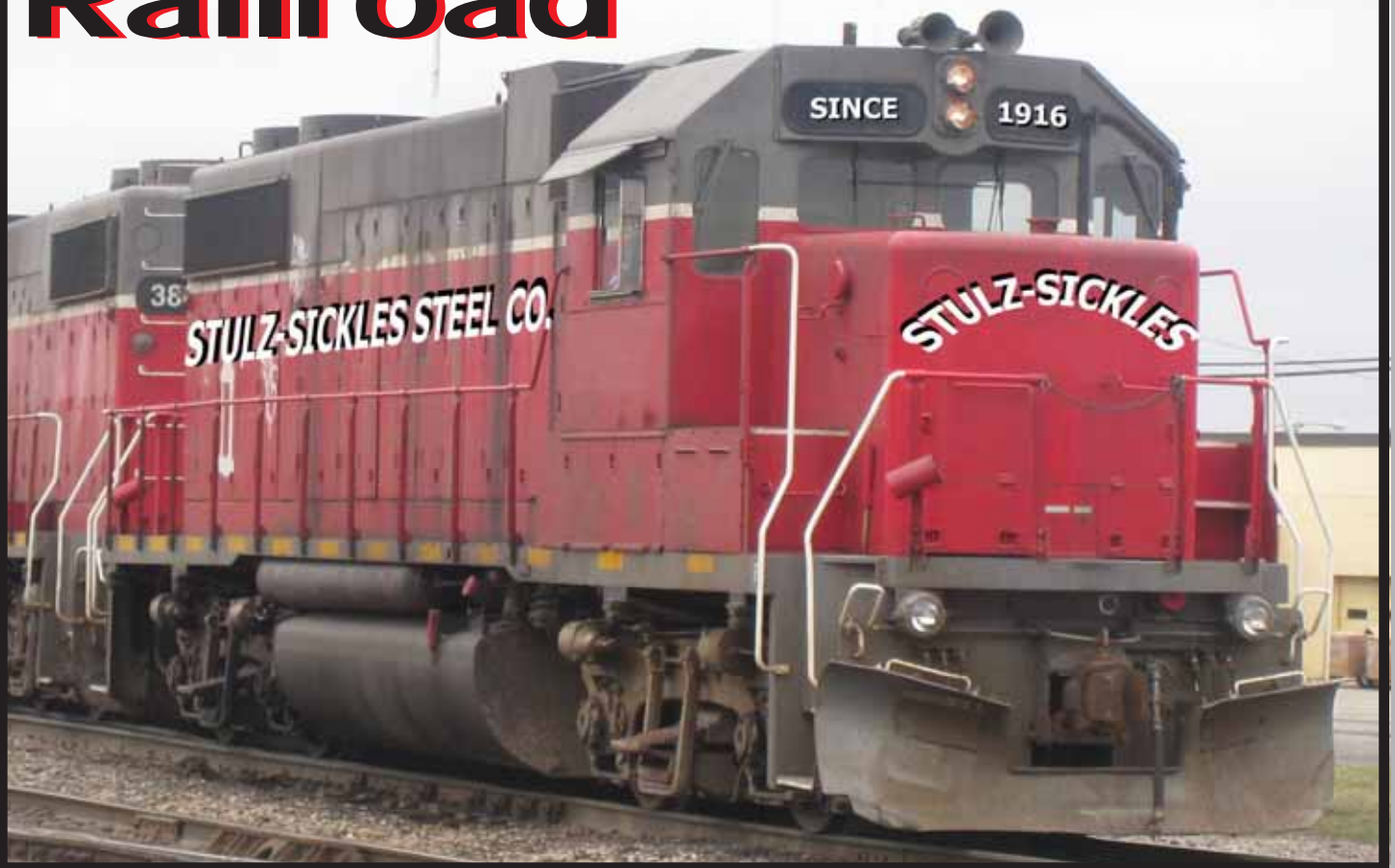


STULZ-SICKLES STEEL COMPANY

SINCE 1916

Providing Years of Wear Resistant Service to the Railroad Industry

Railroad



ELIZABETH, NEW JERSEY ♦ COLTON, CALIFORNIA
800-351-1776 800-572-5809
www.stulzsicklessteel.com www.manganal.com

STULZ SICKLES STEEL CO.

MANGANAL

HADFIELD GRADE HIGH MANGANESE STEEL

PHYSICAL PROPERTIES

Yield Strength 60,000/85,000 psi
Tensile Strength 120,000/130,000 psi
% Elongation in 2" 35%/50%
Hardness as Rolled 230 bhn
Work Hardens-up to 550 bhn

CHEMICAL ANALYSIS

Mn-12.0/14.0	Si-0.60 Max.
C-1.1/1.4	P-0.05 Max.
	S-0.04 Max.

CHARACTERISTICS

- RESISTS ALL IMPACT AND ABRASION
- WORK HARDENS RAPIDLY UP TO 550 BRINELL DUE TO HIGH CARBON CONTENT
- REMAINS DUCTILE THROUGHOUT, NEVER BRITTLE
- WORK HARDENED SURFACE BECOMES ALMOST FRICTIONLESS WHICH ALLOWS THE MATERIALS TO SLIDE EASILY
- HAS NON-MAGNETIC PROPERTY
- CAN BE CUT BY OXY-ACETYLENE TORCH, PLASMA, WATER JET, OR LASER

**WELD WITH STULZ MANGANESE-XL
OR STULZ 1616**

HADFIELD GRADE
FULLY HEAT TREATED
FULLY AUSTENITIC
ASTM A128

MANGANAL IS USED HERE FOR MAINTENANCE AND REPAIR WITHIN THE RAILROAD INDUSTRY . . .

- HORIZONTAL WEAR LINERS
- VERTICAL WEAR LINERS
- JOURNAL BOX WEAR LINERS
- PEDESTAL WEAR LINERS
- PEDESTAL ROOF LINERS
- LUG LINERS
- CARRIER COUPLER WEAR LINERS
- BRAKE BEAM POCKET LINERS
- SIDE FRAME COLUMN WEAR LINERS
- BOLSTER POCKET SIDE WALL WEAR LINERS
- BOLSTER POCKET WEAR PLATE
- MOTOR NOSE SUPPORT LINERS
- COLUMN WEAR LINERS

. . . . and any other places where heavy impact, abrasion or metal-to-metal wear is a problem.

FREQUENTLY ASKED QUESTIONS

WHAT IS UNUSUAL ABOUT MANGANAL?

Manganal thrives on severe wear conditions. The more impact and hammering it receives, the harder the surface becomes. This characteristic, known as work-hardening, plus the fact that it remains ductile underneath, makes it a most effective steel in combating impact and abrasion.

HOW HARD CAN THE SURFACE GET BY WORK-HARDENING?

Depending on deformation of the surface crystalline structure, it can work-harden up to more than 550 Brinell. When originally put into service it is about 230 Brinell.

HOW DOES MANGANAL BEHAVE UNDER IMPACT WITH NO ABRASION?

One example of surface work-hardening under almost pure impact is the liners of shot blast cabinets. Manganal work-hardens rapidly, takes a smooth polish due to its low friction property, yet retains its great toughness under the hardened surface. Generally, the heat-treated alloy and tool steels, although of high hardness, tend to erode comparatively fast, and break down on the surface.

HOW IMPORTANT IS THE CARBON CONTENT IN MANGANAL?

The carbon content is very important because when a Manganal plate is impacted, the carbon binds with the manganese and allows the surface to work harden. The result is less wear on the thickness of the plate prior to complete work-hardening. For manganese steel to be considered Hadfield grade, the carbon content must be 1.0% or higher.

HOW ABOUT MACHINING MANGANAL?

Manganal is machined within limits, using special methods and tooling. When a drill or cutting tool is applied to Manganal, it quickly work-hardens the area to the extent that machining becomes very difficult. Therefore Manganal does not lend itself to machining by usual machine shop methods.

WHAT METHODS ARE EASILY USED TO WORK MANGANAL?

It can be flame cut by oxy-acetylene torch, cut by abrasive cut-off machine and electric welded (minor preheating is recommended). Shearing, bending, and rolling require heavy equipment which has at least twice the capacity that would be needed for the same thickness of mild steel.

MANGANAL

WEAR RESISTANT HIGH MANGANESE STEEL APPLICATOR BARS AND PLATE

STULZ HADFIELD GRADE ♦ 12-14% MANGANESE ♦ 1.1/1.4 CARBON

FLATS						ROUNDS	SQUARES	PLATES
SIZE	SIZE	SIZE	SIZE	SIZE	SIZE	SIZE	SIZE	THICKNESS
3/16" x 2-1/2"	3/8" x 1"	1/2" x 1"	3/4" x 1-1/2"	1" x 1-1/2"	1-1/2" x 2"	3/8" 2-1/4"	3/8"	1/8"* 1-1/8"
1/4" x 1"	1-1/2"	1-1/2"	2"	2"	6"	1/2" 2-1/2"	1/2"	3/16" 1-1/4"
1-1/2"	2"	2"	2-1/2"	3"		5/8" 3-1/8"	5/8"	1/4" 1-3/8"
2"	2-1/2"	2-1/2"	3"	4"	2" x 3"	3/4" 3-1/2"	3/4"	5/16" 1-1/2"
2-1/2"	3"	3"	3-1/2"	5"	4"	7/8" 4-1/8"	1"	3/8" 1-5/8"
3"	4"	3-1/2"	4"	6"	6"	1" 4-1/2"	1-1/4"	1/2" 1-3/4"
4"	4-1/2"	4"	5"	8"		1-1/8" 5-1/8"	1-1/2"	5/8" 2"
5"	5"	5"	6"			1-1/4" 5-1/2"	2"	3/4" 2-1/4"
	6"	6"				1-1/2" 6-1/8"		7/8" 2-1/2"
						1-3/4" 6-3/4"		1" 3"
						2" 7-1/8"		

FABRICATED PARTS TO SPECIFICATION

WELDED, PUNCHED, DRILLED
AND FORMED FABRICATIONS WILL
BE QUOTED ON SUBMISSION OF
SKETCH OR BLUEPRINT SPECIFICATIONS.

ANGLES
2" X 2" X 1/4"

**PINS &
BUSHINGS**

**SHOT-BLAST
GRATING**

STOCK PLATE SIZES

48" X 96"

48" X 144"

60" X 120"

72" X 144"

84" X 120"

96" X 240"

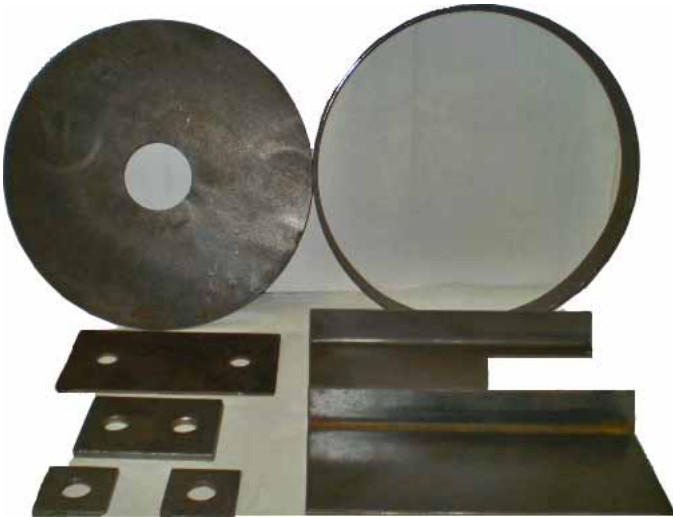
& Lengths up to 24 ft.

* 1/8" x 40" x 99"

CUSTOM MANGANAL PRODUCTS



STULZ HADFIELD GRADE MANGANESE WEAR PARTS



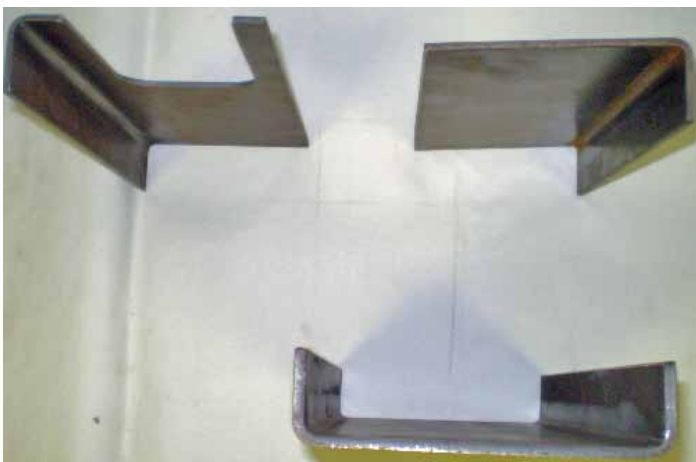
**ALL PARTS FABRICATED
TO ORDER FROM PRINTS**



**STULZ HADFIELD GRADE
HORIZONTAL BOLSTER WEAR LINER**



**STULZ
HADFIELD GRADE
HORIZONTAL AND
VERTICAL BOLSTER
WEAR LINERS**



**STULZ
HADFIELD
GRADE
PEDESTAL
WEAR
LINERS**



STULZ HADFIELD GRADE MANGANESE WEAR PARTS



**STULZ
HADFIELD
GRADE
WEAR PLATES**



**STULZ HADFIELD GRADE
CARRIER COUPLER
WEAR PLATES**



**STULZ HADFIELD GRADE
COUPLER CLIP**

TUFFWEAR

400 AND 500 BRINELL PLATE AND 400 BRINELL HOT ROLLED ALLOY WEAR BARS

Heat Treated for High Hardness, High Tensile Strength
to Resist Severe Abuse and Abrasion

TUFFWEAR IS USED HERE FOR MAINTENANCE AND REPAIR WITHIN THE RAILROAD INDUSTRY . . .

- PEDESTAL WEAR LINERS
- PEDESTAL ROOF LINERS
- BRAKE BEAM POCKET LINERS
- SIDE FRAME COLUMN WEAR LINERS
- BOLSTER POCKET SIDE WALL WEAR LINERS
- BOLSTER POCKET WEAR PLATE
- MOTOR NOSE SUPPORT LINERS
- COLUMN WEAR LINERS
- SHEAR PADS
- LUG LINERS

WELDABLE

Use Stulz Special Alloy
Welding Electrodes

FORMABLE

Double Grained Plate
Allows For Forming in
Either Direction

UNIFORM HARDNESS

Through Hardened
Quench and Tempered

PHYSICAL PROPERTIES

TUFFWEAR 400

Hardness 390/400 Brinell
Tensile Strength 180,000 Min. PSI

TUFFWEAR 500

Hardness 490/500 Brinell
Tensile Strength 230,000 Min. PSI

TUFFWEAR PLATE

TUFFWEAR 400 390/400 BRINELL HARDNESS

SIZE	WGT. PER SQ. FOOT (lbs.)
3/16"	7.7
1/4"	10.2
3/8"	15.3
1/2"	20.4
5/8"	25.5
3/4"	30.6
1"	40.8
1-1/4"	51.0
1-1/2"	61.2
2"	81.6

Other sizes on request

TUFFWEAR 500 490/500 BRINELL HARDNESS

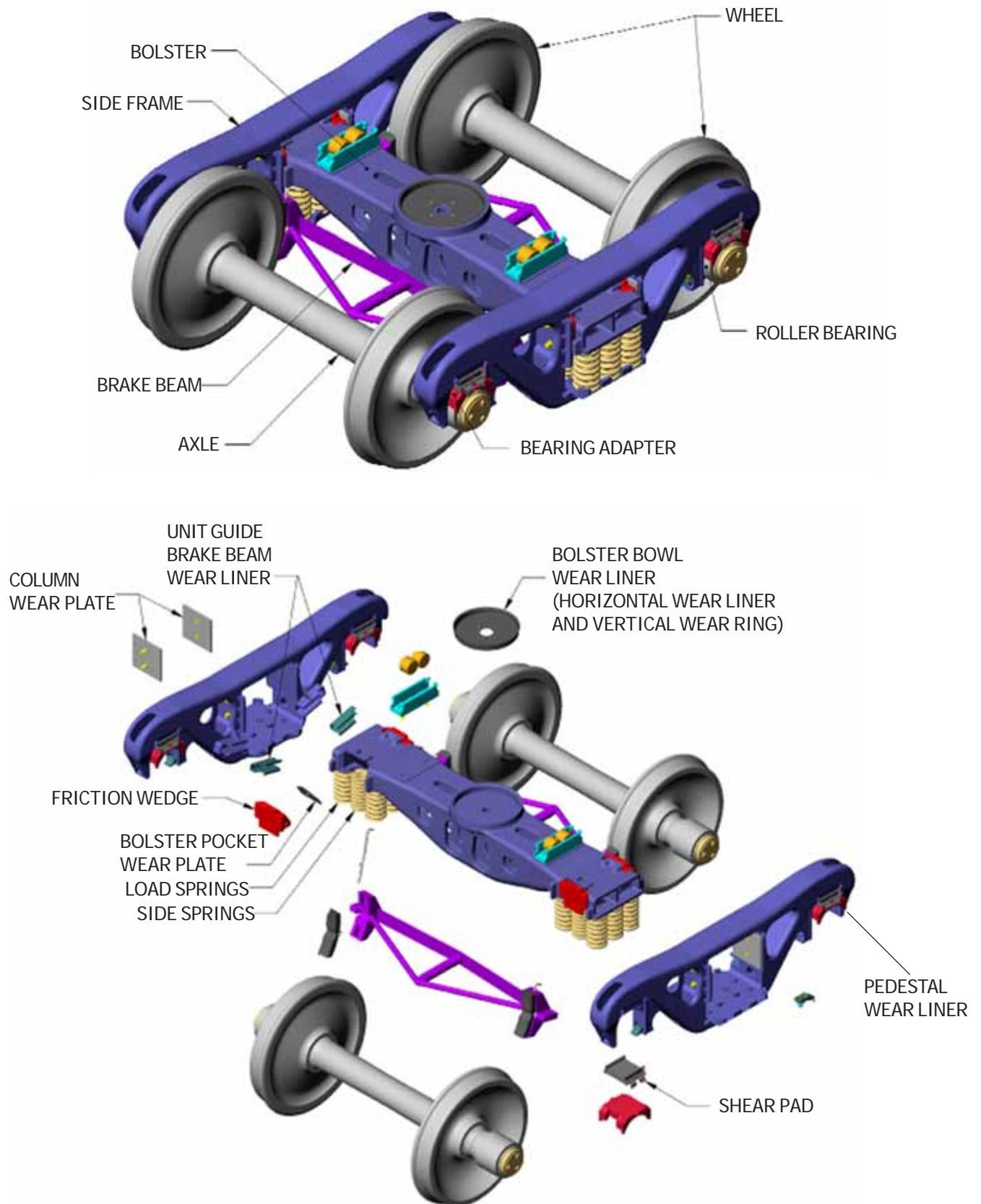
SIZE	WGT. PER SQ. FOOT (lbs.)
1/4"	10.2
3/8"	15.3
1/2"	20.4
3/4"	30.6
1"	40.8

Other sizes on request

STULZ ALLOY-WEAR BARS 390/400 BRINELL Q.T.

SIZE	WGT. PER FOOT (lbs.)	STANDARD LENGTH (ft.)
1/4" x 1"	.85	20
1-1/2"	1.28	20
2"	1.70	20
3"	2.55	20
4"	3.40	20
6"	5.10	20
3/8" x 1"	1.28	20
2"	2.55	20
2-1/2"	3.19	20
3"	3.83	20
4"	5.10	20
5"	6.40	20
6"	7.65	20
8"	10.20	20
1/2" x 1"	1.70	20
1-1/2"	2.55	20
2"	3.40	20
2-1/2"	4.25	20
3"	5.10	20
3-1/2"	5.95	20
4"	6.80	20
5"	8.50	20
6"	10.20	20
8"	13.60	20
3/4" x 2"	5.10	20
2-1/2"	6.38	20
3"	7.65	20
4"	10.20	20
5"	12.75	20
6"	15.30	20
8"	20.40	20
1" x 2"	6.80	20
2-1/2"	8.50	20
3"	10.20	20
4"	13.60	20
5"	17.00	20
6"	20.40	20
8"	27.20	20

TRUCK COMPONENT PARTS DIAGRAM



WELDING HADFIELD GRADE AUSTENITIC MANGANESE STEEL

1. OBJECTIVE: This document provides information on the properties and welding of Austenitic Manganese Steel (AMS) components. It is intended for welding and engineering personnel involved in the fabrication or repair of AMS rail components.

2. ALLOY DESCRIPTION: AMS is widely known as Hadfield Grade manganese steel and is highly alloyed containing 11-14% manganese and approximately 1.2% carbon. The alloy was discovered and pioneered by one of the world's leading metallurgists, Roberts A. Hadfield, in 1882. This was the first alloy steel that was extremely hardwearing and proved the perfect material for early railway track components. Currently it has applications in railway track particularly at crossings where resistance to high metal-to-metal wear and impact loading is required.

AMS is characterized by high strength, high ductility, and excellent wear resistance. As an austenitic steel it is non-magnetic. On this latter point it should be pointed out that this steel has a large capacity to work harden and is widely used in equipment and parts that are subjected to heavy impact and compressive loads. In rail applications the loading tends to be high compressive loads. With AMS, these loads actually harden the new surface as the old is slowly worn away.

3. RAIL APPLICATIONS: AMS is primarily used at switches and diamond crossings where high transverse axle loads produce high compressive loads and metal-to-metal wear.

AMS finds applications at crossings because it has the following features and properties:

- resistant to severe impact and abrasion
- work hardens rapidly under the influence of impact and abrasion and can reach surface hardness levels in the order of 500 HV
- retains good toughness
- exhibits a low coefficient of friction in metal-to-metal applications

4. TYPICAL PHYSICAL PROPERTIES & CHEMICAL COMPOSITION OF AMS

Yield Strength: 350 Mpa	Work Hardenability: From 180 HV up to 580 HV
Tensile Strength: 800-1000 Mpa	Manganese: 12-14%
Elongation in 50mm: 35% to 50%	Silicon: 0.6% Max.
Hardness: 180 HV after quenching from 1000-1050 degree C	Carbon: 1-1.4%
	Phosphorous: 0.05% Max.
	Sulphur: 0.04% Max.
	Iron: Balance

SEMI-AUTOMATIC OPEN ARC WELDING WIRES

STULZ MANGANESE XL- S/A

Used for build-up and replacement of worn manganese steel by semi-automatic method.

7/64", 1/16" and .045 Dia.

OPEN ARC

STULZ #1616-SA

All purpose high chromium, high manganese for high strength joining of manganese steel to other alloy steels and for multi-pass build-up for good wear resistance. Cannot be flame cut.

7/64", 1/16" and .045 Dia.

OPEN ARC



WELDING ELECTRODES FOR RAILROAD INDUSTRY

STULZ MANGANESE-XL

A high manganese-nickel chrome electrode for joining manganese and building-up parts of manganese, carbon and alloy steels that are subject to extreme shock, impact and abrasion. No peening is required. May be applied multiple pass. Tensile strength 125,000 PSI. Six 10 lb. waterproof containers per carton. Standard length 14".

AC-DC

STULZ 1616 ELECTRODES

All purpose high chromium, high manganese for high strength joining of manganese steel to other alloy steels and for multi-pass build-up for good wear resistance. Cannot be flame cut. Six 10 lb. waterproof containers per carton. Standard length 14".

AC-DC

**WE
ACCEPT**



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