HARDFACING ALLOYS
For Railroad Track Components
Repair & Rebuilding

Stoody.com
Stoody has a long history of supplying engineered welding alloys for rail maintenance - with both SMAW electrodes and open arc wires for the repair and rebuilding of manganese steel or carbon steel track components including frogs, crossings, switch points, rail ends and other rail damage including battered welds, wheel burns, and wheel slip streaks.

Founded in 1921, Stoody created the hardfacing category of welding products and today continues to lead innovation in hardfacing and high alloy joining consumables for industries around the world. In addition to the railroad industry, we serve power generation, mining, construction, steel production, petrochemical, recycling, agriculture, and pulp and paper industries among others. Located in Bowling Green, Kentucky, Stoody offers the largest hardfacing and high alloy joining product portfolio in the world along with complete engineering and laboratory services to ensure high standards of quality control as well as custom metallurgy and product development.

Contact Stoody directly for assistance in selecting the right hardfacing and high alloy products for your wear resistance and joining needs. If a situation warrants a customized hardfacing solution, Stoody will be there from conceptualization through field application and beyond.

Stoody.com
**TABLE OF CONTENTS**

Railroad Track Repair - Recommended Stoody Products .................. 4
Product Equivalence - Competitive Cross Reference .................. 4

**STOODY ALLOYS — MANGANESE STEEL TRACK REPAIR**

*RECOMMENDED* - Nicromang Frog (SMAW) .................. 5
*RECOMMENDED* - Nicromang Frog (Open Arc Wire) .................. 5
Nicromang (SMAW) ........................................... 6
Dynamang (Open Arc Wire) ...................................... 6
Nicromang Plus (SMAW) ....................................... 7
Nicromang Plus (Open Arc Wire) .................................. 7
Foundry Co-Mang (SMAW) ..................................... 7
Foundry Co-Mang (Open Arc Wire) ................................ 8
Trackwear (SMAW) ............................................ 8
Trackwear (Open Arc Wire) ..................................... 8
Stoody 2110 (SMAW) ......................................... 9
Stoody 110 (Open Arc Wire) .................................... 9

**STOODY ALLOYS — CARBON STEEL TRACK REPAIR**

*RECOMMENDED* - Rail End 932 - Coated (SMAW) ............. 10
*RECOMMENDED* - Rail End-O (Open Arc Wire) .................. 10
Stoody Build-Up LH (SMAW) .................................. 11
Stoody Build-Up (Open Arc Wire) ................................ 11
Stoody Super Build-Up (Open Arc Wire) .......................... 12

**ESAB RAIL SOLUTIONS**

Electrode Solutions ........................................ 13
Moulding Welding Kit ....................................... 13

**MANGANESE STEEL TRACK CASTINGS REPAIR**

General Information & Tips .................................. 15
Inspection, Preparation, Welding, and Finishing Recommendations .... 19
Grinding Recommendations .................................. 20
Instructions for Arc Gouging ................................ 20
Typical Track Welding Problems & Solutions ..................... 21

**CARBON STEEL COMPONENT REPAIR**

Rail Ends: Inspection & Preparation ................................ 22
Rail Ends: Welding Recommendations ............................ 23
Rail Ends: Grinding & Slotting .................................. 28
Wheel Burns, Battered Welds, & Wheel Slip Streaks .................. 28
Switch Points: Inspection & Repair ................................ 29

**GENERAL STOODY PRODUCT INFORMATION**

Product Reference ........................................ 30
Packaging Details .......................................... 31

Refer to product data sheets. Typical product properties shown herein. Product performance in service can be heavily influenced by welding procedures, including but not limited to preheat and interpass temperatures.

NOTICE: Failure to follow manufacturer’s directions for use may result in equipment or material failure and void any applicable warranty. The data provided or referenced herein is provided for informational purposes only, without guarantee or warranty and represents “typical” results when Stoody products are used in accordance with internal Stoody procedures. Other tests and procedures may produce differing results. Stoody expressly disclaims any liability resulting from reliance on this data.
### RAILROAD TRACK REPAIR - RECOMMENDED STOODY PRODUCTS

<table>
<thead>
<tr>
<th>RAIL APPLICATION</th>
<th>PROCESS</th>
<th>RECOMMENDED STOODY PRODUCTS</th>
<th>ALTERNATIVE STOODY PRODUCTS OPTIONS</th>
</tr>
</thead>
</table>
| Austenitic Manganese Steel Frogs  
Austenitic Manganese Steel Inserts  
Austenitic Manganese Steel Crossings | SMAW | Nicromang Frog - CTD | Nicromang  
Nicromang Plus  
Foundry Co-Mang  
Trackwear  
Stoody 2110 |
|                  | WIRE   | Nicromang Frog              | Dynamang  
Nicromang Plus  
Foundry Co-Mang-O  
Trackwear  
Stoody 110 |
| High Carbon Steel Frogs  
High Carbon Steel Switch Points  
High Carbon Steel Rail Ends | SMAW | Railend 932 - CTD           | Stoody Build-Up LH |
|                  | WIRE   | Railend 932-O               | Stoody Build-Up  
Stoody Super Build-Up |

### PRODUCT CROSS REFERENCE - COMPETITIVE CONVERSIONS

**STOODY TRACK REPAIR & MAINTENANCE ALLOYS**

<table>
<thead>
<tr>
<th>STOODY</th>
<th>Welding Alloys</th>
<th>Lincoln Electric</th>
<th>Bohler/UTP</th>
<th>Hobart McKay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nicromang Frog (SMAW)</td>
<td>AP-E</td>
<td>Wearshield Frog Mang, Mangjet, 15CrMn</td>
<td>Fox Chromos, 12MN1-A, UTP 7200, UTP BMC</td>
<td>Hardalloy 119, 118, Chrome-Mang</td>
</tr>
<tr>
<td>Railend 932 (SMAW)</td>
<td>250-E</td>
<td>Wearshield BU, BU30</td>
<td>UTP Dur 250</td>
<td>Hardalloy 32, M-932</td>
</tr>
</tbody>
</table>
NICROMANG® FROG - COATED

NICROMANG FROG is a high strength, high manganese alloy, designed for buildup repair of castings such as manganese railroad frogs and crossings, crusher hammers, and impact bars. The high alloy content of the Nicromang Frog allows for high work hardening while maintaining high impact resistance and toughness. Deposits are austenic whether applied to carbon steel or manganese steel, non-magnetic, machinable with carbide tools, and can be flame cut.

Welding Procedures/Characteristics: Can be applied AC or DC, either polarity (reverse preferred) using stringer or weave beads. Weldability is good in the flat and horizontal positions. Multiple layers can be applied without difficulty when proper procedures are followed. Maintain low heat input, do not exceed 500°F (260°C) interpass temperature and peen with the flat face of a hammer, when possible, to relieve weld stress.

Applications: Manganese Railroad Frogs and Crossings, Manganese Steel Castings

Typical Chemical Composition:
Alloy Content – 23%  (Manganese, Chromium, Carbon, Molybdenum, Nickel)
Iron Base

MANGANESE STEEL TRACK REPAIR ALLOYS - RECOMMENDED

NICROMANG® FROG

NICROMANG FROG is a high strength, high manganese alloy, designed for buildup repair of castings such as manganese railroad frogs and crossings, crusher hammers, and impact bars. The high alloy content of the Nicromang Frog allows for high work hardening while maintaining high impact resistance and toughness. Deposits are austenic whether applied to carbon steel or manganese steel, non-magnetic, machinable with carbide tools, and can be flame cut.

Welding Procedures/Characteristics: DC reverse polarity recommended (electrode positive). Use stringer or weave beads 3/8" - 5/8" (10 mm - 16 mm) wide. Weldability is good in the flat position. Multiple layers can be applied without difficulty when proper procedures are followed. Maintain low heat input, do not exceed 500°F (260°C) interpass temperature.

Applications: Manganese Railroad Frogs and Crossings, Manganese Railroad Track Components, Crusher Cone Nuts and Mantles, Crusher Hammer Rolls, Impactor Bars and Rotors

Nominal Composition:
Alloy Content – 23%  (Manganese, Chromium, Carbon, Molybdenum, Nickel)
Iron Base

Typical Mechanical Properties:
Hardness / Work Hardens to ......................... 235 BHN / 55 HRC
Tensile Strength ..................................................132 ksi (910 MPa)
Yield Strength .................................................. 89 ksi (615 MPa)
Elongation .......................................................... 35%

Part Number Pkg Dimensions Amperage (AC, DC±)
11972600 10 lb Box 3/16" x 14" 170 – 225
11972500 10 lb Box 1/4" x 18" 230 – 330

Rail frog repair (switch frog)
MANGANESE STEEL TRACK REPAIR ALLOYS – SMAW & WIRE

**NICROMANG® - COATED**

NICROMANG is an out of position extruded electrode with excellent impact strength. It work hardens under impact. Deposits can be flame cut. NICROMANG has a high deposition rate. Designed for build-up, and joining of manganese steels. No limit to deposit thickness.

**Welding Procedures/Characteristics:** Can be applied AC or DC, either polarity (reverse preferred). Use straight polarity for fastest deposition. Minimum spatter loss. Produces a thin, non-popping slag that is easily removed. Weave beads 2–3x electrode diameter are preferred. Deposits are non-magnetic and machinability is poor. Interpass temperature should not exceed 500°F (260°C) maximum. Not recommended for build-up of carbon steel.

**Applications:** Dipper and Tooth Build-up, Crusher Rolls, Dredge Pump Parts, Rolling Mill Couplers, Rolling Mill Spindles, Crusher Jaws, Impact Breaker Bars, Hammer Mill, Shovel Pads, Railroad Frogs (manganese)

**Typical Chemical Composition:**
- Alloy Content – 23% (Manganese, Chromium, Nickel, Carbon, Silicon)
- Iron Base

**DYNAMANG®**

DYNAMANG is an austenitic manganese material containing chromium and nickel. It produces a tough, high strength deposit that workhardens under impact. Primarily used for the build-up, repair and joining of manganese steel. Deposit thickness is unlimited and can be flame cut without difficulty.

**Welding Procedures/Characteristics:** DCEP (reverse polarity) recommended, using either stringer or weave beads ½¨ to ¾¨ (13 mm - 19 mm) wide. Wire extension (arc length) is very important. If it becomes too long, excessive spatter results; if too short, “stubbing” will occur. The use of CO₂ shielding gas reduces the amount of spatter with the 1/16¨ (1.6 mm) diameter wire. Limit interpass temperature to 500°F (260°C) maximum.

**Applications:** Crusher Rolls, Jaw Crushers, Hammer Crushers, Dredge Pump, Cutters, Shovel Pads, Buckets and Teeth, Gyrotrary Crusher Mantles, Railroad Frogs (manganese)

**Nominal Composition:**
- Alloy Content – 20% (Manganese, Chromium, Nickel, Carbon)
- Iron Base

**Typical Mechanical Properties:**
- Hardness (2 Layers) / Work Hardens to ........... 200 BHN / 500 BHN
- Tensile Strength..................................................120 ksi (830 MPa)
- Yield Strength.......................................................70 ksi (480 MPa)
- Elongation in 2 in..................................................42%

### Typical Mechanical Properties:

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Pkg</th>
<th>Dimensions</th>
<th>Welding Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Diameter x Length</td>
<td>CTWD</td>
</tr>
<tr>
<td>11836400</td>
<td>33 lb WB (15 kg)</td>
<td>1/8&quot; x 14&quot;</td>
<td>Open-arc or CO₂</td>
</tr>
<tr>
<td>11446700</td>
<td>33 lb WB (15 kg)</td>
<td>1/8&quot; x 14&quot;</td>
<td>Open-arc or CO₂</td>
</tr>
<tr>
<td>11470200</td>
<td>50 lb PP (22.7 kg)</td>
<td>1/8&quot; x 14&quot;</td>
<td>Open-arc or CO₂</td>
</tr>
<tr>
<td>11249800</td>
<td>60 lb Coil (27.2 kg)</td>
<td>7/64&quot; x 14&quot;</td>
<td>Open-arc</td>
</tr>
<tr>
<td>11250100</td>
<td>110 lb OP (50 kg)</td>
<td>7/64&quot; x 14&quot;</td>
<td>Open-arc</td>
</tr>
<tr>
<td>11250200</td>
<td>200 lb HP (90.7 kg)</td>
<td>7/64&quot; x 14&quot;</td>
<td>Open-arc</td>
</tr>
</tbody>
</table>
MANGANESE STEEL TRACK REPAIR ALLOYS – SMAW & WIRE

NICROMANG® PLUS - COATED
NICROMANG PLUS is similar to Stoody NicroMang except it is formulated to produce a higher hardness in the “as-welded” condition. This higher hardness will reduce the amount of initial metal deformation under heavy loads. NicroMang Plus is not recommended for buildup on carbon steel.

Welding Procedures/Characteristics: Can be applied AC or DC, either polarity (reverse preferred) using stringer or weave beads. Weldability is good in the flat and horizontal positions. Multiple layers can be applied without difficulty when proper procedures are followed. Maintain low heat input, do not exceed 500°F (260°C) degrees interpass temperature and peen with the flat face of a hammer, when possible, to relieve weld stress.

Applications: Manganese Railroad Frogs and Crossings, Manganese Steel Castings

Typical Chemical Composition:
Alloy Content – 23% (Manganese, Chromium, Carbon, Molybdenum, Nickel); Iron Base

Typical Mechanical Properties:
Hardness / Work Hardens to ................................. 235 BHN / 55 HRC
Tensile Strength .................................................. 132 ksi (910 MPa)
Yield Strength .................................................... 89 ksi (615 MPa)
Elongation .......................................................... 35%

Typical Mechanical Properties:
All weld metal .................................................... 230 BHN
Workhardened to ............................................... 55 HRC

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Pkg</th>
<th>Dimensions Diameter x Length</th>
<th>Amperage (AC, DC±)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11857000</td>
<td>10 lb Box (4.5 kg)</td>
<td>1/8&quot; x 14&quot; (3.2 mm x 35.6 cm)</td>
<td>100 – 160</td>
</tr>
<tr>
<td>11857000</td>
<td>10 lb Box (4.5 kg)</td>
<td>5/32&quot; x 14&quot; (4.0 mm x 35.6 cm)</td>
<td>140 – 200</td>
</tr>
<tr>
<td>11852900</td>
<td>10 lb Box (4.5 kg)</td>
<td>3/16&quot; x 14&quot; (4.8 mm x 35.6 cm)</td>
<td>170 – 225</td>
</tr>
<tr>
<td>11852000</td>
<td>60 lb Bulk Pak (27.2 kg)</td>
<td>3/16&quot; x 14&quot; (4.8 mm x 35.6 cm)</td>
<td>170 – 225</td>
</tr>
<tr>
<td>11872900</td>
<td>10 lb Box (4.5 kg)</td>
<td>1/4&quot; x 18&quot; (6.4 mm x 45.7 cm)</td>
<td>230 – 330</td>
</tr>
<tr>
<td>11876800</td>
<td>10 lb Box (4.5 kg)</td>
<td>5/16&quot; x 18&quot; (8.0 mm x 45.7 cm)</td>
<td>270 – 390</td>
</tr>
</tbody>
</table>

NICROMANG® PLUS (OPEN ARC WIRE)
NICROMANG PLUS is similar to NicroMang except it is formulated to produce a higher hardness in the “as-welded” condition. This higher hardness will reduce the amount of initial metal deformation under heavy loads. NicroMang Plus is not recommended for buildup on carbon steels.

Welding Procedures/Characteristics: DC reverse polarity recommended (electrode positive). Use stringer or weave beads 3/8" - 5/8" (10 mm - 16 mm) wide. Weldability is good in the flat position. Multiple layers can be applied without difficulty when proper procedures are followed. Maintain low heat input, do not exceed 500°F (260°C) degrees interpass temperature.

Applications: Manganese Railroad Frogs and Crossings, Manganese Steel Castings

Nominal Composition:
Alloy Content – 23% (Manganese, Chromium, Carbon, Molybdenum, Nickel); Iron Base

Typical Mechanical Properties:
Hardness / Work Hardens to ......................... 170-210 BHN / 350-450 BHN
Tensile Strength ........................................... 128 ksi (880 MPa)
Yield Strength ............................................ 71 ksi (490 MPa)
Elongation .................................................... 42%

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Pkg</th>
<th>Wire Dia.</th>
<th>Shielding Gas</th>
<th>Welding Parameters</th>
<th>CTWD</th>
<th>Amps</th>
<th>Volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>11873100</td>
<td>33 lb WB (15 kg)</td>
<td>1/16&quot; (1.6 mm)</td>
<td>Open-arc or CO2</td>
<td>1/2&quot;-1&quot; (13-25 mm)</td>
<td>200-250</td>
<td>23-27</td>
<td></td>
</tr>
<tr>
<td>11950200</td>
<td>33 lb WB (15 kg)</td>
<td>5/64&quot; (2.0 mm)</td>
<td>Open-arc</td>
<td>3/4&quot;-1&quot; (19-25 mm)</td>
<td>220-260</td>
<td>27-28</td>
<td></td>
</tr>
<tr>
<td>11887100</td>
<td>25 lb PSL (11.3 kg)</td>
<td>3/32&quot; (2.4 mm)</td>
<td>Open-arc</td>
<td>3/4&quot;-1/&quot; (19-32 mm)</td>
<td>200-300</td>
<td>24-27</td>
<td></td>
</tr>
<tr>
<td>11852000</td>
<td>60 lb Coil (27.2 kg)</td>
<td>7/64&quot; (2.8 mm)</td>
<td>Open-arc</td>
<td>3/4&quot;-1/&quot; (19-32 mm)</td>
<td>275-375</td>
<td>25-28</td>
<td></td>
</tr>
<tr>
<td>11851900</td>
<td>200 lb HP (90.7 kg)</td>
<td>7/64&quot; (2.8 mm)</td>
<td>Open-arc</td>
<td>3/4&quot;-1/&quot; (19-32 mm)</td>
<td>275-375</td>
<td>25-28</td>
<td></td>
</tr>
</tbody>
</table>

FOUNDRY CO-MANG® - COATED
FOUNDRY CO-MANG is a manganese steel coated electrode and provides an excellent color match to the manganese base metal. It is suitable for multi-layer buildup and has excellent work hardening characteristics. It is usable for austenitic manganese steel repair, buildup and joining.

Welding Procedures/Characteristics: Can be applied AC or DCEP (reverse polarity). Weave beads 2-3 times the electrode diameter are preferred. Deposits are non-magnetic and machinability is poor. Interpass temperature should not exceed 500°F (260°C). Not recommended for buildup up of carbon steel.

Applications: Rock Crushing and Mining: Crusher Roll, Jaws, Grizzly Bars, Screens, Grates, Impactor Bars, Dredge Pump Parts, Hammer Mill Hammers, Shovel Pads, Latch Pins, Dipper Front Edge and Teeth.

Typical Chemical Composition:
Alloy Content – 18% (Carbon, Manganese, Molybdenum); Iron Base

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Pkg</th>
<th>Dimensions Diameter x Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>11814000</td>
<td>10 lb Box (4.5 kg)</td>
<td>5/32&quot; x 14&quot; (4.0 mm x 35.6 cm)</td>
</tr>
<tr>
<td>44441050</td>
<td>60 lb Bulk Pak (27.2 kg)</td>
<td>5/32&quot; x 14&quot; (4.0 mm x 35.6 cm)</td>
</tr>
<tr>
<td>11814100</td>
<td>10 lb Box (4.5 kg)</td>
<td>3/16&quot; x 14&quot; (4.8 mm x 35.6 cm)</td>
</tr>
<tr>
<td>44441250</td>
<td>60 lb Bulk Pak (27.2 kg)</td>
<td>3/16&quot; x 14&quot; (4.8 mm x 35.6 cm)</td>
</tr>
<tr>
<td>44441650</td>
<td>60 lb Bulk Pak (27.2 kg)</td>
<td>1/4&quot; x 18&quot; (6.4 mm x 45.7 cm)</td>
</tr>
</tbody>
</table>
MANGANESE STEEL TRACK REPAIR ALLOYS – SMAW & WIRE

FOUNDRY CO-MANG®-O (OPEN ARC WIRE)
FOUNDRY CO-MANG-O is a manganese steel wire. It is suitable for multi-layer buildup and has excellent work hardening characteristics. It is usable for austenitic manganese steel repair, buildup and joining and provides an excellent color match to the manganese base metal.

Welding Procedures/Characteristics: DCEP (reverse polarity) recommended, using either stringer or weave beads ½” to ¾” (13 mm - 19 mm) wide. Contact tip to work piece distance (arc length) is very important. If it becomes too long, excessive spatter results; if too short, “stubbing” will occur. Limit interpass temperature to 500°F (260°C) maximum.

Applications: Rock Crushing, Mining, Dredge Pump Parts, Hammer Mill Hammers, Shovel Pads, Crusher Rolls, Jaws, Grizzly Bars, Screens, Grates, Impactor Bars, Manganese Railroad Frogs, Latch Pins

Nominal Composition: Alloy Content – 18% (Carbon, Manganese, Molybdenum) Iron Base

TRACKWEAR® - COATED
TRACKWEAR is a high strength manganese steel electrode especially developed for the build-up of parts subject to heavy battering loads, such as railroad frogs and crossings. Its initial strength and hardiness is high and it work hardens quickly with minimal flow and roll over. It works well when applied to standard manganese steel alloy castings, nickel manganese steel alloy castings, and molybdenum manganese steel castings. It is also compatible with any other standard manganese steel welding material that may have been applied previously.

Welding Procedures/Characteristics: Can be applied AC or DC, either polarity (straight preferred). Deposits do not respond to heat treatment. Weave beads 2-3 times electrode diameter are preferred. Machinability is poor. Not recommended for build-up of carbon steel. Interpass temperature should not exceed 500°F (260°C) maximum.

Applications: Railroad Frogs, Railroad Crossings, Track Castings, Steel Mill Rolls, Wobbler Spindles, Coupling Boxes, Crusher Parts

TRACKWEAR® (OPEN ARC WIRE)
TRACKWEAR® is a very high strength austenitic manganese containing vanadium developed for the build-up of manganese steel castings. Deposits have a higher initial yield strength than other austenitic manganese steel wires, work hardens much faster and also develops minimal flow and rollover in service.

Welding Procedures/Characteristics: DCEP (reverse polarity) recommended. This alloy can be deposited in multiple layers although if build-up of more than a ½” (13 mm) is required, NICROMANG would be preferred. Machinability is very poor and deposits can be flame cut. Limit interpass temperature to 500°F (260°C) maximum.

Applications: Top Layer on Frog Heel Extension, Manganese Insert, Top 2 Layers on Build-up of Manganese Steel Frog Point, Crusher Rolls, Dredge Pump Parts, Dipper Fronts and Teeth, Impact Breaker Bars, Hammer Mill Hammers, Latch Pins, Roll Wobblers and Spindles, Shovel Pads, Crusher Jaws, Railroad Frogs and Crossings

Nominal Composition: Alloy Content – 19% (Manganese, Carbon, Vanadium) Iron Base

Typical Mechanical Properties:

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Pkg</th>
<th>Wire Dia.</th>
<th>Shielding Gas</th>
<th>CTWD</th>
<th>Amps</th>
<th>Volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>11847800</td>
<td>33 lb WB (15 kg)</td>
<td>1/16” (1.6 mm)</td>
<td>Open-arc</td>
<td>1/2”-1” (13-25 mm)</td>
<td>200-250</td>
<td>25-27</td>
</tr>
<tr>
<td>11863600</td>
<td>50 lb PF (22.7 kg)</td>
<td>1/16” (1.6 mm)</td>
<td>Open-arc</td>
<td>1/2”-1” (13-25 mm)</td>
<td>200-250</td>
<td>25-27</td>
</tr>
<tr>
<td>11908300</td>
<td>60 lb Coil (27.2 kg)</td>
<td>3/32” (2.4 mm)</td>
<td>Open-arc</td>
<td>1/4”-1/2” (6-13 mm)</td>
<td>225-275</td>
<td>25-27</td>
</tr>
</tbody>
</table>

Typical Chemical Composition:

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Pkg</th>
<th>Wire Dia.</th>
<th>Dimensions Diam x Length</th>
<th>Amperage (AC, DCs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>48701500</td>
<td>60 lb Bulk Pak (27.2 kg)</td>
<td>5/32” x 1” (4.0 mm x 35.6 cm)</td>
<td>100 – 160</td>
<td></td>
</tr>
<tr>
<td>48701250</td>
<td>60 lb Bulk Pak (27.2 kg)</td>
<td>3/16” x 1” (4.8 mm x 35.6 cm)</td>
<td>140 – 230</td>
<td></td>
</tr>
<tr>
<td>48701550</td>
<td>60 lb Bulk Pak (27.2 kg)</td>
<td>1/4” x 1” (6.4 mm x 45.7 cm)</td>
<td>200 – 300</td>
<td></td>
</tr>
</tbody>
</table>

FOUNDRY CO-MANG®-O (OPEN ARC WIRE)
FOUNDRY CO-MANG-O is a manganese steel wire. It is suitable for multi-layer build up and has excellent work hardening characteristics. It is usable for austenitic manganese steel repair, buildup and joining and provides an excellent color match to the manganese base metal.

Welding Procedures/Characteristics: DCEP (reverse polarity) recommended, using either stringer or weave beads ½” to ¾” (13 mm - 19 mm) wide. Contact tip to work piece distance (arc length) is very important. If it becomes too long, excessive spatter results; if too short, “stubbing” will occur. Limit interpass temperature to 500°F (260°C) maximum.

Applications: Rock Crushing, Mining, Dredge Pump Parts, Hammer Mill Hammers, Shovel Pads, Crusher Rolls, Jaws, Grizzly Bars, Screens, Grates, Impactor Bars, Manganese Railroad Frogs, Latch Pins

Nominal Composition: Alloy Content – 18% (Manganese, Carbon, Molybdenum) Iron Base

Typical Mechanical Properties:

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Pkg</th>
<th>Wire Dia.</th>
<th>Shielding Gas</th>
<th>CTWD</th>
<th>Amps</th>
<th>Volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>11821000</td>
<td>33 lb WB (15 kg)</td>
<td>5/64” (2.0 mm)</td>
<td>Open-arc</td>
<td>3/4”-1 1/4” (19-32 mm)</td>
<td>225-275</td>
<td>23-27</td>
</tr>
<tr>
<td>61800755</td>
<td>60 lb Coil (27.2 kg)</td>
<td>7/64” (2.8 mm)</td>
<td>Open-arc</td>
<td>3/4”-1 1/4” (19-32 mm)</td>
<td>200-450</td>
<td>23-26</td>
</tr>
</tbody>
</table>

Typical Chemical Composition:

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Pkg</th>
<th>Wire Dia.</th>
<th>Dimensions Diam x Length</th>
<th>Amperage (AC, DCs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>48701250</td>
<td>60 lb Bulk Pak (27.2 kg)</td>
<td>5/32” x 1” (4.0 mm x 35.6 cm)</td>
<td>100 – 160</td>
<td></td>
</tr>
<tr>
<td>48701550</td>
<td>60 lb Bulk Pak (27.2 kg)</td>
<td>3/16” x 1” (4.8 mm x 35.6 cm)</td>
<td>140 – 230</td>
<td></td>
</tr>
<tr>
<td>48701500</td>
<td>60 lb Bulk Pak (27.2 kg)</td>
<td>1/4” x 1” (6.4 mm x 45.7 cm)</td>
<td>200 – 300</td>
<td></td>
</tr>
</tbody>
</table>
MANGANESE STEEL TRACK REPAIR ALLOYS – SMAW & WIRE

STOODY® 2110 - COATED
STOODY 2110 is a solid core extruded electrode with alloys in the coating designed for build-up of austenitic manganese steel parts subject to high impact loading without limitations to deposit thickness. It is a modified high chromium-high manganese steel that combines toughness and wear resistance. This alloy can be applied to low carbon steel and used to join austenitic manganese steels to low carbon steel.

Welding Procedures/Characteristics: Can be applied AC or DCEP (reverse polarity). Weldability is excellent with low spatter. Build-up is superior to other electrodes of this type. Use stringer or weave beads. Deposits are dense, porosity-free, extremely tough and workhardens rapidly. Cannot be flame cut; machinable with carbide tools, non-magnetic. Not recommended for cast iron.

Applications: Sugar Mill Hammers, Knives, Press Roll Flanges; Drive Tumblers, Shovel Pads, Roll Crushers, Hammers, Shovel Teeth, Grate Bars, Carbon, Steel Frogs, Switch Points, Manganese Rail Components

Typical Chemical Composition:
Alloy Content – 31% (Manganese, Chromium, Nickel, Carbon, Silicon)
Iron Base

STOODY® 110 or 110MC*
STOODY 110 is a modified high chromium high manganese steel widely used in the rebuilding of manganese steel parts subject to severe impact loading. This material offers excellent cavitation resistance; good toughness and wear resistance; and is sometimes used as the final hardfacing layer in extreme impact situations.

Welding Procedures/Characteristics: DCEP (reverse polarity) recommended, using either stringer or weave beads 1/2" to 3/4" (13 mm - 19 mm) wide. Deposits cannot be flame cut, are machinable with carbide tools, are non-magnetic and are not recommended for cast iron. The addition of CO₂ shielding gas with the 1/16" (1.6 mm) diameter wire reduces the amount of spatter and improves the weldability.

Applications: Sugar Mill Hammers, Knives, Press Roll Flanges; Drive Tumblers, Shovel Pads, Shovel Teeth, Turbine Cone, Wobbler Feeder, Manganese Frogs, Crusher Rolls

Nominal Composition:
Alloy Content – 35% (Chromium, Manganese, Nickel, Silicon, Carbon) Iron Base

Typical Mechanical Properties:
Hardness:
2 Layers (1020 Steel)/Work Hardens……………………………..200 BHN
Work hardens to………………………………………..48-53 HRC
2 Layers (Mang. Steel)………………………………………..210 BHN
Work hardens to………………………………………..50-55 HRC
5 Layers (Mang. Steel)………………………………………..220 BHN
Work hardens to………………………………………..50-55 HRC

Tensile Strength…………………………………………………..119 ksi (820 MPa)
Yield Strength…………………………………………………..76.5 ksi (525 MPa)
Elongation…………………………………………………..40%

Typical Mechanical Properties:
Hardness:
2 Layers (1020 Steel)/Work Hardens……………………………..200 BHN
Work hardens to………………………………………..48-53 HRC
2 Layers (Mang. Steel)………………………………………..210 BHN
Work hardens to………………………………………..50-55 HRC
5 Layers (Mang. Steel)………………………………………..220 BHN
Work hardens to………………………………………..50-55 HRC

Tensile Strength…………………………………………………..119 ksi (820 MPa)
Yield Strength…………………………………………………..76.5 ksi (525 MPa)
Elongation…………………………………………………..40%

*MC = “Metal Cored” – Part Numbers
11836900 and 11836800
RAIL END 932 - COATED (SMAW)

STOODY Rail End 932 is a solid cored electrode designed specifically for repair of carbon steel railroad track components. It has excellent tensile strength to maintain the desired rail dimensions. Rail End 932 has fine weldability and a good contour. It has a low hydrogen type of coating and is formulated for welding onto high carbon steel rails and frogs. It is not intended for use on manganese steel.

Welding Procedures/Characteristics: DCEP (reverse polarity) recommended, using either stringer or weave beads. Weldability is very good and can be applied in multiple layers with proper preheat and interpass temperature procedures. Designed for high carbon steel rails and frogs, not for use on manganese steel.

Applications: Carbon Steel Rail Ends, Wheel Burns, Frogs, Crossings

Typical Chemical Composition:
Alloy Content – 6% (Carbon, Chromium, Manganese, Molybdenum, Silicon)
Iron Base

RAIL END 932-O (OPEN ARC WIRE)

STOODY RAIL END-O semi-automatic open arc wire was designed specifically for repair of carbon steel railroad track components. It has excellent tensile strength to maintain the desired rail dimensions. Rail End-O is formulated for welding onto high carbon steel rails and frogs and is not intended for use on manganese steels.

Welding Procedures/Characteristics: DC reverse polarity recommended (electrode positive). Use stringer or weave beads 3/8" - 5/8" (10 mm - 16 mm) wide. Weldability is good in the flat position. Multiple layers can be applied without difficulty when proper procedures are followed. Maintain low heat input, do not exceed 500°F (260°C) interpass temperature.

Applications: Carbon Steel Rail Ends, Wheel Burns, Frogs, Crossings

Nominal Composition:
Alloy Content – 6% (Carbon, Chromium, Manganese, Molybdenum, Silicon)
Iron Base

Typical Mechanical Properties:
Impact Resistance.................................Excellent
Abrasion Resistance.................................Moderate
Hardness..................................................38-40 HRC
Deposit Layers........................................Multiple
Tensile Strength......................................150 ksi (1035 MPa)

--- Table ---

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Packaging</th>
<th>Diameter x Length</th>
<th>Amperage (DC+)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11704800</td>
<td>10 lb Vac Pak (4.5 kg)</td>
<td>1/8&quot; x 14&quot; (3.2 mm x 35.6 cm)</td>
<td>100-160</td>
</tr>
<tr>
<td>11704700</td>
<td>10 lb Vac Pak (4.5 kg)</td>
<td>5/32&quot; x 14&quot; (4.0 mm x 35.6 cm)</td>
<td>140-240</td>
</tr>
<tr>
<td>11504600</td>
<td>10 lb Vac Pak (4.5 kg)</td>
<td>3/16&quot; x 14&quot; (4.8 mm x 35.6 cm)</td>
<td>180-280</td>
</tr>
<tr>
<td>11704600</td>
<td>10 lb Vac Pak (4.5 kg)</td>
<td>1/4&quot; x 14&quot; (6.4 mm x 35.6 cm)</td>
<td>200-330</td>
</tr>
</tbody>
</table>

Typical Mechanical Properties:
Impact Resistance.................................Moderate
Abrasion Resistance.................................High
Hardness..................................................34-38 HRC
Magnetic...............................................Yes
Deposit Layers........................................Multiple
Surface Cross Checks................................No
Machinability.........................................Yes

--- Table ---

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Pkg</th>
<th>Wire Dia.</th>
<th>Shielding Gas</th>
<th>Welding Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>11802500</td>
<td>33 lb WB (15 kg)</td>
<td>1/16&quot; (1.6 mm)</td>
<td>Open Arc</td>
<td>3/4&quot;-1½&quot; (19-32 mm)</td>
</tr>
<tr>
<td>11950300</td>
<td>33 lb WB (15 kg)</td>
<td>5/64&quot; (2.0 mm)</td>
<td>Open Arc</td>
<td>1½-1½&quot; (19-32 mm)</td>
</tr>
<tr>
<td>11887000</td>
<td>25 lb PS (11.3 kg)</td>
<td>3/32&quot; (2.4 mm)</td>
<td>Open Arc</td>
<td>1½-1½&quot; (19-32 mm)</td>
</tr>
</tbody>
</table>
CARBON STEEL TRACK REPAIR ALLOYS - SMAW & WIRE

STOODY® BUILD-UP LH - COATED
STOODY BUILD-UP LH is a solid core electrode with a special low hydrogen coating to provide a high strength fusion bond on carbon and low alloy steels. When used as a base alloy for hardsurfacing overlays or for restoring parts to original dimensions, it provides a weld deposit with excellent compressive strength and ductility capable of absorbing heavy impact and/or compressive loads. It can be applied in multiple layers without cracking, spalling or mushrooming. It is machinable in the “as welded” condition with reasonable procedural care and can be forged at red heat. It is not recommended for manganese steel or cast iron and will work harden under high impact loads.

Welding Procedures/Characteristics: Can be applied AC or DC, either polarity - DCEP (reverse preferred) in stringer or weave beads. Preheat and slow cool prior to machining; carbide tools are recommended. Strongly magnetic on carbon and low alloy steel. This electrode is recommended for joining. Vertical welding can be done by welding a horizontal shelf approximately 2” (5 cm) wide and then using proper welding techniques. Slag removal is very good. This wire is not recommended for manganese steel or cast iron and will workharden under impact.

Applications: Tractor Rollers, Steel Shovel Pads, Tractor and Shovel Idlers, Gear Teeth, Sprockets, and Shafts

Typical Chemical Composition:
Alloy Content – 4.5% (Chromium, Molybdenum, Manganese, Silicon, Carbon)
Iron Base

Typical Mechanical Properties:

<table>
<thead>
<tr>
<th>Base Metal</th>
<th>Layers</th>
<th>Hardness</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.10% C</td>
<td>2</td>
<td>24-28 HRC</td>
</tr>
<tr>
<td>0.40% C</td>
<td>2</td>
<td>30-35 HRC</td>
</tr>
<tr>
<td>0.80% C</td>
<td>2</td>
<td>38-42 HRC</td>
</tr>
</tbody>
</table>

Part Number Pkg Wire Dia. Shielding Gas Welding Parameters

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Pkg</th>
<th>Wire Dia.</th>
<th>Shielding Gas</th>
<th>Welding Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>11143100</td>
<td>10 lb Vac Pak (4.5 kg)</td>
<td>.045&quot;</td>
<td>98% Ar/2% O or 75-80% Ar, Bal. CO₂</td>
<td>1/2&quot;-3/4&quot; (13-19 mm)</td>
</tr>
<tr>
<td>11142900</td>
<td>10 lb Vac Pak (4.5 kg)</td>
<td>.045&quot;</td>
<td>98% Ar/2% O or 75-80% Ar, Bal. CO₂</td>
<td>1/2&quot;-3/4&quot; (13-19 mm)</td>
</tr>
<tr>
<td>11125800</td>
<td>33 lb WB (15 kg)</td>
<td>.045&quot;</td>
<td>98% Ar/2% O or 75-80% Ar, Bal. CO₂</td>
<td>1/2&quot;-3/4&quot; (13-19 mm)</td>
</tr>
<tr>
<td>11129300</td>
<td>33 lb WB (15 kg)</td>
<td>.045&quot;</td>
<td>98% Ar/2% O or 75-80% Ar, Bal. CO₂</td>
<td>1/2&quot;-3/4&quot; (13-19 mm)</td>
</tr>
<tr>
<td>11134900</td>
<td>60 lb Coil (27.2 kg)</td>
<td>3/32&quot;</td>
<td>Open-arc or CO₂</td>
<td>1/16&quot;-1/16&quot; (25-38 mm)</td>
</tr>
<tr>
<td>11139600</td>
<td>60 lb Coil (27.2 kg)</td>
<td>2.8 mm</td>
<td>Open-arc</td>
<td>1/16&quot;-1/16&quot; (25-38 mm)</td>
</tr>
<tr>
<td>11128000</td>
<td>60 lb Coil (50 kg)</td>
<td>3/32&quot;</td>
<td>Open-arc</td>
<td>1/16&quot;-1/16&quot; (25-38 mm)</td>
</tr>
<tr>
<td>111000000</td>
<td>60 lb Coil (27.2 kg)</td>
<td>2.8 mm</td>
<td>Open-arc</td>
<td>1/16&quot;-1/16&quot; (25-38 mm)</td>
</tr>
<tr>
<td>111128000</td>
<td>60 lb Coil (50 kg)</td>
<td>2.8 mm</td>
<td>Open-arc</td>
<td>1/16&quot;-1/16&quot; (25-38 mm)</td>
</tr>
<tr>
<td>111813000</td>
<td>200 lb PP (90.7 kg)</td>
<td>7/64&quot;</td>
<td>Open-arc</td>
<td>1/16&quot;-1/16&quot; (25-38 mm)</td>
</tr>
<tr>
<td>111869000</td>
<td>500 lb POP (226.8 kg)</td>
<td>7/64&quot;</td>
<td>Open-arc</td>
<td>1/16&quot;-1/16&quot; (25-38 mm)</td>
</tr>
</tbody>
</table>

Typical Mechanical Properties:

<table>
<thead>
<tr>
<th>Mechanical Properties</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Strength</td>
<td>118 ksi (815 MPa)</td>
</tr>
<tr>
<td>Yield Strength</td>
<td>113 ksi (780 MPa)</td>
</tr>
<tr>
<td>Elongation</td>
<td>6%</td>
</tr>
<tr>
<td>Hardness</td>
<td>27 HRC</td>
</tr>
<tr>
<td>29 HRC</td>
<td></td>
</tr>
<tr>
<td>31 HRC</td>
<td></td>
</tr>
</tbody>
</table>

U.S. Customer Care: 800-426-1888 • Canada Customer Care: 905-827-4515
International Customer Care: 940-381-1212

1/2" to 3/4" (13 mm - 19 mm) wide. Can be applied out of position with either polarity - DCEP (reverse preferred) in stringer or weave beads. Preheat and slow cool prior to machining; carbide tools are recommended. Strongly magnetic on carbon and low alloy steel. This electrode is not recommended for manganese steel or cast iron and will work harden under impact.

Applications: Sugar Mill Press Roll Tooth (Major Repairs), Press Roll Sprockets; Hammers, Wheel Burns, Repairing Battered Rail, Steel Mill Wobblers and Pods, Carbon Steel Shovel Pads, Shafting, Rolls, Pump Parts

Nominal Composition:
Alloy Content – 4% (Manganese, Chromium, Silicon, Molybdenum, Carbon)
Iron Base

For further information, please contact:
• 800-426-1888
U.S. Customer Care:
International Customer Care:
STOODY® SUPER BUILD-UP

STOODY SUPER BUILD-UP is used both as a build-up and hardfacing material because it has good compressive strength, hardness, and wear resistance. It is not intended to be used as an underbase for subsequent hardfacing. When a shielding gas is used, machinability is very good with carbide tools.

Welding Procedures/Characteristics: DCEP (reverse polarity) recommended, using either stringer or weave beads. Weldability is very good and can be applied out-of-position. The addition of CO₂ shielding gas with the 1/16" (1.6 mm) diameter wire reduces the amount of spatter and improves the weldability. Multiple layers can be applied without difficulty when proper preheat and interpass temperatures are maintained.

Applications: Gear Teeth, Sprockets, Steel Shovel Pads, Overlaying Carbon Steel Shafts.

Nominal Composition:
Alloy Content – 5% (Chromium, Manganese, Molybdenum, Silicon, Carbon); Iron Base

Typical Mechanical Properties:
Base Metals.................................................................0.20% C Steel
Layers.................................................................................2
Hardness..............................................................................35-40 HRC

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Pkg</th>
<th>Wire Dia.</th>
<th>Shielding Gas</th>
<th>CTWD</th>
<th>Amps</th>
<th>Volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>11423700</td>
<td>10 lb</td>
<td>0.045&quot;</td>
<td>98% Ar / 2% O₂ or Bal. CO₂</td>
<td>1/2&quot; - 3/4&quot; (13-19 mm)</td>
<td>120-220</td>
<td>18-24</td>
</tr>
<tr>
<td>11423600</td>
<td>33 lb WB</td>
<td>0.045&quot;</td>
<td>98% Ar / 2% O₂ or Bal. CO₂</td>
<td>1/2&quot; - 3/4&quot; (13-19 mm)</td>
<td>120-220</td>
<td>18-24</td>
</tr>
<tr>
<td>11946200</td>
<td>33 lb WB</td>
<td>1/16&quot;</td>
<td>98% Ar / 2% O₂</td>
<td>180-300</td>
<td>24-28</td>
<td></td>
</tr>
<tr>
<td>11426500</td>
<td>33 lb WB</td>
<td>1/16&quot;</td>
<td>98% Ar / 2% O₂</td>
<td>180-300</td>
<td>24-28</td>
<td></td>
</tr>
<tr>
<td>11426400</td>
<td>50 lb PP</td>
<td>0.045&quot;</td>
<td>98% Ar / 2% O₂</td>
<td>180-300</td>
<td>24-28</td>
<td></td>
</tr>
<tr>
<td>11837900</td>
<td>50 lb PP</td>
<td>3/32&quot;</td>
<td>Open-arc or CO₂</td>
<td>200-350</td>
<td>24-28</td>
<td></td>
</tr>
<tr>
<td>11466200</td>
<td>200 lb HP</td>
<td>3/32&quot;</td>
<td>Open-arc</td>
<td>200-350</td>
<td>24-28</td>
<td></td>
</tr>
</tbody>
</table>
ESAB ELECTRODES - AUSTENITIC MANGANESE RAIL CROSSINGS

ESAB has been very successful globally providing consumables and equipment for track repair and maintenance of carbon/manganese and 14% manganese crossings, carbon/manganese switchblades and plain rail. These products are used beyond the railway sector and are suitable for tramways and underground transportation systems. ESAB products meet the highest safety standards and offers solutions for any type of rail component wear and for all material grades making it easier to achieve consistent, effective maintenance efforts that result in higher lifetime and lower life cycle costs.

esab.com

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>CLASSIFICATIONS &amp; APPROVALS</th>
<th>PART / GIN DIA. (mm)</th>
<th>HARDNESS (HRC)</th>
<th>MICRO-STRUCTURE</th>
<th>C</th>
<th>Si</th>
<th>Mn</th>
<th>Cr</th>
<th>Ni</th>
<th>Al</th>
<th>Mo</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>OK 67.45</td>
<td>EN 1600: E 18 8 Mn B 4 2 ABS, VdTÜV, Sisproz</td>
<td>67454030G0 4.0 mm</td>
<td>22 / 40</td>
<td>Austenitic</td>
<td>0.11</td>
<td>0.50</td>
<td>6.0</td>
<td>18.50</td>
<td>9.0</td>
<td>&lt;0.50</td>
<td>&lt;0.50</td>
<td></td>
</tr>
<tr>
<td></td>
<td>67455030G0 5.0 mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>18/8/6 type electrode partially proposed for buffer and filling layers for build up welds executed on austenitic-manganese crossings.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OK 68.81</td>
<td>EN 1600: E 29 9 R 3 2 Sisproz</td>
<td>68814030G0 4.0 mm</td>
<td>22 / 40</td>
<td>Duplex</td>
<td>0.12</td>
<td>0.75</td>
<td>0.75</td>
<td>29.0</td>
<td>9.70</td>
<td>&lt;0.50</td>
<td>&lt;0.50</td>
<td></td>
</tr>
<tr>
<td></td>
<td>68815030G0 5.0 mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Buffer, filling, surfacing and dissimilar welds. OK 68.81 offers higher &quot;as welded&quot; hardness but lower work hardening ability. OK 68.81 is suitable for surfacing newly developed Maraging-type crossing tips.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OK 86.28</td>
<td>EN 14700: E Z Fe9</td>
<td>8628404020 4.0 mm</td>
<td>17 / 41</td>
<td>Austenitic</td>
<td>0.75</td>
<td>&lt;0.3</td>
<td>14.0</td>
<td>—</td>
<td>3.50</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>18628504020 5.0 mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Surfacing electrode for austenitic-manganese track components.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OK 86.30</td>
<td>EN 14700: E Fe9</td>
<td>8630404020 4.0 mm</td>
<td>20 / 44</td>
<td>Austenitic</td>
<td>0.30</td>
<td>0.50</td>
<td>14.0</td>
<td>18.0</td>
<td>1.50</td>
<td>—</td>
<td>—</td>
<td>&lt;0.10</td>
</tr>
<tr>
<td></td>
<td>Surfacing electrode for austenitic-manganese track components with 18% Cr content.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OK 67.60</td>
<td>EN 14700: E 23 12 L R 3 2 L</td>
<td>67605030G0 5.0 mm</td>
<td>—</td>
<td>Duplex</td>
<td>&lt;0.03</td>
<td>0.70</td>
<td>0.85</td>
<td>24.0</td>
<td>13.0</td>
<td>&lt;0.30</td>
<td>&lt;0.10</td>
<td></td>
</tr>
<tr>
<td>FILARC MN</td>
<td>EN 14700: E Z Fe9</td>
<td>67605030G0 5.0 mm</td>
<td>19-21 / 52</td>
<td>Austenitic</td>
<td>0.60</td>
<td>&lt;0.10</td>
<td>13.50</td>
<td>4.50</td>
<td>4.50</td>
<td>—</td>
<td>&lt;0.10</td>
<td>&lt;0.10</td>
</tr>
<tr>
<td></td>
<td>SNCF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>For hardfacing and rebuilding of 14% autenitic-manganese casting applied on a buffer layer of OK 67.45 or OK 68.81.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ESAB ELECTRODES - CARBON-MANGANESE RAIL APPLICATIONS

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>CLASSIFICATIONS &amp; APPROVALS</th>
<th>PART / GIN</th>
<th>DIA. (mm)</th>
<th>HARDNESS (HRC)</th>
<th>MICRO-STRUCTRE</th>
<th>C</th>
<th>Si</th>
<th>Mn</th>
<th>Cr</th>
<th>Ni</th>
<th>Al</th>
<th>Mo</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>OK 83.28</td>
<td>EN 14700: E Z Fe1 DB, CE, Seproz</td>
<td>83284040G0</td>
<td>4.0 mm</td>
<td>30</td>
<td>Martensitic</td>
<td>0.10</td>
<td>&lt;0.70</td>
<td>0.70</td>
<td>3.30</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>83285040V0</td>
<td>5.0 mm</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>OK 83.27</td>
<td>EN 14700: E Fe1</td>
<td>8327404020</td>
<td>4.0 mm</td>
<td>35</td>
<td>Martensitic</td>
<td>0.15</td>
<td>&lt;0.70</td>
<td>0.70</td>
<td>29.0</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>OK 83.29</td>
<td>EN 14700: E Fe1</td>
<td>8329324030</td>
<td>3.2 mm</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>8329404020</td>
<td>4.0 mm</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>8329504020</td>
<td>5.0 mm</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>FILARC 340R</td>
<td>EN 14700: E Z Fe1 SNCF</td>
<td>57944047Y7</td>
<td>4.0 mm</td>
<td>40</td>
<td>Ferritic</td>
<td>&lt;0.15</td>
<td>&lt;0.80</td>
<td>0.75</td>
<td>1.0</td>
<td>3.50</td>
<td>—</td>
<td>0.55</td>
<td>&lt;0.10</td>
</tr>
</tbody>
</table>

Best seller hardfacing electrode for rails and for C-Mn crossing components in Europe.

OK 83.27 is designed to meet the higher hardness requirements demanded by the head hardened rail grades up to R400 HT.

The high deposit rate version of OK 83.28 offering 50% higher deposit rate than the standard type.

For surfacing of conventional rail grades.

ESAB RAIL JOINING - MOULD WELDING KIT

ESAB® MOULD WELDING KIT
The ESAB mould welding kit has proven to deliver competitive results to aluminothermic welding for joining rail. Advantages of mould welding include obtaining correct hardness in the rail head post welding plus the strength of the joint is superior to that produced by te alumino-thermic method. Each kit contains SMAW electrodes and backing for two joints: OK 21.21, a backing affixed under the joint when welding the rail foot; OK 74.78, a high strength electrode for welding the rail foot; and, OK 83.28, a hardfacing electrode for capping the rail surface.

<table>
<thead>
<tr>
<th>PART / GIN</th>
<th>KIT CONTENTS</th>
<th>DIA. (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2121747800</td>
<td>OK 21.21 - Qty. 2</td>
<td>—</td>
</tr>
<tr>
<td>OK 74.78 - Qty. 30</td>
<td>5.0 mm</td>
<td></td>
</tr>
<tr>
<td>OK 83.28 - Qty. 6</td>
<td>5.0 mm</td>
<td></td>
</tr>
</tbody>
</table>

ESAB ELECTRODES - RAIL JOINING APPLICATIONS

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>CLASSIFICATIONS &amp; APPROVALS</th>
<th>PART / GIN</th>
<th>DIA. (mm)</th>
<th>Micro-STRUCTRE</th>
<th>C</th>
<th>Si</th>
<th>Mn</th>
<th>Cr</th>
<th>Ni</th>
<th>Al</th>
<th>Mo</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>OK 74.78</td>
<td>EN 757: E 55 4 MnMo B 3 2 HS ABS, BV, CE, DB, DNV, LR, VdTÜV</td>
<td>74784040G0</td>
<td>4.0 mm</td>
<td>HSLA Ferritic</td>
<td>0.05</td>
<td>0.35</td>
<td>1.0</td>
<td>&lt;0.10</td>
<td>&lt;0.10</td>
<td>&lt;0.03</td>
<td>0.38</td>
<td>&lt;0.03</td>
</tr>
<tr>
<td></td>
<td>74785040V0</td>
<td>5.0 mm</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

Basic MMA electrode for the joining of C-Mn rails up to grade R280.

OK 67.43

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>CLASSIFICATIONS &amp; APPROVALS</th>
<th>PART / GIN</th>
<th>DIA. (mm)</th>
<th>MICRO-STRUCTRE</th>
</tr>
</thead>
<tbody>
<tr>
<td>OK 67.43</td>
<td>EN 1600: E 18 8 Mn B 1 2 EN 14700 E Fe10 CE, DB, VdTÜV</td>
<td>67434030G0</td>
<td>4.0 mm</td>
<td>Austenitic</td>
</tr>
<tr>
<td></td>
<td>67435040G0</td>
<td>5.0 mm</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

OK 67.43 is specifically recommended for dissimilar joints between carbon-manganese rail end and austenitic-manganese crossing legs.
MANGANESE STEEL TRACK CASTINGS – GENERAL INFORMATION

GENERAL INFORMATION & TIPS
The purpose of this section is to supply accurate information about materials and welding recommendations for the reclamation of manganese steel track castings; data which has aided many railroads in reducing maintenance and operating cost.

Each frog or crossing may be considered as an individual job with its own peculiar characteristics and problems. The general comments and instructions, however, apply to all manganese steel track castings (for more information on manganese steel, see Manganese Steel Castings, pages 12-14).

1. Manganese steel castings are reclaimed by welding cracks, defects and building up the worn areas.
2. A frog is a track structure used to form the intersection of two running rails. The frog permits the wheels on either rail to cross the other rail.
3. Bolted rigid frogs are constructed with four rails that are specially fabricated from standard tee rails. Fillers placed between the rails maintain correct alignment. The assembly is fastened with heat-treated bolts. This type of frog is used in yards and industrial tracks where the traffic is light on both sides of the frog.
4. A Solid Manganese Steel Self-Guided Frog is constructed with guides or flanges above its running surface. These flanges contact the tread rims of the wheels and safely guide the wheel flanges past the point of the frog. This type of frog is used for yard tracks and main-line tracks where speeds do not exceed 30 mph.
5. A Solid Manganese Steel Frog is essentially a one-piece casting made of manganese steel.
6. The areas of the most wear on a frog casting are:
   - The nose or point
   - The ends of the frog at the rail joint
   - The wings adjacent to the point
   - The guard on self guarded frogs
7. Welding frogs in a weld shop can be a problem due to warpage. This can be minimized by constructing a heavy duty weld jig or bolting the frog to the floor, using concrete bolts. A 5/8” (16 mm) thick plate is placed under the frog and clamps or bolts at the heel and toe of the frog are tightened until the frog is bowed.
8. A bolted rigid frog brought into a shop for repairs, should be taken apart and examined for cracks. Remove any cold flow areas and “V” cracks out no wider than necessary for weld repair. Reassemble frog and place in jig for welding.
9. A crossing is a structure used where two tracks intersect. It consists of four connecting frogs. Crossing designs consist of the following types:
   - Bolted Rail Crossings
   - Solid Manganese Steel Crossings
   - Manganese Steel Inserts Crossings
   - Movable Points and Slips
10. The areas of most wear on crossing castings are:
    - Points
    - Ends of castings at the rail joint
11. Some manganese steel frogs and crossings may only require grinding the roll-over along the flange way to bring it back to gauge.
12. Manganese steel work hardens under heavy impact loading and some frogs come from the factory already work hardened. The work hardened metal must be removed before rebuilding. To remove the work hardened surface may require a 3/16” - 1/4” (4.8 mm - 6.5 mm) be removed. A series of hardness tests can be conducted to help detect work hardened surfaces. Work hardened surfaces between 35 - 55 HRC and higher should be removed.
13. Manganese in a non-work hardened condition is non-magnetic.
14. Cracks should be “V”ed out the full length and depth of the crack before welding.
15. The casting running surface usually has areas which are not worn to any great extent. Using a straight edge in these areas, low spots can be determined as well as the amount of weld metal required.
16. Manganese steel castings are unlike the carbon steel rails which require preheat and post weld heat treatment to reduce hard martensite in the heat effected zone. The manganese steel when over heated will become embrittled at temperatures above 500°F (260°C). The higher the temperature above 500°F (260°C), the faster the manganese steel makes the transformation (see chart Effects of Time and Temperature on the Ductility when Reheating Autenitic Manganese Steel, page 13).
MANGANESE STEEL TRACK CASTINGS – GENERAL INFORMATION

SOLID MANGANESE STEEL SELF-GUARDED FROGS

BOLTED RIGID FROGS
MANGANESE STEEL TRACK CASTINGS – GENERAL INFORMATION

SOLID MANGANESE STEEL CROSSINGS

EFFECTS OF TIME & TEMPERATURE ON DUCTILITY WHEN REHEATING AUSTENITIC MANGANESE STEEL

Manganese Steel tested (1.2% C, 13% Mn, 0.5% Si); at 2000°F (1093°C) for 2 hours and water quenched. Evaluation based on metallurgy. Source: Welding Handbook, Volume Four, Seventh Edition
MANGANESE STEEL TRACK CASTINGS – GENERAL INFORMATION

FROG & CROSSING FLANGEWAY GAUGE

![Diagram of Frog and Crossing Flange](image)

- Frog Selfguard
- Clearance
- Guard - New Frog
- Guard - Worn Frog
- Frog Point
- Frog Flangeway
- SG

Dimensions:
- FRA Minimum Flangeway 1-1/3"
MANGANESE STEEL TRACK CASTINGS – GENERAL INFORMATION

INSPECTION, PREPARATION, WELDING & FINISHING RECOMMENDATIONS

1. Lightly grind the surface to be welded and insect castings for cracks and defects. If required, use dye penetrant to locate cracks and defects.

2. Grind or arc gouge out detected cracks or defects - don't use a cutting torch for this operation as it may cause overheating. Note: When grinding, do not use excessive pressure as this may cause overheating of the surface causing the manganese to become embrittled. Embrittled manganese can cause cracking, including under bead cracking leading to weld metal spalling.

3. Remove all work hardened surfaces by arc gouging and/or grinding before any weld repairs begin. The removal of the work hardened surface may require between 3/16” - 1/4” (4.8 mm - 6.4 mm) in thickness to be removed (see General Information & Tips, page 16).

4. Remove by grinding all roll-over, sharp corners, and battered surfaces.

5. The area to be welded must be clean. Remove grease, scale, and foreign matter by grinding.

6. Use a flange way gauge to check flame way opening (see Frog & Crossing Flange Way Gauge, page 14).

7. The area to be welded must be clean. Remove grease, scale, and foreign matter by grinding.

8. During welding, the weld bead width should be between 1/2” - 5/8” (13 mm - 16 mm) and no wider. Wide, heavy, thick beads are caused by slow travel speed. The slow travel speed causes higher heat input into the casting.

9. To prevent overheating, make frequent temperature tests of the weld area using a 500°F (260°C) Tempilstick. Welding should stop when temperature is above 500°F (260°C). Skip welding is recommended when possible to help control the interpass temperature. Caution: The longer the manganese casting is above 500°F (260°C) the quicker it will become embrittled (see Time & Temperature Chart, page 13).

10. Reversing the direction of the weld beads will help minimize the build up of stresses.

11. Weld beads should not be started at the edge of the casting. Start from the center and work out, making sure all edges have been rounded.

12. Important: At the end of the weld bead, be sure to fill the crater before stopping. This will eliminate small crater cracks that could cause problems later on.

13. Repairing cracks:
   - When welding the groove, use stringer beads with a good crown. Avoid flat and concave beads.
   - Use recommended weld parameters; avoid cold welds or under cutting.
   - Peening is normally not required, but can be beneficial in helping to minimize the possibility of cracking caused by stress build up during the cool down of the weld bead. When peening, use a blunt instrument like a hammer and use only enough force to slightly deform the surface.
   - After applying the root pass, check for soundness. If crack free, continue with additional weld beads.
   - After each weld bead, remove the slag from the bead with a wire brush. Thoroughly check the weld and casting for new cracks. Note: There can be very fine line type cracks, so very close inspection is required.
   - If new cracks are visible in the weld or casting, remove the crack before continuing with the weld repair.
   - Contine applying weld beads until crack/groove is completely repaired.
   - When welding repairs are long in length, it is best to apply short weld beads. One way to break up the weld beads is to start in the center of the repair and weld outward, keeping the weld beads at or below 5” (12.7 cm). Another way is to make short welds of 3” - 5” (7.6 cm - 12.7 cm) and use a skip pattern.

14. Turn Out Frog points at the tip should be 1/4” (6.4 mm) lower than the adjacent wings and slopes upward so that the point and wings are level at a distance back from the points of:
   - 8” (20.3 cm) for a number 8 or smaller frog.
   - 10” (25.4 cm) for a number 10 frog.
   - 11” (28 cm) for a number 14 frog.
   - 12” (30.5 cm) for a number 16 frog.
   - 15” (38 cm) for a number 20 frog.

15. A radius from 3/8” - 5/8” (10 mm - 16 mm) should be ground on the top edges of the points and wings.

16. Crossing Frogs should be ground 3/16” (4.8 mm) below the running surface at the tip of the point, and taper to level where the frog point is 2½” (65 mm) wide.

17. Mating surfaces between manganese castings and binder rail should be slotted with a 3/16” (4.8 mm) slotting wheel. This is to prevent spalling of the manganese steel which will cold flow under heavy impact loading.
MANGANESE STEEL TRACK CASTINGS – GENERAL INFORMATION

GRINDING RECOMMENDATIONS
It is important to know that manganese steel will deform under heavy loading. During the deformation period, as a result of high compression loading and impact, the manganese steel will work harden. The thin cross section at the casting edges and lops will often approach 50-55 HRC during continual heavy loading.

A flange way opening can become smaller than the original gauge size as a result of deformation and cold flow. If the cold flow material is not ground away, the wheels can lift and tear it off the casting body (frog or crossing). Cracks can also develop along the flange way edges during this process.

INSTRUCTIONS FOR 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 requirements would be 5 hp for intermittent operation or 7.5 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. Refer to product parameters recommended by electrode manufacture. In general, the minimum and maximum recommended current by diameter:
   - 3/16” (4.8 mm) - 150-200 A.
   - 1/4” (6.4 mm) - 200-400 A.
   - 5/16” (8.0 mm) - 250-450 A.
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 anle 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 low.
12. For a shallow groove, electrode angle should be flat with fast speed.
13. Width of groove is determined by electrode size used, normally 1/8” (3.2 mm) wider than electrode diameter.
14. Travel speed should be 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 right on top of this surface.
17. If arc striking is hard and irregular, the air is not on.
18. Low amperage 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 arc will be sputtery.
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.

Examples of properly arc gouged surfaces.
MANGANESE STEEL TRACK CASTINGS – GENERAL INFORMATION

TYPICAL TRACK WELDING PROBLEMS AND SOLUTIONS

1. Deformed metal along the outside edges of casting should be removed by grinding. Any cracks in casting should be cut out. Flange way grinding should be according to gauge.

2. Arc gouge cross point to bottom of crack and cut a groove just wide enough for proper welding. Arc weld with manganese steel electrode.

3. Pass number one, called the root pass, must have good penetration. Apply each bead with light weaving motion. Reverse direction of each bead. Do not make beads wider than 5/8" (16 mm). Make two adjacent beads as soon as feasible. Remove slag or flux after each bead. Follow bead sequence as per sketch. Do not let temperature go above 500°F (260°C). Last beads must be higher than the casting surface. Grind surface, round off lip and finish grind according to gauge and contour. Do not use electrodes larger than 3/16" (4.8 mm).

4. Check with dye penetrant if crack goes completely through. If only a surface crack, grind out crack and rebuild with manganese steel electrode.

5. Start with edge beads when welding arc air 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. Casting surface was rebuilt by arc welding. However, after welding and grinding, a crack developed. Sometimes such a crack will "open up" after a few days of traffic. Solution: The crack was there before welding was started. Casting should have been checked by 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, arc air 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 insure good weld penetration without under cut.

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 electrodes or wires. Grind surface according to contour.
CARBON STEEL COMPONENT REPAIR – RAIL ENDS

RAIL ENDS: INSPECTION AND PREPARATION

1. Repairs of rail ends by arc welding is limited to jointed rail and insulated joints.
2. Inspect joint bars prior to welding to make sure they are fully bolted and all bolts are tight. If needed, replace bolts/joint bars that are cracked, broken, or worn.
3. Low joints are to be raised and tamped prior to welding.
4. Inspect battered rail ends for cracks, chips, roll over, and other defects.
5. Use a straight edge to determine length of low area needing to be built up. Do not check across the joint with the straight edge; each rail end should be examined independently.
6. Important: To eliminate possibility of cracks starting at the bolt hole, under no circumstances is the rail to be welded past the last bolt hole in the joint bar.
7. If rail end batter exceeds 0.015” (0.4 mm), refer to Railroad Welding Manual or contact your welding supervisor to determine maximum allowable depth of deposit before welding. Length of deposit should not exceed last bolt hole in joint bar.
8. Battered, chipped, spalled, and excess cold flow must be removed by grinding only. Air arc and oxyacetylene torch cutting is not acceptable. Remove all dirt and grease from area to be welded.
9. Rail End Mismatch: The lower rail with the most wear should be built up first and tapered toward the higher rail. The grade of ramp shall be determined by allowing a .007” (0.2 mm) rise per inch of weld length. Place a straight edge on the high rail with the end of the straight edge extending straight out above the lower rail and measure the indicated batter between the end of the low rail and the straight edge. This measurement in thousandths of an inch and divided by .007” (0.2 mm) determines the length of the weld.

EXAMPLE: A joint that is .035” (1 mm) low would require a weld 5” (125 mm) long to equal a .007” (0.2 mm) rise per 1” (25.4 mm).

NOTE: Weld repairs are not to be made past the end of the joint bar.
CARBON STEEL COMPONENT REPAIR – RAIL ENDS

RAIL ENDS: WELDING RECOMMENDATION

1. The following is a recommendation for preheating and post weld heat treatment for rail ends.

<table>
<thead>
<tr>
<th>Type of Rail</th>
<th>Preheat Rail Surface</th>
<th>Post Weld Heat Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Std High Carbon</td>
<td>700°F (371°C)</td>
<td>1,000°F (538°C)</td>
</tr>
<tr>
<td>Alloy Rail*</td>
<td>1,000°F (538°C)</td>
<td>1,200°F (649°C)</td>
</tr>
</tbody>
</table>

* See special welding suggestions for alloy rail.

2. Preheating can be accomplished by an oxyacetylene torch or an LP gas heater crucible designed for rail ends. To start preheating, measure 1” (2.54 cm) from rail end and start preheating from that point out (see figure below). During colder weather it may be necessary to use an additional heating source to assist with preheating and to help maintain interpass temperature.

3. When welding high carbon and high alloy rail steels it is desirable for the heat input to be higher as this will help maintain interpass temperature and will reduce the chance of porosity. When using SMAW, OAW, or GMAW welding processes it is recommended to use the upper end of the parameter range. Note: A rail end with the shortest weld area should be welded first or for mismatched rails the lower rail should be welded first and tapered toward the higher rail (see Inspection and Preparation, page 18).

4. All weld beads should be deposited parallel with the rail except in low or chipped areas.

5. Weld beads should be staggered at the end of the welded area to form a "V" or half round pattern in the center of the ball, or a 45 degree angle with the shortest bead starting on the field side and the longest bead being on the gauge side. This minimizes stress build up in either the gauge or field side (see Weld Bead Patterns, page 20).

6. A weave pattern is recommended with a bead width approximately two times the diameter of the electrode or 1/2"-5/8" (13 mm - 16 mm) maximum width if using a semi-automatic welding system.

7. Weld beads should be continuous. It is not advisable to start and stop on the extreme edge of the rail. At the end of each weld bead, craters must be properly filled and the arc should be broken by crossing back into the surface of the weld bead. This is to avoid stress concentrations and cracks in the bead craters.

8. All weld beads should be peened after 6"-9" (15 cm - 23 cm) of weld or after any interruption in the welding process. It is better to peen welds no matter how small. Peening should always be started at the beginning of the weld bead and work toward the finishing end. Peen hard enough to cause some deformation or flattening of the deposit, but not to the extent that the deposited metal tears or cracks. Peening reduces tensile stresses and places welds in compression.

9. Be sure to allow sufficient material that is free of slag inclusion and porosity so that the rail end can be finished and slotted properly.

10. Rails must not be allowed to cool during the welding process. If welding has to be interrupted and rail temperature falls below recommended temperature, it should be reheated to the recommended preheat.

11. A post weld heat treatment is advisable as soon as welding has been completed (see Post Weld Heat Treating Recommendations, page 22).

12. Slow cool after welding by covering or packing insulation around the welded area.

13. Insulated joints should be inspected and tested to insure that it is not damaged after welding. If the insulation is damaged in any way, it should be replaced before any other repairs are made affecting the same track circuits.

14. Welding repairs are not intended to be used to correct drooping rail ends, surface bent rails, or to compensate for worn joint bars, loose bolts and poor track surface.

15. There are several weld patterns which can be used for successful rail end welding repairs (see Rail End Weld Bead Patterns, page 22). The strip welding techniques as shown in the "Weld Bead Patterns - Good Practices" sketches are recommended.
CARBON STEEL COMPONENT REPAIR – RAIL ENDS

RAIL END WELD BEAD PATTERNS - POOR PRACTICES

Wide beads are difficult to control manually, which can produce a rougher and more uneven surface with possible depressions after grinding. Note that an automated solution such as the ESAB BV2000 can produce this weld pattern consistently even up to 70 mm bead width.

Showing that both craters were finished in a straight line which could result in rail cracking.

RAIL END WELD BEAD PATTERNS - GOOD PRACTICES

Used for first pass on the lowest portion of ground rail end.
Note: At the end of each bead, the craters must be properly filled and the arc is to be broken by crossing back into the surface of the welded bead.
RAIL END POST WELD HEAT TREATMENT RECOMMENDATIONS

Immediately after the welding is completed, the weld areas should be post weld heat treated. This is to provide a Brinell hardness within the range of 363-401 at the rail end and a Brinell hardness within the range of 275-325 at the opposite end of the weld - see illustrations below for recommended post weld heat treatment zones.

<table>
<thead>
<tr>
<th>Type of Rail</th>
<th>Post Weld Heat Approx. Temperatures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard High Carbon Rail</td>
<td>1,000°F (538°C)</td>
</tr>
<tr>
<td>Alloy Rail</td>
<td>1,200°F (649°C)</td>
</tr>
</tbody>
</table>

**Welds Under 7’’ (17.8 cm)**

- **Left side**: 7’’
- **Right side**: 1’’
- Under 7’’

**Welds Over 7’’ (17.8 cm)**

- **Left side**: 9’’
- **Right side**: 3’’
- Over 7’’
- Heat 3’’ past the end of weld
CARBON STEEL COMPONENT REPAIR – RAIL ENDS

USE OF HEATER CRUCIBLE - POST WELD HEAT TREATMENT

TYPICAL SATISFACTORY BRINELL HARDNESS PATTERNS

Standard Strength Rail - 260 to 300 Brinell Hardness

<table>
<thead>
<tr>
<th>1&quot; (25 mm) From Rail End</th>
<th>Center of Weld</th>
<th>1/2&quot; (13 mm) From End of Weld</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ 380 to 400</td>
<td>O 340 to 360</td>
<td>□ 300 to 320</td>
</tr>
<tr>
<td>+ 360 to 380</td>
<td>O 330 to 350</td>
<td>□ 300 to 320</td>
</tr>
<tr>
<td>+ 340 to 360</td>
<td>O 320 to 340</td>
<td>□ 270 to 300</td>
</tr>
</tbody>
</table>

View looking down at the rail
CARBON STEEL COMPONENT REPAIR – RAIL ENDS

RAIL ENDS: GRINDING & SLOTTING
1. Surface grinding of the welded rail ends should be done after heat treating. Be sure to allow time for the rail end to cool down before grinding. Grinding at high temperatures will cause excessive wear of the grinding disc and destroy it’s bonding material.
2. A hand grinder is not recommended for surface grinding. Use an angle grinder mounted on a surface grinding guide.
3. The flange way and radius gauges should be used to check and control the amount of grinding being done.
4. The ground surface of the ball of the rail should be checked with a 24” straight edge to assure proper level/taper.
5. The finished surface should be free of any blemishes and gouge marks from the grinding wheel. The surface should be ground to conform to the existing rail surface. Tolerance for surface grinding should be .005” - .010” (.127 mm - .254 mm) low.
6. The field side of the rail must be ground smooth and the edge rounded, so that the bond wires can be properly applied (signal wires).
7. After surface grinding, the rail ends at open joints should be beveled horizontally between 1/16” - 3/32” (1.6 mm - 2.4 mm) and down between 1/4” and 5/16” (6.4 mm - 8 mm). Rail ends at a closed joint should be slotted and care must be taken to center the slotting wheel to avoid cutting either of the rails more than the other. For rail ends at an insulated joint, remove deformed metal from rail ends leaving the end square or slightly beveled at the top corners. Note: If during the grinding and slotting of the rail ends the joint bars are cut by the grinder, the joint bars must be replaced.
8. Metal particles produced during the grinding operation should be cleaned from an insulated joint.
9. If worn rail is on the low side of the curve, slotting or beveling should always follow the contour of the rail head and must have sufficient depth in the center.
10. Slotting stones used in slotting rail ends should not exceed 5/32” (3.4 mm) in thickness.

WHEEL BURNS, BATTERED WELDS, & WHEEL SLIP STREAKS
1. Before repairing wheel burns, battered welds, or annealing wheel slip streaks, contact the welding supervisor.
2. Weld deposits should be made using the electric arc process. Note: The oxyacetylene torch is to be used only for preheating, post heating, and annealing.
3. IMPORTANT: Wheel burns, battered rails and wheel slip streaks should not be repaired outside the joint bars. If areas of the rail to be repaired are outside the joint bars, the rails should be split and the joint bars added. Repairs should then proceed as a rail end repair (see rail end repair section for welding recommendations on carbon steel rails).
CARBON STEEL COMPONENT REPAIR – SWITCH POINTS

SWITCH POINTS: INSPECTION & REPAIR
1. Switch points can be repaired in and out of the track using manual electrodes or semi-automatic wires. NOTE: Reclamation of switch points is limited to yard and industry tracks.
2. A copper plate is used between the switch point and the stock rail to speed up the repair and to prevent the switch point from being welded to the stock rail.
3. Before any repairs are started, tighten any loose bolts in the heel block and tamp the ties under the switch point heel block.
4. Remove any defective materials using a grinder (fatigued, spalled, and other defective materials).
5. Preheat carbon steel switch point to 800°F (427°C). Interpass temperature should be held at preheat temperature or higher, 800°F-1,000°F (427°C-538°C).
6. Do not allow the unit being welded to cool during the welding operation.
7. If the welding operation is interrupted and the material being welded cools, reheat the material to 800°F (427°C) before resuming the weld repair.
8. Welding on switch points should be started from the end of the point toward the heel.
9. A tapered profile, both vertical and horizontal, must be maintained during welding.
10. It is recommended that the welded portion of the switch point not exceed 18" (46 cm) in length.
11. After each weld bead, remove the slag before applying the next weld bead. Do not weld over the slag.
12. Due to the thin section of metal being welded, it is not recommended to post weld heat switch points after welding.

FINISH GRINDING
1. The welded point area should be ground to a smooth finish and to an approximate original shape and dimension.
2. The tip of the point should be ground to 5/8" (16 mm) below the top of the stock rail and taper back 18" (46 cm), at which point it should be even with the stock rail top.
3. Point thickness on the top at the extreme end should be approximately 1/8" (3.2 mm) 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.

SWITCH POINT CONSTRUCTIONS

DOUBLE REINFORCED for Heavy Loads

SINGLE REINFORCED for Intermediate Loads

NON-REINFORCED for Light Loads

SWITCH POINT END - SIDE VIEW
Typical for all constructions and details
### General Information – Stoody Packaging Details

#### Manual Rods & Electrodes

<table>
<thead>
<tr>
<th></th>
<th>Weight</th>
<th>Width</th>
<th>Height</th>
<th>Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vacuum Package (Vac Pak) Box</td>
<td>5 lb (2.27 kg)</td>
<td>14-5/8&quot; (37.2 cm)</td>
<td>4-7/16&quot; (11.3 cm)</td>
<td>2-1/8&quot; (5.4 cm)</td>
</tr>
<tr>
<td>Vacuum Package (Vac Pak) Box</td>
<td>10 lb (4.5 kg)</td>
<td>14-5/8&quot; (37.2 cm)</td>
<td>4-7/16&quot; (11.3 cm)</td>
<td>2-1/8&quot; (5.4 cm)</td>
</tr>
<tr>
<td>Box - 14&quot; (35.6 cm) Product</td>
<td>10 lb (4.5 kg)</td>
<td>15&quot; (38.1 cm)</td>
<td>4-1/4&quot; (10.8 cm)</td>
<td>2-1/16&quot; (5.4 cm)</td>
</tr>
<tr>
<td>Box - 18&quot; (45.7 cm) Product</td>
<td>10 lb (4.5 kg)</td>
<td>19-1/8&quot; (48.6 cm)</td>
<td>4-5/16&quot; (11.0 cm)</td>
<td>2-1/4&quot; (5.7 cm)</td>
</tr>
<tr>
<td>Bulk Package - 14&quot; (35.6 cm) Product</td>
<td>60 lb (27.2 kg)</td>
<td>15-7/16&quot; (39.2 cm)</td>
<td>6&quot; (15.2 cm)</td>
<td>5-7/8&quot; (14.9 cm)</td>
</tr>
<tr>
<td>Bulk Package -18&quot; (45.7 cm) Product</td>
<td>60 lb (27.2 kg)</td>
<td>18-3/4&quot; (47.6 cm)</td>
<td>5-1/4&quot; (13.3 cm)</td>
<td>5-1/4&quot; (13.3 cm)</td>
</tr>
</tbody>
</table>

#### Wire - Boxed Spools & Wire Baskets

<table>
<thead>
<tr>
<th></th>
<th>Weight</th>
<th>Width</th>
<th>Height</th>
<th>Depth</th>
<th>Outer Dia. (O.D.)</th>
<th>Inner Dia. (I.D.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastic Spool (PS) Box - Cardboard</td>
<td>5 lb (2.27 kg)</td>
<td>8-1/4&quot; (21 cm)</td>
<td>7-7/8&quot; (20 cm)</td>
<td>3-3/4&quot; (9.5 cm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10 lb (4.5 kg)</td>
<td>8-1/4&quot; (21 cm)</td>
<td>7-7/8&quot; (20 cm)</td>
<td>3-3/4&quot; (9.5 cm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plastic Spool (PS) Box - Cardboard</td>
<td>25 lb (11.3 kg)</td>
<td>12-3/16&quot; (31 cm)</td>
<td>11-3/4&quot; (29.9 cm)</td>
<td>7-1/2&quot; (19.1 cm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plastic Spool (PS) Box - Cardboard</td>
<td>33 lb (15 kg)</td>
<td>12-3/16&quot; (31 cm)</td>
<td>11-3/4&quot; (29.9 cm)</td>
<td>7-1/2&quot; (19.1 cm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wire Basket (WB) Box - Cardboard</td>
<td>25 lb (4.5 kg)</td>
<td>12-3/16&quot; (31 cm)</td>
<td>11-3/4&quot; (29.9 cm)</td>
<td>7-1/2&quot; (19.1 cm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wire Basket (WB) Box - Cardboard</td>
<td>33 lb (15 kg)</td>
<td>12-3/16&quot; (31 cm)</td>
<td>11-3/4&quot; (29.9 cm)</td>
<td>7-1/2&quot; (19.1 cm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plastic Spool (PS) Box - Cardboard</td>
<td>50 lb (22.7 kg)</td>
<td>16-7/8&quot; (42.9 cm)</td>
<td>16-1/2&quot; (41.9 cm)</td>
<td>12&quot; (30.5 cm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coil (Cardboard Core) Box - Cardboard</td>
<td>60 lb (27.2 kg)</td>
<td>16-7/8&quot; (42.9 cm)</td>
<td>16-1/2&quot; (41.9 cm)</td>
<td>12&quot; (30.5 cm)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Wire - Drums

<table>
<thead>
<tr>
<th></th>
<th>Weight</th>
<th>Height</th>
<th>Outer Dia. (O.D.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Twist Pak (NTP)</td>
<td>Varies</td>
<td>32-1/4&quot; (81.9 cm)</td>
<td>20 -7/8&quot; (53 cm)</td>
</tr>
<tr>
<td>Quarter Pak (QP)</td>
<td>110 lb (50 kg)</td>
<td>15&quot; (38.1 cm)</td>
<td>23 -7/8&quot; (60.6 cm)</td>
</tr>
<tr>
<td>Half Pak (HP)</td>
<td>200 lb (90.7 kg)</td>
<td>15&quot; (38.1 cm)</td>
<td>23 -7/8&quot; (60.6 cm)</td>
</tr>
<tr>
<td>Payoff Pak (POP)</td>
<td>500 lb (226.8 kg)</td>
<td>31-1/2&quot; (80 cm)</td>
<td>23 -7/8&quot; (60.6 cm)</td>
</tr>
<tr>
<td>Payoff Pak (POP)</td>
<td>750 lb (340.2 kg)</td>
<td>35&quot; (88.9 cm)</td>
<td>23 -7/8&quot; (60.6 cm)</td>
</tr>
</tbody>
</table>
### General Information – Stoody Packaging Details

#### Coated Electrode Size

<table>
<thead>
<tr>
<th>Coated Electrode Size</th>
<th>Coated Electrode Length</th>
<th>Standard Shipping Container Weight</th>
<th>Units in Standard Packaging</th>
<th>Unit Container</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/32” (2.4 mm)</td>
<td>9” (231 mm)</td>
<td>30 lb (13.6 kg)</td>
<td>6</td>
<td>5 lb (2.27 kg)</td>
</tr>
<tr>
<td>1/8” (3.2 mm), 5/32” (4.0 mm), 3/16” (4.8 mm), 1/4” (6.4 mm)</td>
<td>14” (356 mm)</td>
<td>60 lb (27.2 kg)</td>
<td>6</td>
<td>10 lb (4.54 kg)</td>
</tr>
</tbody>
</table>

#### Pallet Weights for Stoody® Products

<table>
<thead>
<tr>
<th>Item</th>
<th>Pallet Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual Rods &amp; Electrodes</td>
<td></td>
</tr>
<tr>
<td>10 lb (4.5 kg) Vacuum Packages</td>
<td>1440 lb (653 kg)</td>
</tr>
<tr>
<td>10 lb (4.5 kg) Boxes</td>
<td>1440 lb (653 kg)</td>
</tr>
<tr>
<td>60 lb (27.2 kg) Bulk Packages</td>
<td>1800 lb (816 kg)</td>
</tr>
</tbody>
</table>

Note: Bare cast rods come in 5 lb (2.27 kg) tubes

Stainless Steel, Cobalt and Nickel Wires

- 25 lb (11.3 kg) Spools 600 lb (272 kg)
- 33 lb (15 kg) Wire Baskets 792 lb (359 kg)
- 50 lb (22.7 kg) PP 1200 lb (544 kg)
- 60 lb (27.2 kg) Coils 1440 lb (653 kg)

Submerged Arc Wires

- 33 lb (15 kg) Wire Baskets 792 lb (359 kg)
- 50 lb (22.7 kg) PP 1200 lb (544 kg)
- 60 lb (27.2 kg) Coils 1440 lb (653 kg)
- 500 lb (226.8 kg) POP 500 lb (227 kg)
- 110 lb (50 kg) QP 220 lb (100 kg)
- 200 lb (90.7 kg) HP 400 lb (181 kg)

#### Packaging

- 5 lb and 10 lb plastic spools measure 2” I.D. x 8” O.D.
- 25 lb and 33 lb wire baskets measure 2” I.D. x 12” O.D.
- 50 lb Polypaks and 60 lb coils have 12” I.D.

**Packaging Abbreviations**

- HP = Half Pak (200 lb)
- LLW = Level Layer Wound
- NTP = No Twist Pak
- POP = Payoff Pak (500 lb)
- PP = Polypak
- PS = Plastic Spool
- QP = Quarter Pak (110 lb)
- WB = Wire Basket

#### Metric Conversion Chart

<table>
<thead>
<tr>
<th>Metric</th>
<th>Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.035”</td>
<td>0.9 mm</td>
</tr>
<tr>
<td>0.045”</td>
<td>1.2 mm</td>
</tr>
<tr>
<td>0.052”</td>
<td>1.3 mm</td>
</tr>
<tr>
<td>1/16”</td>
<td>1.6 mm</td>
</tr>
<tr>
<td>5/64”</td>
<td>3.2 mm</td>
</tr>
<tr>
<td>3/32”</td>
<td>2.4 mm</td>
</tr>
<tr>
<td>1 lb</td>
<td>0.4536 kg</td>
</tr>
</tbody>
</table>

### Warning

**Protect yourself and others.** Before you use this product, read and understand the label, the appropriate Material Safety Data Sheet (MSDS), the manufacturer's instructions and your employer's safety practices. The MSDS is available upon request from your distributor, your employer.

- **Heat rays (infrared radiation from flame or hot metal),** from oxyfuel process can injure eyes. **Electric shock** can kill. **Arc rays** can injure eyes and burn skin. **Fumes and gases** can be hazardous to your health.

- Keep your head out of fumes. The primary entry route for welding fumes and gases is by inhalation. Short-term over-exposure to welding fumes may result in fever, dizziness, nausea, or dryness or irritation of nose, throat or eyes and may aggravate pre-existing respiratory conditions. Long term over-exposure to welding fumes may harm your respiratory function and pulmonary function and may lead to siderosis (iron deposits in the lungs). Manganese over-exposer may affect the central nervous system, resulting in impaired speech and movement. OSHA considers chromium and nickel compounds carcinogenic.

- Use enough ventilation and exhaust at the arc (flame) to keep fumes and gases from your breathing zone and general area. If you are concerned about the ventilation of your work area, request that your employer conduct appropriate testing.

- Wear correct eye, ear, and body protection.

- Do not permit electrically live parts to touch skin, clothing or gloves. Insulate yourself from work and ground.

This information is intended for the end user of this product. Do not remove or obstruct this information.

WARNING: Cancer and Reproductive Harm. www.P65Warnings.ca.gov Wash hands after handling.