties of the manganese steel. Currents high enough to produce satisfactory penetration and fusion should be used.

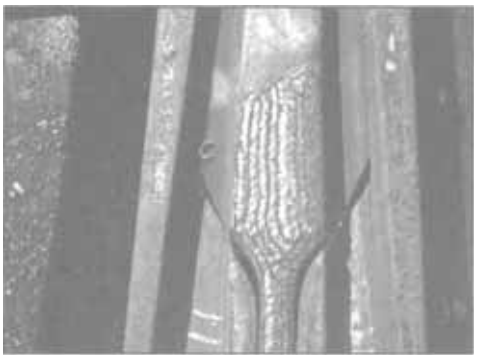
Semi-Automatic (Open Arc) Welding Data

When welding with a 5/64" (2.0mm) tubular wire, start with a welding current of approximately 250 amps on DC reverse polarity. Depending on the size and cross section of a casting, increase or decrease the current. It is important to remember the faster the welding travel speed, the lower the heat input in casting. Also, the wider the bead, the slower the travel speed and, therefore, the higher the heat input. The semi-automatic welding technique is similar to the/or described in the welding manual. In addition, it is recommended that for 5/64" (2.0mm) diameter wire an extension of approximately 1 - 1½" (25-40mm) be maintained during welding. The shorter possible arc length (low arc voltage) should be used.

Good multiple layer build up of a manganese steel frog point using Postalloy® FrogTuff-FCO 5/64" (2.0mm).



With older frog designs, the heel extension has a tendency to crack into two pieces. These two pieces are bolted securely to the rails and if welded together would crack again, so the two parts are arc aired and built up like two separate castings.



Correctly welded frog heel extension using Postalloy® FrogTuff-FCO 5/64" (2.0mm). Note the uniformity of the weld beads and the angle the beads end at to reduce mechanical stress buildup.

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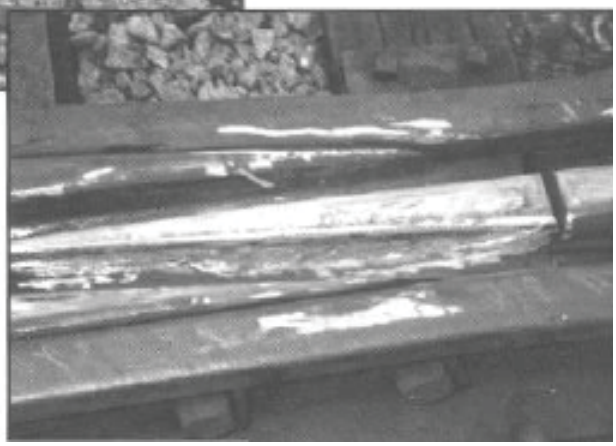
Manganese Steel Track Castings
Grinding Procedures

Manganese steels will deform under traffic. During the deformation period, as a result of high compression and pounding from impact, manganese steel will work harden. The thin cross section at the casting edges and lips will often approach a Brinell hardness of 550 if subjected to continual heavy loading. A flangeway opening might be smaller than the original gauge size as a result of deformation and flow. If the deformed material is not ground away, the wheels can lift and tear it off the casting body (frog or crossing). Cracks might develop along the flangeway edges during this process. Other important wear areas are, for example, where a manganese steel wing is in rigid contact (under compression) with a carbon steel wing rail (rail bound frogs) where the mating manganese steel surface will flow against the rail. Since the deformed material has no place to go, it will crack, spall and break away from the casting base. To prevent such sections in manganese steel frogs and crossings from spalling, breaking, or cracking prematurely, it is extremely important that a preventative program for grinding and slotting wear areas be implemented and followed. Frog life can be greatly extended by a well planned and executed grinding program.

FINISH GRINDING

A casting should be finish ground after all welds have been completed. All surface irregularities should be removed by grinding to provide a smooth straight surface, and the flangeways ground to the proper width and radius. Gauges are available for proper grinding of frogs and crossings. It is important to grind the surface of the frog point to 3/16"(4.8 mm) lower than the gauge side of the wing rail. Taper should conform to castings specifications. Maintaining flangeways by grinding to gauge promotes longer life. Even new manganese steel track castings should be checked and ground to gauge after they have been in service for 60 to 90 days or less, depending upon the traffic. As manganese steel work hardens, it flows into the flangeways and should be removed.



ABOVE: Finish grinding of a manganese steel frog after all welds have been completed.

RIGHT: Finished ground frog. All weld surface irregularities have been removed to provide a smooth surface, and the flangeways ground to proper width and radius.

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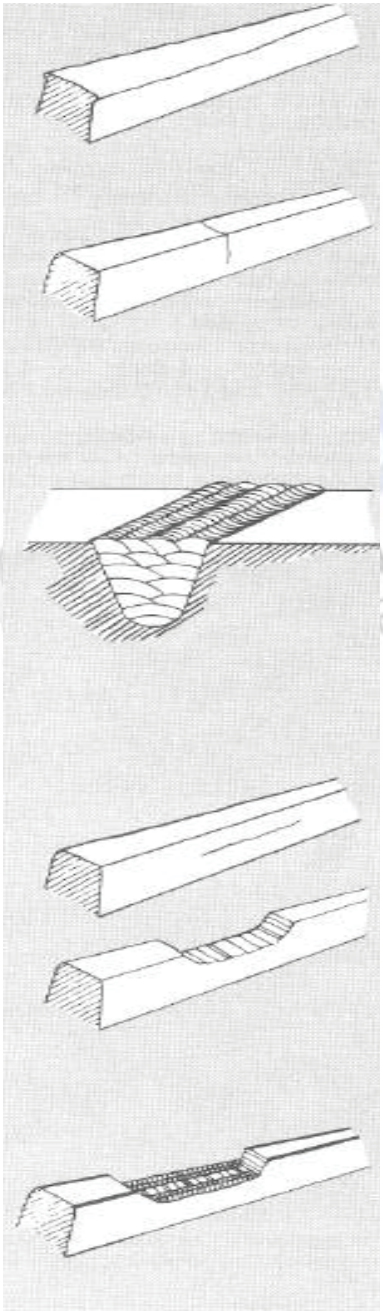
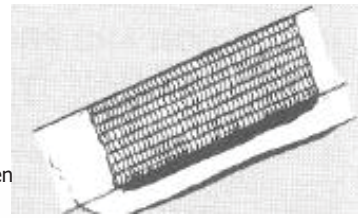
Manganese Steel Track Castings

Typical Track Welding Problems and What to Do About Them

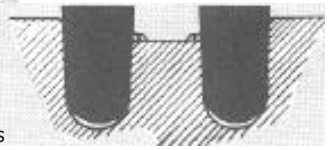
1. Deformed metal along the outside edges of casting should be removed by grinding. Any cracks in casting should be cut out. Flangeway grinding should be according to gauge.
2. Air Arc Gouge across point to bottom of crack and cut a groove just wide enough for proper welding. Arc weld with Postalloy® FrogTuff-FCO reverse direction of each bead. Do not make wide beads.
3. Pass No. 1, called the root pass, must have good penetration. Apply each bead with light weaving motion. Reverse direction of each bead. Don't make beads wider than 5/8" (16mm). Make two adjacent beads as soon as feasible. Remove slag or flux after each bead. Follow bead sequence as per sketch. Do not allow temperature to exceed 500°F (260°C). Last beads must be higher than the casting surface. Grind surface; round off lips and finish grind according to gauge and contour.



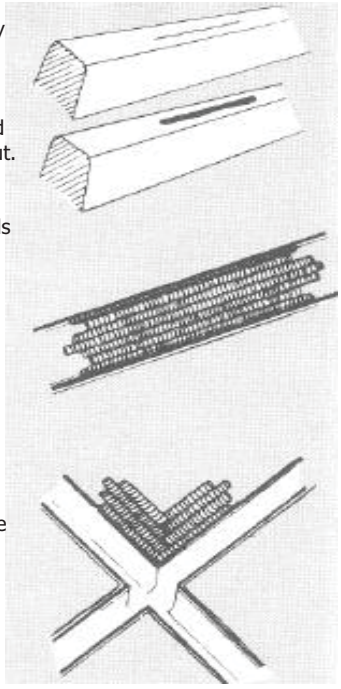
4. Use dye penetrant to determine whether crack goes completely through. If only a surface crack, grind out crack and rebuild with manganese steel electrode. If crack is very deep and goes through the casting, Air Arc Gouge and remove all material above crack and as wide as point. Build up with Postalloy® FrogTuff-FCO wire. Check to see if other cracks have opened.
5. Start with edge beads when welding Air Arc gouged surface of point. Proceed by welding adjacent beads. Reverse direction of each bead. Round out edges by grinding before welding. NEVER start welding before grinding edges.
6. If a crack develops after welding and grinding on a casting surface rebuilt by arc welding, the crack was there before welding began. Sometimes such a crack will "open up" after a few days of traffic. Casting should have been checked using dye penetrants. Never build up a surface if there is a crack in the casting parallel to the running surface. This area of the casting will crack further and spall (come loose) if the surface is built up without cutting out all material above the defect.



7. The use of carbon blocks is recommended to make perfect edge beads without having the weld metal running down. These blocks are removed after welding leaving a smooth weld surface requiring very little grinding. Blocks are reusable.



8. When a surface crack is detected in the casting, Air Arc Gouge the crack as deep as needed and only wide enough to permit the deposit of one or two beads. Sides of the gouged out area should be tapered to ensure good weld penetration without undercut.
9. Before welding, round out edges by grinding. Start with edge beads to build up surfaces. Proceed by welding adjacent beads and reversing the welding direction after each bead.
10. As shown, all weld beads should be staggered to avoid stress concentration. Cracks could develop if all beads start and end in line with each other. There is no restriction in the number of passes if welding with manganese steel wires. Grind surface according to contour.



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Carbon Steel Track Components

Rail Ends/Inspection and Preparation

The welding procedures for track components made of high carbon steel are different from those used for manganese steel. When rebuilding rails ends, the use of semi-automatic welding at higher welding currents is recommended although manual arc and oxyacetylene may be used.

Inspection And Preparation

1. Repairing of rail ends by arc welding is limited to jointed rail and insulated joints.
2. Welder should inspect joint prior to welding to make sure joint is fully bolted and all bolts are tight. Tighten and/or replace bolts as needed before welding.
3. Low joints should be raised and tamped prior to welding.
4. Inspect battered rail ends for cracks, chips, or other defects.
5. Use straight edge to determine length of low spot or amount of build up needed. Do not bridge joint with straight edge to determine amount of buildup needed, examine each rail independently.
6. To eliminate the possibility of cracks starting at bolt hole under no circumstances is a rail to be welded past the last bolt hole in the angle bar.
7. If rail end batter is 0.015" (0.4mm) or less, no surface grinding or welding is necessary but joint should be slotted.

Inspection And Preparation (cont.)

8. If batter exceeds 0.015" (0.4mm), refer to Railroad Welding Manual or contact your welding supervisor to determine maximum allowable depth and length of deposit before welding.
9. Rails to be welded must be clean and free from dirt and grease.
10. If rails are mismatched, lower rail where most wear should be built up first and taper towards higher rail.
11. To determine length of buildup needed for high/low rails use the following formula: With straight edge on high rail and extending 1" (25.4mm) beyond end, use taper gauge to measure difference in high and low rail, .007" (0.2mm) = 1" (25.4mm) of welds.
    Examples: Joint is .035" (1mm) low then weld a 5" (125mm) long tampered build up; Joint is .090" (2mm) then weld a 13" (330mm) long tapered build up.
12. Battered, chipped, spalled, work hardened, defective and excess flow metal must be removed by grinding before welding. Oxyacetylene torch cutting is not acceptable.

Correctly welded, ground, and cross slotted rail ends. Rail ends should be preheated to 700°F (367.4°C) and after welding post heated to 1100°F (587°C). Slow cool using cooling box to cover rail ends is recommended. Rail ends above were rebuild with Postalloy® RailTuff-FCO.

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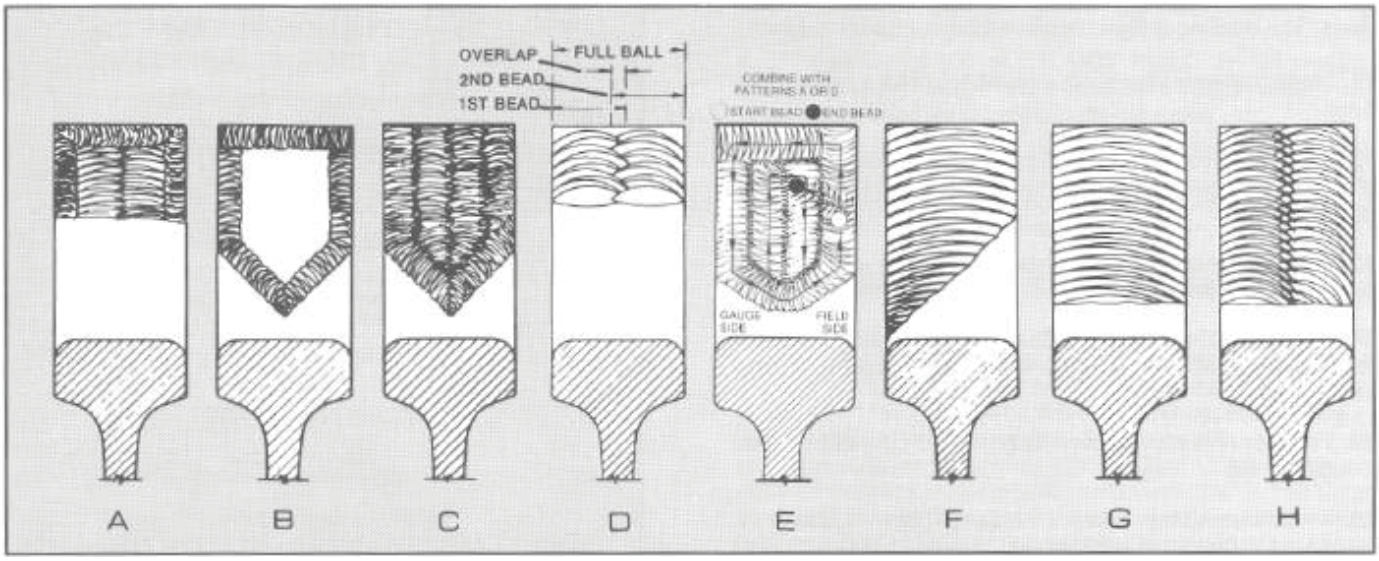
Carbon Steel Track Components

Rail Ends/Welding Procedures

Use Postalloy® RailTuff-FCO 5/64" (2.0mm) semiautomatic wire. There are several patterns that can be used for successful rail end welding. A few are shown in the table below. However, we suggest the strip welding technique as shown in sketch B, C, and E. Use sketch D for first pass on lowest portion of ground rail end.

1. Preheat rail ends to at least 600°F (316°C) prior to welding. Preheat can be accomplished with the use of an oxyacetylene torch or an LP gas heating device. In extreme cold weather (below 32°F (0°C)) use a second torch to preheat stem and web at the same time as the ball.
2. In welding these relatively high carbon steels, increased heat input is desirable compared to welding manganese. Thus, the amperage for 5/64" (2.0mm) diameter wire should be in the range of 250 - 300 amperes.
3. If rails are mismatched, lower rails should be built up first and tapered toward higher rail.
4. Weld beads should be deposited parallel with rail except in low or chipped areas.
5. Weld pattern can be half ball or several smaller adjacent beads.
6. First weld bead will be deposited on field side of rail. Remaining beads will be deposited alternately on gauge and field side of rail. Adjacent beads should overlap approximately 1/3" (8.5mm) of bead width.
7. Length of beads should be clearly marked.
8. Weld beads should be staggered at end of welded area to form a "V" or half round pattern in center of ball. This is done to minimize stress build up in either gauge or field side.
9. Do not start or stop welding on extreme edge of rail. At end of each bead, crater must be properly filled and the arc broken by crossing back into the surface of the welded bead. This is to avoid stress concentrations and cracks in bead craters.
10. Rebuilt worn areas should be high enough to allow sufficient material for finish grinding.
11. Rails must not be allowed to cool during the welding operation. If welding has to be interrupted and rail temperature falls below 600°F (316°C) it should be brought back up to a preheat temperature.
12. Sufficient weld metal must be deposited on the extreme edge of the rail end to leave a smooth weld surface free of slag inclusions or porosity after the rail ends are slotted.
13. A post heat of 1100°F (590°C) is advisable.
14. Slow cool after welding.
15. No undercutting is permissible due to notch-causing effect.
16. The other patterns shown in the table below are not recommended for the following reasons:
    Illustration F. Bead is too wide and should not be finished on either gauge or field side. Finishing welds on the side could result in underbead or rail cracking.
    Illustration G. Bead is too wide. Wide beads are difficult to control, have rougher, uneven surfaces, and might have depressions after surface grinding (especially the craters).
    Illustration H. Both craters were finished in a straight line which could result in rail cracking.

Rail End Weld Bead Patterns



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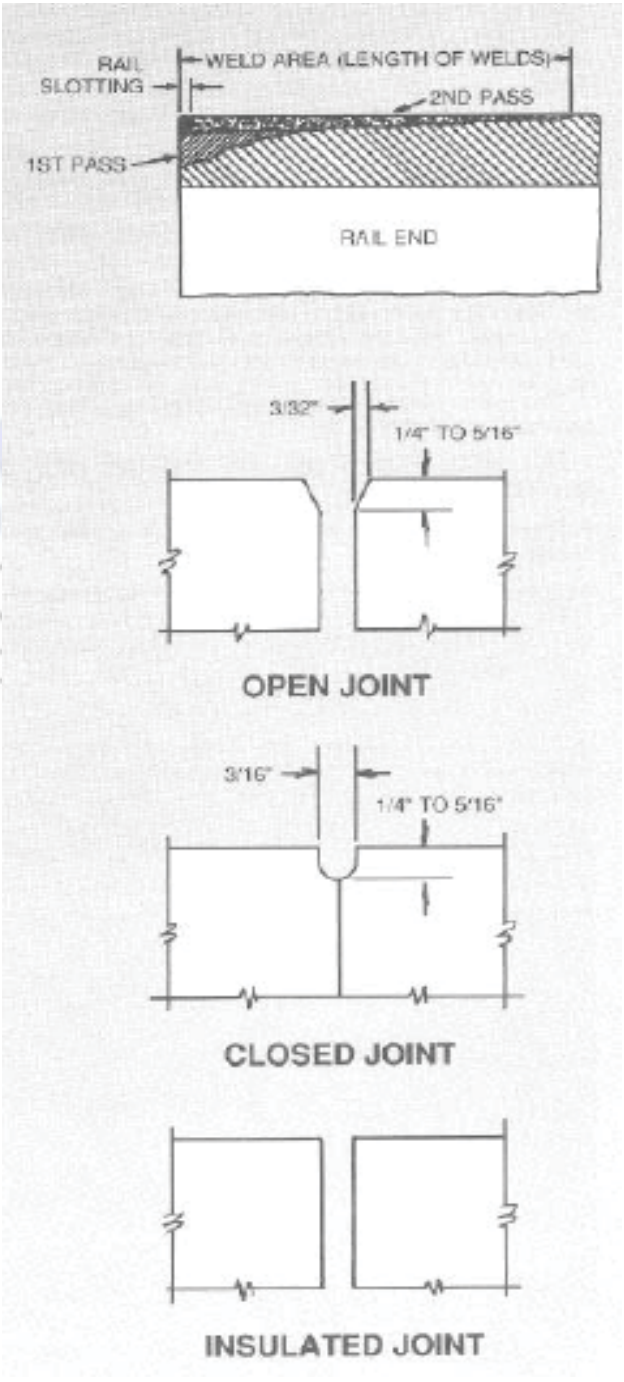
Carbon Steel Track Components

Rail Ends/Grinding and Slotting

1. Surface grinding of the welded rail ends should be done immediately after welding, however, if welds are still extremely hot, wait a few minutes. Grinding at high temperatures can wear the grinding wheel prematurely and/or destroy the bonding material.
2. Do not use a hand grinder for surface grinding, but an angle grinder mounted in a surface grinding guide.
3. Surface grinding and cross slotting of all welded rail ends must be completed the same day welding is done.
4. The ground surface of the ball of a rail must be checked with an 18" (450mm) straightedge to assure proper level and/or taper. The finished surface of the welded area can be a few thousandths of an inch higher than the existing rail surface, allowing for a change in height as a result of metal flow.
5. Finished surface should be free of any blemishes and gouge marks from the grinding wheel and should be ground to conform with the contour of the rest of the rail.
6. Field side must be ground smooth and edge rounded so signal maintainer can bond joint with bond wire.
7. Welding of insulated joints can be done very slowly to help minimize damage to the end post and angle bars from heat during welding. The side of the ball of the rail should not exceed 300°F (150°C) for any length of time. Some railroads, however, preheat to higher temperatures and weld at higher amperages. In such instances, the bonded insulation is replaced.
8. Immediately after welding and grinding has been completed at an insulated joint, the insulation must be inspected to make certain no damage has occurred.
9. If bonded insulated joints are not replaced, do not preheat, because heat could destroy the bonding material.
10. After surface grinding, the rail ends should be slotted or beveled horizontally, approx. 1/4" (6.4mm) to 5/16" (8.0mm) deep. The drawing at right shows welding and slotting details.
11. Slotting wheels should not exceed 3/16" (4.8mm) in thickness.
12. If worn rail is on low side of curve, slotting or beveling must always follow contour of the rail head and must have sufficient depth in center.
13. Rail ends at closed joints should be slotted. Rail ends at open joints should be beveled.
14. Rail ends at insulated joint; the deformed metal should be removed from all rail ends leaving ends square or slightly beveled on top corners.
15. Particles of metal removed by grinding must not be left in insulated joint.
16. If weld deposit exceeds standard depth of slots, slot must be ground to bottom of weld deposit.



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Carbon Steel Track Components

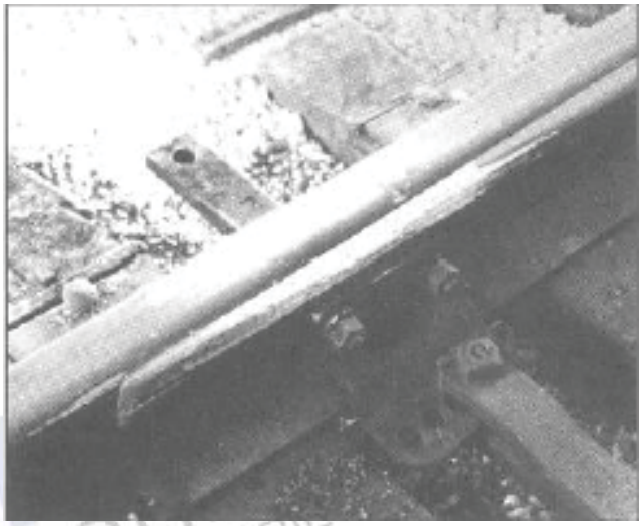
Carbon Steel Switch Points

Inspection and Preparation

1. Switch points can be built up in and out of track using semi-automatic wires. Reclamation of switch points is limited to yard and industry tracks.
2. Postalloy® RailTuff-FCO 5/64" (2.0mm) wire is recommended due to its excellent metal-to-metal properties.
3. A copper plate is used to speed up the welding operation and to prevent the deposit from sticking to the stock rail. The plate should be securely clamped between the switch point and stock rail. This also reduces the need for grinding on the stock rail side. The plate should be as long as the area to be welded.
4. Before welding, any loose bolts in the heel block should be tightened and ties under the heel block should be tamped up if they are low.
5. Prior to welding switch points, all roll over on the stock rail and back side of the switch points should be ground off within the entire contact area. In order to house the switch point into the stock rail, grind off the gauge side of the stock rail from a point four 4" (100mm) in advance of the end of the switch point for a distance of 24" (610mm). If necessary, switch points should be adjusted to fit securely against stock rail.
6. Welding of switch points where bad stock rails are present will usually result in failure.
7. Switch points should be ground at least 1/4" (25mm) below wear area and tapered in a straight line from point to heel.

Welding Procedure

1. Use the semi-automatic welding process.
2. Preheat the head, web, and base of the switch point in the area to be welded to a minimum of 400°F (200°C). Visually check for cracks during and after preheat.
3. If a welded switch point protector is to be applied to the stock rail, it should be completed before welding on the switch point has begun. Switch point protector should have the following dimensions:
   Total length 9½" (240mm). One end tapered 8" (200mm).
   End next to switch point tapered 1½" (380mm).
   Thickness to be between 3/16" (4.8mm) and 1/4" 6.4mm).
   End of Protector 1-3/8" (35mm) from end of switch point.
4. Welding on switch points should be done from end of point towards heel.
5. If the point is too thin, horizontal beads just below the ground surface should be applied first.
6. A tapered profile, both vertical and horizontal, must be maintained during welding.
7. It is recommended that the welded portion of the switch point not exceed 18" (460mm) in length.
8. After each bead make certain that slag is removed before applying another bead. Do not weld over slag.
9. In building up the point, check for distortion. If need be, hammer the point against the stock rail for proper fit and shape.



Welded area of the point has been ground to a smooth finish and to it's approximate original shape and dimension. Stock rail has been ground smooth and straight. Postalloy® RailTuff-FCO

10. When the desired height and width have been obtained, the newly completed area should be heated to a forging temperature (bright red, approximately 1,500°F (820°C)), then close the switch point against the stock rail and shape to desired contour with flat side of hammer. Hammering should be done immediately after welding while point is still at a high temperature. Point will crack if hammered when cold.
11. Engines or cars should not be allowed to pass over weld if point is over 400°F (200°C).
12. The following technique can be used if a copper plate is not available:
    a) Move point against stock rail.
    b) Apply stringer beads without having arc in contact with stock rail.
    c) After each bead, remove slag on top of bead but leave slag in between point and stock rail.
    d) Continue to build up until point is welded to proper shape.
    e) Never allow the weld to touch stock rail.
    f) Observe other steps taken when using copper plate.

Finish Grinding

1. Welded area of the point should be ground to a smooth finish and to an approximate original shape and dimension.
2. The top of the point should be ground 1/2" (13mm) to 5/8" (16mm) below the top of the stock rail and tapered back 18" (460mm). At that point, it should be level with the top of the stock rail.
3. Point thickness on the top at the extreme end should be approximately 1/8" (3.2mm) and sloped downward.
4. All sharp edges should be lightly rounded, and if necessary, final adjustments made so that the switch point fits firmly against the stock rail.

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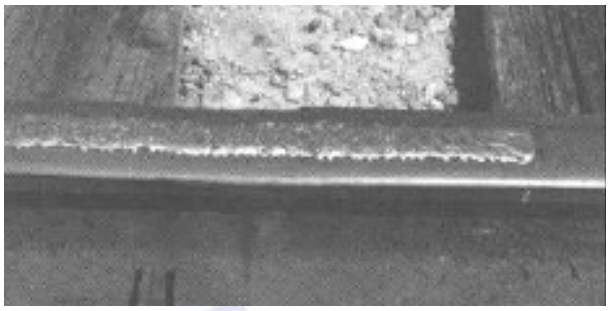
Rails

Wheel Burns, Battered Welds and Wheel Slip Streaks

1. Before repairing welding wheel burns, battered welds, or annealing wheel slip streaks, welder and helper must be qualified by the Welding Supervisor and/or designated representative.
2. Weld deposit should be made using the electric arc process. (The oxyacetylene torch to be used only for preheating, post heating and annealing.)
3. Welders must not make repairs to wheel-burned rail or battered welds if not properly supported by well-tamped ties. Ties should be tamped prior to making repairs.
4. Wheel burns and battered welds should not be repaired on rail with excessive head wear that is badly curve-worn or scheduled to be removed from track in the near future.
5. Avoid, if possible, the repairing of wheel burns or battered welds on continuous welded rail during extremely high or low temperatures.
6. In general remove all shatter cracks, damaged and work hardened metal from area to be welded by grinding.
7. Rail should always be preheated (uniformly) to the required temperature in the area to be welded. Preheating to be done with approved heating equipment. Use Tempilstick or pyrometer to assure correct temperature.
8. During preheating, the welder should closely observe and examine the ground out area of the rail for cracks not visible before heating. Should cracks be found, they must be ground out before welding is started.
9. Welders should attempt to arrange their work to avoid having trains pass over the rail while the welded area is hot.
10. During the welding operation, including preheating and post heating cycles, the welded area must be shielded from strong winds, rain, and cold weather conditions. The shields should be left in place for protection until the heated area of the rail has cooled to a temperature below 300°F (150°C) - this is to relieve accumulated stresses. Heat must be applied evenly and in such a manner to prevent warping or dipping of rail.

Special Instructions For Welding Wheel Burns

1. Except for special cases as accepted by the Welding Supervisor, wheel burns more than 12" (300mm) in length-including batter, but exclusive of adjacent slip streaks-shall not exceed 3/8" (9.5mm). These limits apply after all damaged metal has been ground off.
2. Wheel burns (and wheel slip streaks) on switch points, stock rails, and the spring wing rail or spring rail frogs shall not be repaired. Also, repairs should not be made on other parts of frogs on rails where proper preheating and post heating of the rail is not possible.
3. Postalloy® RailTuff-FCO wires may be used for the welding of wheel burns.
4. Weld beads should be 1/2" (12.5mm) to 5/8" (16mm) wide and deposited parallel with the rail. In order to avoid warping, beads must be deposited alternately on field and gauge sides of rail. When depositing weld beads at outer edges of rail, beads must not be started or ended at extreme edge of rail. Each bead will be deposited in opposite direction from adjacent bead and overlap adjacent bead approximately 1/3 rd. Beads must be staggered at ends of welded area to form a "V" at the center of the rail head or at a 45° angle.



Repair welding of wheel burns and soft, battered flash welds. Postalloy® RailTuff-FCO is recommended.

5. After the welded area has cooled sufficiently, it will be ground to a true straightedge surface, being certain no grounding gouges or nicks are left which could cause wheel pounding. Surface grinding is essential.

Special Instructions For Building Up Battered Welds

1. Determine length of batter with straightedge.
2. Battered welds more than 24" (610mm) in length should not be repaired.
3. Remove all work hardened metal to a depth of 1/16" (1.6mm), also all "shelly" or spalled metal on rail head surfaces by grinding. Remove all roll over by grinding.
4. Postalloy® Rail-Tuff-FCO wires are all used for repairing battered welds.
5. Welding sequence is the same as for wheel burns. If more than one pass is required to fill battered area, first pass should be made in area of greatest depth of batter. Final pass should be full length or area to be welded.

Annealing Wheel Slip Streaks

Hard wheel slip streaks on rail when not heat cracked or chipped can be annealed by proper application of heat. First the area on rail to be annealed should be preheated to approximately 300°F (150°C). After this initial preheat and holding at 300°F (150°C) for approximately 5 minutes, raise streak area temperature to approximately 1,000°F (540°C) to remove excessive hardness. Allow to slowly cool down to 300°F (150°C) for 15 minutes. To ensure slow cooling, cover up area with a heat resistant material or use torch.

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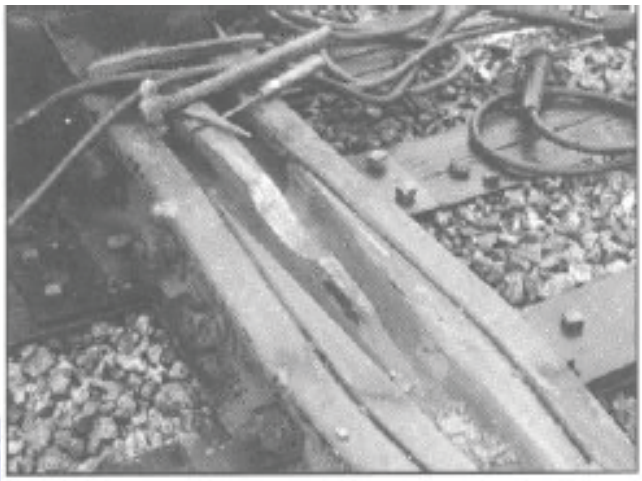
Instructions for Air Carbon Arc Gouging

1. Compressed air at 80 to 100 psi is standard.
2. A compressor should deliver from 26 to 33 C.F.M. for standard torches.
   Horsepower requirement:
   5 hp for intermittent operation.
   7½ hp for continuous operation.

3. The same welder used for track welding is normally used if of sufficient size. The amperage needed depends upon the electrode diameter. Best results are obtained when maximum amperage is used.
   Recommended current:

Electrode dia. in.(mm)	3/16"(4.8mm)	1/4"(6.0mm)	3/8"(8.0mm)
Min. Amps	150	200	250
Max Amps	200	400	450

4. Welding machine should be set at the desired amperage.
5. Air should be on before cutting or gouging.
6. Torch should be held so electrode slopes back from direction of travel with air blast behind electrode.
7. If air blast is above (in front) of electrode, the metal is not removed properly and cut surface is covered with oxide (dull surface).
8. Only a straight forward motion without weaving is recommended during gouging.
9. An electrode angle of approximately 45% is recommended.
10. Depth and contour of groove produced are controlled by electrode angle and travel speed.
11. For a narrow and deep groove, electrode angle should be steep and gouging speed slow.
12. For a shallow groove, electrode angle should be flat with fast speed.
13. Width of groove is determined by electrode size used, normally about 1/8" (3.2mm) wider than electrode diameter.
14. Travel speed should be in uniform. Proper speed produces a good, clean cut without any appreciable oxide.
15. During gouging, a short arc must be maintained by progressing in direction of cut, fast enough to keep up with metal removal.
16. A clean-cut surface does not have to be ground. Welding can be done directly on top of this surface.
17. If arc striking is hard and irregular, the air is not on.
18. Low amperage and/or a bad ground will result in sputtering arc and intermittent, skimpy cuts.
19. If electrode is on wrong polarity, it will heat up rapidly and the arc will sputter.
20. Irregular gouging action is a result of too slow a travel speed.
21. If slag is adhering to edges, the air pressure is too low.
22. Carbon, stainless, and manganese steels should be cut and gouged with electrode on DC reverse polarity.



The above photos show proper Air Arc Gouging.

Postalloy® FrogTuff
Data Sheet

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Description

Ideal for use on manganese steel. Under severe impact, such as hammering or pounding, deposits quickly become tougher and harder, and will not spall or mushroom. **POSTALLOY® FrogTuff** may be used alone, as a combination build-up and hardfacing alloy, or used as a build-up and cushion prior to overlaying .

POSTALLOY® FrogTuff is an all-position electrode for joining or overlaying for high impact. It operates on either AC or DC reverse; the arc is smooth and stable with low spatter loss. Slag removal is easv.

Specifications

Tensile Strength .....125,000 psi
Yield Strength .....80,000 psi
Elongation 34%
Hardness as deposited .....15 - 22 Rc
Work-Hardens up to .....55 Rc
Deposit Thickness .....as required
Machinability .....poor
Can be flame cut

Applications

•Railroad Frogs
•Manganese Crossovers

Welding Procedure: AC or DC Reverse.

Clean weld area. Use **POSTALLOY® 250** to remove damaged metal. Do not preheat manganese steels. Maintain a short to medium arc. Direct the arc on deposited weld metal depositing 3 to 4 inches at a time (75mm-100mm). Interpass temperatures should be kept low on manganese steel by back-stepping and skip-welding. Skip welding is advisable on large parts. Peening while hot helps shape the deposit and reduce stress. Cool slowly.

DIAMETER:	1/8" (3.2mm)	5/32" (4.0mm)	3/16" (4.8mm)	7/32" (5.6mm)
AMPERAGES:	80-125	120-150	140-175	150-190

Also available as a semi-automatic wire - **Postalloy® FrogTuff-FCO**

Approved by Union Pacific Railroad Company

Postalloy® FrogTuff-FCO
Data Sheet

HARDFACE TECHNOLOGIES by POSTLE INDUSTRIES

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Description

Postalloy® FrogTuff-FCO is a high alloy austenitic manganese steel welding wire for joining, build-up or hardfacing. Produces high-strength, crack resistant deposits that are tough, ductile and work-harden rapidly. The high yield strength reduces mushrooming from impact.

Specifications

Wire Type: Flux-cored, Open-arc.

Weld Deposit Properties:

Tensile Strength:.....135,000 psi
Yield Strength:..... .....90,000 psi
Elongation: 30%
Hardness as deposited: ..... 20 Rc
Work-hardened: .....50 - 55 Rc
Deposits can be flame-cut
Cannot be machined

Applications

- Railroad Frogs
- Manganese Crossovers

Welding Parameters - Use DC Reverse Polarity and Globular Metal Transfer

Diameter	**1/16" (1.6mm)**	**5/64" (2.0mm)**
Current *amps*	150-300	220-290
Voltage (DCRP) *volts*	23-28	24-29
Stickout *inch (mm)*	1"-1½"(25-40mm)	1-1½"(25-40mm)
Gas Flow *cfh (l/hr)*	NA	NA

Packaging

Diameter	**.045" (1.2mm)**	**1/16" (1.6mm)**	**5/64" (2.0mm)**	**7/64" (2.8mm)**
25 Lb. Spools	Standard	Standard	Standard	NA
55 Lb. Coils	NA	Available	Available	Standard
110, 220 Lb. drums	Available	Available	Available	Standard

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12/15 RK-5
FrogTuff-FCO

Postalloy® RailTuff
Data Sheet

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Description

POSTALLOY® RailTuff is a build-up electrode in the machinable range of hardness providing wear resistance that is far superior to low and medium carbon steel and low alloy steels.

Deposits are extremely tough and have a high resistance to impact and deformation and are not subject to spalling or roll-over. In addition, deposits are dense, crack-free and porosity-free.

Specifications

Hardness .....32 - 38Rc
Deposit Thickness .....as required
Impact Resistance .....Excellent
Compressive Strength .....High
Abrasion Resistance.....Fair
Can be flame cut.

Applications

- Rail Ends
- Wheel Burns
- Wheel Slip Streaks
- Carbon Steel Switch Points

Welding Procedures - AC/DC Reverse Polarity

Clean weld area. Use of **POSTALLOY® 250** is recommended to remove fatigued or damaged metal. Preheat heavy sections to about 250°F (121°C). Use stringer or weaving technique holding a short to medium arc. Long deposits may be made without danger of cracking. Do not allow excessive heat build-up. Chip slag between passes. Allow part to cool slowly.

SIZES:	**5/32" (4.0mm)**	**3/16" (4.8mm)**	**1/4" (6.0mm)**
AMPERAGES:	100-150	170-225	190-260

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Postalloy® RailTuff-FCO
Data Sheet

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Description
Postalloy® RailTuff-FCO is a strong, tough, low alloy build-up wire. It can be applied to carbon and low alloy steels. Weld deposits are exceptionally sound and dense, and heavy build-ups are possible without danger of cracking.

Specifications
Wire Type: Flux-cored, open-arc

Weld Deposit Properties:
Hardness: 30 - 35 Rc
Maximum Deposit Thickness: Unlimited
Machinable with carbide tools

Applications
- Rail Ends
- Wheel Burns
- Wheel Slip Streaks
- Carbon Steel Switch Points

Welding Parameters - DC Reverse(DCEP)

Diameter	**.045" (1.2mm)**	**1/16" (1.6mm)**	**5/64"(2.0mm)**
Current *amps*	125-225	225-375	220-290
Voltage (DCRP)*volts*	20-26	23-28	24-29
Stickout *inch(mm)*	1/2"-1"(12-25mm)	1"-1½"(25-40mm)	1"-1½"(25-40mm)
Gas Flow *cfh (l/hr)*	NA	NA	NA

Packaging

Diameter	**.045"(1.2mm)**	**1/16"(1.6mm)**	**5/64"(2.0mm)**
25 lb Spools	Standard	Standard	Standard
55 Lb. Coils	NA	Available	Available

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Postalloy® 301
Data Sheet

HARDFACE TECHNOLOGIES by POSTLE INDUSTRIES

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Description

POSTALLOY® 301 is a high strength, ductile, crack resistant welding alloy specifically designed for welding problem steels such as, low alloy, high carbon or crack sensitive tool steels. Ideal for welding dissimilar steels - low alloy, spring steels, carbon steels, tool steels, and manganese steel.

MANGANESE CASTING - High strength electrode used to join and fill deep cracks in manganese castings. Deep penetrating characteristics allow it to tie in and fill casting defects and sand pockets. Also used as an underlayment for the FROG BUILD products.

ACTS AS A SHOCK ABSORBER DURING OPERATION - Since **POSTALLOY® 301** does not respond to heat-treatment and remains ductile, it has the ability to withstand heavy impact or shock loading.

Specifications

Tensile Strength .....up to 120,000 psi
Yield Strength.....79,000 psi
Elongation 25%
Machinable with Carbide Tools
Cannot be flamecut

Applications

- Gear tooth build-up
- Shovel teeth and blades
- Wear plates
- Repair cracked manganese castings
- Grousers
- Heat-treating parts
- Cracked steel casings

Welding Procedures - AC or DC Reverse Polarity

Clean weld area of contaminants. Remove any defective or fatigued weld metal. Bevel heavy sections 90°. Tilt the electrode about 15° in the direction of travel and use the lowest amperage possible. For certain high alloy steels, a preheat of 300°-400°F(149°-204°C) is recommended. Hold a short arc and use stringer beads. Peen to reduce stresses. Allow to cool and remove slag.

Diameter	**3/32 (2.5mm)**	**1/8 (3.2mm)**	**5/32 (4.0 mm)**
Current *amps*	50-80	80-125	100-150

Approved by Union Pacific Railroad Company

06/15 RK-4
301 - RR