

Index

PAGE NO.	PRODUCTS
1	SHIELDING GAS SELECTION TABLE
2-5	FLUX AND METAL CORED WIRES FOR MILD STEELS
6-7	FLUX CORED WIRES FOR LOW ALLOY STEELS
8-15	FLUX CORED AND METAL CORED WIRES FOR STAINLESS STEELS
16-17	FLUX CORED WIRES FOR BUILD-UP AND HARDFACING STAINLESS
18-25	STEEL SOLID WIRES
26-37	STAINLESS STEEL COVERED ELECTRODES
38-40	CAST IRON ELECTRODES AND WIRES
41-42	BUILD-UP & HARDFACING ELECTRODES
43-45	COBALT HARDFACING RODS & ELECTRODES
46-60	MILD STEEL, LOW HYDROGEN & LOW ALLOY STEEL ELECTRODES
61-71	MILD STEEL & LOW ALLOY STEEL MIG, TIG & SUBARC WIRES
72-73	SILVER & PHOS-COPPER-SILVER BRAZING ALLOYS
74-80	ALUMINUM MIG & TIG WIRES
81-82	MAGNESIUM WIRES
83-84	ARC GOUGING CARBONS
85-87	COPPER BASED WELDING & BRAZING ALLOYS
88-90	COPPER BASED FLUX-COATED ELECTRODES
91	TITANIUM WIRES
92-101	NICKEL BASED ALLOY MIG, TIG & SUBARC WIRES
102-107	NICKEL-BASED ALLOY FLUX-COATED ELECTRODES
108-116	SPECIAL PURPOSE ELECTRODES
117-123	TOOL, DIE & MOLD STEEL TIG WIRES
124	TUNGSTEN ELECTRODES
125-126	HELMETS & HELMET PARTS / ACCESSORIES
127	GROUND CLAMPS & ELECTRODE HOLDERS
128-131	ACCESSORIES

RECOMMENDED SHIELDING GASES FOR WASHINGTON ALLOY FILLER METALS

ALUMINUM WIRES & RODS	TIG: 100% Argon, or 75% Ar/25% He MIG: 100% Argon or 75% Ar/25% He (Mechanized welding on heavy plate: 100% He or 75% He/25% Ar)
COPPER BASED WIRES & RODS	100% Argon, 100% Helium or 75% Ar/25% He. Nitrogen may also be used
FLUX-CORED WIRE (mild-steel, stainless steel, buildup and hardsurfacing)	100% CO ₂ or 75% AR/25% CO ₂
LOW ALLOY/HIGH STRENGTH WIRES	98% Ar/2% O ₂ or 75% Ar/25% CO ₂
MAGNESIUM WIRES & RODS	100% Argon or 100% Helium or a mixture of the two (i.e., 75% Ar/25% He)
MILD STEEL WIRE	Short Arc for Globular Transfer: 100% CO ₂ or 75% Ar/25% He Spray Transfer: Ar/O ₂ (1-10% O ₂), Ar/CO ₂ (5-15% CO ₂), Ar/CO ₂ /O ₂
NICKEL ALLOY WIRES & RODS	100% Argon or 75% Argon/25% Helium
STAINLESS STEEL WIRES & RODS	100% Argon, 98% Ar/2% O ₂ , 90% He/7.5% Ar/2.5% CO ₂ , 90% Ar/8% CO ₂ /2% O ₂
TITANIUM WIRES & RODS	100% Argon or 100% Helium or mixtures of the two (i.e., 75% Ar/25% He)

CAUTION: Protect yourself and others. Read and understand this label. ELECTRIC SHOCK can kill. FUMES and GASES can be dangerous to your health. ARC RAYS can injure eyes and burn skin.

- Read and understand the Material Safety Data Sheet (MSDS), manufacturer's instruction and your employer's safety practices.
- If MSDS not enclosed, obtain from your employer or your supplier.
- Keep your head out of the fumes.
- Use enough ventilation, or exhaust at the arc end, or both, to keep fumes and gases from your breathing zone and general area.
- Wear correct eye, ear and body protection.
- Do not touch live electrical parts.
- See American National Standard Z49.1 "Safety in Welding and Cutting", published by the American Welding Society, 550 Le Jeune Road, Miami, FL 33126, and OSHA Safety and Health Standard, 29 CFR 1910, available from U.S. Dept. of Labor, Washington, D.C. 20210.

Washington Alloy Company believes that the information and data contained in this catalog is correct. However, all technical information, data and applications are provided to assist you in making your own evaluations and decisions and should not be mistaken as expressed or implied warranties. Chemical and mechanical properties are typical or average values that have been obtained by testing and comparing many heats of the same material. Minimum or maximum values are noted accordingly and are not intended for specification purposes. Washington Alloy assumes no liability for results or damages incurred from the use of any information contained herein, in whole or in part.

FLUX AND METAL CORED WIRES

For Mild Steel

USA E70C-3C AWS A5.18 CLASSES E70C-3C/3M	USA E70C-6M AWS A5.18 CLASS E70C-6M	USA E70T-1 AWS A5.20 CLASSES E70T-1C/E70T-1M																														
DESCRIPTION USA E70C-3C is a metal cored gas-shielded wire for single and multi-pass flat and horizontal fillet welds on mild steels used for field construction, erection and fabrication of heavy equipment, construction machinery, and general mild steel fabrication. USA E70C-3C is noted for its smooth, stable arc, nearly free from slag coverage, virtually free of spatter, reduced clean-up lime and excellent weld bead appearance. USA E70C-3C is also qualified to AWS specs E70C-3C and can be used with Argon rich mixed gases with CO ₂ . This wire can also be used out-of-position with the Pulsed MIG Process.	DESCRIPTION USA E70C-6M is a metal cored gas-shielded wire for single and multi-pass flat and horizontal fillet welds on mild steels used for construction, erection and fabrication of heavy equipment, construction machinery, and general mild steel fabrication. USA E70C-6M is noted for its smooth, stable arc, nearly free from slag coverage, virtually free of spatter, reduced clean-up time and excellent weld beat appearance. USA E70C-6M is designed to be used with argon rich mixed gases with CO ₂ . This wire can also be used out-of-position with the Pulsed MIG Process using sizes 1/16" and under.	DESCRIPTION USA E70T-1 is a flux cored wire for single or multi-pass welds on mild steels and certain low alloy steels. USA E70T-1 is noted for its low spatter generation, high disposition rate and ease of slag removal when used for flat and fillet welds of medium and heavy thickness plates. It has been designed to be used with 100% CO ₂ or 75-80% Argon + balance CO ₂ mixed shield gas.																														
TYPICAL APPLICATIONS: USA E70C-3C is used extensively in the fabrication, erection and repair of heavy structural fabrication of mild steels. It is used in applications where better wetting action than solid wire is required on heavier plate where cold-laps may be a concern. It has lower fume levels and higher deposit efficiency than most flux-cored wires. USA E70C-3C provides excellent mechanical properties on heavier plate thicknesses. USA E70C-3C is noted for its smooth arc and minimum spatter. The virtually slag-free deposits reduce clean-up time and the weld deposit efficiency of nearly 96% provides greater productivity than solid wire. When used for horizontal fillet joints the weld bead has equal leg lengths, flat faced fillets with fine ripples.	TYPICAL APPLICATIONS: USA E70C-6M is used extensively in the fabrication, erection and repair of heavy structural fabrication of mild steels. It is often used in robotic applications where slag removal between passes is not practical. It has lower fume levels and higher deposit efficiency than most flux-cored or solid wires. USA E70C-6M provides excellent mechanical properties on heavier plate thickness of plate having tensile strengths up to 70,000 psi. USA E70C-6M is noted for its smooth arc, minimum spatter, and virtually slag-free deposits. Reduced clean-up time and the weld deposit efficiency of nearly 98% provides greater productivity than solid wire. When used for horizontal fillet joints the weld bead has equal leg lengths, flat faced fillets with fine ripples.	TYPICAL APPLICATIONS: USA E70T-1 is used extensively in the fabrication of bridge structures, pressure vessels, earth moving equipment, general construction, shipbuilding and whenever welds are required to meet structural and nuclear codes.																														
TYPICAL WELD METAL CHEMISTRY (% - tested with 100% CO ₂) <table><tr><td>C</td><td>0.04</td></tr><tr><td>Mn</td><td>1.5</td></tr><tr><td>Si</td><td>0.54</td></tr><tr><td>P</td><td>0.014</td></tr><tr><td>S</td><td>0.011</td></tr></table>	C	0.04	Mn	1.5	Si	0.54	P	0.014	S	0.011	TYPICAL WELD METAL CHEMISTRY % <table><tr><td>C</td><td>0.04</td></tr><tr><td>Mn</td><td>1.55</td></tr><tr><td>Si</td><td>0.54</td></tr><tr><td>P</td><td>0.014</td></tr><tr><td>S</td><td>0.011</td></tr></table>	C	0.04	Mn	1.55	Si	0.54	P	0.014	S	0.011	TYPICAL WELD METAL CHEMISTRY (% - tested with 100% CO ₂ Shield Gas) <table><tr><td>C</td><td>0.03</td></tr><tr><td>Mn</td><td>1.45</td></tr><tr><td>Si</td><td>0.50</td></tr><tr><td>P</td><td>0.014</td></tr><tr><td>S</td><td>0.013</td></tr></table>	C	0.03	Mn	1.45	Si	0.50	P	0.014	S	0.013
C	0.04																															
Mn	1.5																															
Si	0.54																															
P	0.014																															
S	0.011																															
C	0.04																															
Mn	1.55																															
Si	0.54																															
P	0.014																															
S	0.011																															
C	0.03																															
Mn	1.45																															
Si	0.50																															
P	0.014																															
S	0.013																															
TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (As welded – tested with 100% CO ₂ Shield Gas) <table><tr><td>Yield Point (psi)</td><td>74,000 psi</td></tr><tr><td>Tensile Strength (psi)</td><td>80,000 psi</td></tr><tr><td>% Elongation in 2"</td><td>29%</td></tr><tr><td>Charpy V-Notch Impact</td><td>94J (69 Ft.Lbs. at 0°C) 56J (41 Ft. Lbs. at -18°C)</td></tr></table>	Yield Point (psi)	74,000 psi	Tensile Strength (psi)	80,000 psi	% Elongation in 2"	29%	Charpy V-Notch Impact	94J (69 Ft.Lbs. at 0°C) 56J (41 Ft. Lbs. at -18°C)	TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (As welded - tested with 80% Argon and 20% CO ₂ Shield Gas) <table><tr><td>Yield Point (psi)</td><td>77,000 psi</td></tr><tr><td>Tensile Strength (psi)</td><td>89,000 psi</td></tr><tr><td>% Elongation in 2"</td><td>27%</td></tr><tr><td>Charpy V-Notch</td><td>40J (29 Ft.Lbs. at -29°C)</td></tr></table>	Yield Point (psi)	77,000 psi	Tensile Strength (psi)	89,000 psi	% Elongation in 2"	27%	Charpy V-Notch	40J (29 Ft.Lbs. at -29°C)	TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (As welded - tested with 100% CO ₂ Shield Gas) <table><tr><td>Yield Point (psi)</td><td>78,000 psi</td></tr><tr><td>Tensile Strength (psi)</td><td>82,500 psi</td></tr><tr><td>% Elongation in 2"</td><td>25%</td></tr><tr><td>Charpy V-Notch Impact</td><td>50J (37 Ft.Lbs. at -18°C)</td></tr></table>	Yield Point (psi)	78,000 psi	Tensile Strength (psi)	82,500 psi	% Elongation in 2"	25%	Charpy V-Notch Impact	50J (37 Ft.Lbs. at -18°C)						
Yield Point (psi)	74,000 psi																															
Tensile Strength (psi)	80,000 psi																															
% Elongation in 2"	29%																															
Charpy V-Notch Impact	94J (69 Ft.Lbs. at 0°C) 56J (41 Ft. Lbs. at -18°C)																															
Yield Point (psi)	77,000 psi																															
Tensile Strength (psi)	89,000 psi																															
% Elongation in 2"	27%																															
Charpy V-Notch	40J (29 Ft.Lbs. at -29°C)																															
Yield Point (psi)	78,000 psi																															
Tensile Strength (psi)	82,500 psi																															
% Elongation in 2"	25%																															
Charpy V-Notch Impact	50J (37 Ft.Lbs. at -18°C)																															
AVAILABLE SIZES AND RECOMMENDED CURRENTS (DCEP) Reverse Polarity - 100% CO ₂ Shield Gas <table><tr><td>SIZE Diameter (in.)</td><td>FLAT</td><td>HORIZ.FILLETS</td></tr><tr><td>.045"</td><td>200-400</td><td>200-400</td></tr><tr><td>.063" (1/16")</td><td>300-500</td><td>300-500</td></tr></table> A wire stick-out of 5/8" to 1" should be used. PACKAGING: .045"x10 Lb., 33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP* .063"x10 Lb., 33 Lb., 44 Lb. Spool, 60 Lb. Coil. 500 Lb. PP* *Pail-Pac Drum	SIZE Diameter (in.)	FLAT	HORIZ.FILLETS	.045"	200-400	200-400	.063" (1/16")	300-500	300-500	AVAILABLE SIZES AND RECOMMENDED CURRENTS (DCEP) Reverse Polarity - 80% Argon and 20% CO ₂ Shield Gas <table><tr><td>SIZE Diameter (in.)</td><td>FLAT</td><td>HORIZ.FILLETS</td></tr><tr><td>.045"</td><td>160-350</td><td>180-360</td></tr><tr><td>.063" (1/16")</td><td>220-450</td><td>280-450</td></tr></table> A wire stick-out of 5/8" to 1" should be used. PACKAGING: .045"x10 Lb., 33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP* .063"x10 Lb., 33 Lb., 44 Lb. Spool, 60 Lb. Coil. 500 Lb. PP* *Pail-Pac Drum	SIZE Diameter (in.)	FLAT	HORIZ.FILLETS	.045"	160-350	180-360	.063" (1/16")	220-450	280-450	AVAILABLE SIZES AND RECOMMENDED CURRENTS (DCEP) Reverse Polarity - 100% CO ₂ Shield Gas <table><tr><td>SIZE Diameter (in.)</td><td>FLAT</td><td>HORIZ.FILLETS</td></tr><tr><td>.045"</td><td>200-400</td><td>210-400</td></tr><tr><td>.063" (1/16")</td><td>300-500</td><td>300-500</td></tr></table> A wire stick-out of 5/8" to 1" should be used. PACKAGING: .045"x10 Lb., 33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP* .063"x10 Lb., 33 Lb., 44 Lb. Spool, 60 Lb. Coil. 500 Lb. PP* *Pail-Pac Drum	SIZE Diameter (in.)	FLAT	HORIZ.FILLETS	.045"	200-400	210-400	.063" (1/16")	300-500	300-500			
SIZE Diameter (in.)	FLAT	HORIZ.FILLETS																														
.045"	200-400	200-400																														
.063" (1/16")	300-500	300-500																														
SIZE Diameter (in.)	FLAT	HORIZ.FILLETS																														
.045"	160-350	180-360																														
.063" (1/16")	220-450	280-450																														
SIZE Diameter (in.)	FLAT	HORIZ.FILLETS																														
.045"	200-400	210-400																														
.063" (1/16")	300-500	300-500																														
CROSS-REFERENCE TO COMPETITIVE METAL-CORED WIRES ESAB CORE WELD 70, 71 LINCOLN OUTERSHIELD MC710XL HOBART - NA TRI-MARK METALLOY 70X	CROSS-REFERENCE TO COMPETITIVE METAL-CORED WIRES ESAB CORE WELD ULTRA, COREWELD 70 LINCOLN OUTERSHIELD MC710 HOBART N/A TRI-MARK METALLOY 70, METALLOY 71	CROSS-REFERENCE TO COMPETITIVE METAL-CORED WIRES ESAB CORE WELD 70, 71 LINCOLN OUTERSHIELD MC710XL HOBART - NA TRI-MARK METALLOY 70X																														

FLUX AND METAL CORED WIRES

For Mild Steel

USA E70T - 1 EXTRA AWS A5.20 CLASSES E70T-1C/E70T-1M	USA E70T-5M AWS A5.20 CLASSES E70T-5M/E71T-5MJ	USA E71T-1 AWS A5.20 CLASS E71T-1C/E71T-1M
DESCRIPTION USA E70T-1 EXTRA is a basic slag formulation flux cored wire for single or multi-pass welds on mild steels and 490N/mm2 (71.000 psi) class high strength steels. USA 70T-1 EXTRA is noted for it high deposition properties. USA E70T-1 EXTRA also provides excellent arc stability at higher current levels. It provides low spatter, excellent bead appearance and ease of slag removal. USA E70T-1 EXTRA also meets the requirements of AWS E70T- 1M. It has been designed to provide excellent feed ability when used for larger fillet leg welds of heavy thickness plates using 100% CO2 or Argon-CO2 mixed shield gas.	DESCRIPTION USA E70T-5M is a basic slag formulation flux cored wire for single or multi-pass welds on mild steels and 490N/mm2 (71,000 psi) class high strength steels. USA E70T-5M is noted for its low temperature properties and excellent crack resistance. USA E70T-5M also provides low spatter, excellent bead appearance and ease of slag removal. USA E70T-5M also meets the requirements of AWS E71T-5 and E71T-5MJ. It has been designed to provide excellent feed ability when used for all position welds of light, medium and heavy thickness plates using 80% Argon + balance CO2 mixed shield gas. The deposit weld metal analysis is similar to an E7018 or E7018-1 Low Hydrogen Electrode.	DESCRIPTION USA E71T-1 is a special formulation flux cored wire for single or multi-pass all position welds on mild steels and 490N/mm2 (71,000 psi) class high strength steels. USA E71T-1 is noted for its low spatter, smooth arc and ease of slag removal. USA E71T-1 has been designed to provide excellent feed ability when used for all position welds of light medium and heavy thickness plates using 75-80% Arbon + balance CO2 mixed shield gas.
TYPICAL APPLICATIONS: USA E70T-1 EXTRA is used extensively in the fabrication of bridge structures, pressure vessels. earth moving equipment, general construction, and shipbuilding. USA E70T-1 EXTRA is ideal for heavy thickness mild steel fabrication.	TYPICAL APPLICATIONS: USA E70T-5M is used extensively in the fabrication of bridge structures, pressure vessels, earth moving equipment, general construction and ship- building. USA E70T-5M is ideal for medium to heavy thickness mild steel fabrication when crack resistance and superior toughness are required. USA E70T-5M is often used for joining mild steel to low alloy quenched and tempered high strength steels.	TYPICAL APPLICATIONS: USA E71T-1 is used extensively in the fabrication of bridge structures, pressure vessels, earth moving equipment, general construction, shipbuilding and whenever welds are required to meet structural and nuclear codes.
TYPICAL WELD METAL CHEMISTRY (% - tested with 100% CO2 Shield Gas) C 0.04 Mn 1.25 Si 0.41 P 0.014 S 0.011	TYPICAL WELD METAL CHEMISTRY % (% - tested with 80% Ar + bal. CO2 Shield Gas) C 0.04 Mn 1.30 Si 0.34 P 0.015 S 0.013	TYPICAL WELD METAL CHEMISTRY (% - tested with 100% CO2 Shield Gas) C 0.03 Mn 1.45 Si 0.30 P 0.015 S 0.010
TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (As welded - tested with 100% CO2 Shield Gas) Yield Point (psi) 78,000 psi Tensile Strength (psi) 82,000 psi % Elongation in 2" 29% Charpy V-Notch Impact 50J (37 Ft.Lbs. at -18°C)	TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (As welded - tested with 80% Ar + bal. CO2 Shield Gas) Yield Point (psi) 71,000 psi Tensile Strength (psi) 80,000 psi % Elongation in 2" 29% Charpy V-Notch Impact 50J (37 Ft.Lbs. at -29°C)	TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (As welded - tested with 100% CO2 Shield Gas) Yield Point (psi) 72,000 psi Tensile Strength (psi) 75,000 psi % Elongation in 2" 28% Charpy V-Notch Impact 75J (55 Ft.Lbs. at -18°C)
AVAILABLE SIZES AND RECOMMENDED CURRENTS (DCEP) Reverse Polarity - 100%CO2 Shield Gas SIZE Diameter (in.) FLAT HORIZ. FILLETS .045" 200-400 200-400 .063" (1/16") 300-500 300-500	AVAILABLE SIZES AND RECOMMENDED CURRENTS (DCEP) Reverse Polarity - 100% CO2 Shield Gas SIZE Diameter (in.) FLAT HORIZ.FILLETS .045" 200-400 200-400 .063" (1/16") 300-500 300-500	AVAILABLE SIZES AND RECOMMENDED CURRENTS (DCEP) Reverse Polarity - 100% CO2 Shield Gas SIZE Diameter (in.) FLAT HORIZ. FILLETS HORIZ. FILLETS .045" 120-300 120-300 120-250 .063" (1/16") 200-450 200-400 180-220
A wire stick-out of 5/8" to 1" should be used. PACKAGING: .045"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP* .063"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP* *Pail-Pac Drum	A wire stick-out of 5/8" to 1" should be used. PACKAGING: .045"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP* .063"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP* *Pail-Pac Drum	A wire stick-out of 5/8" to 1" should be used. PACKAGING: .045"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP* .063"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP* *Pail-Pac Drum
CROSS-REFERENCE TO COMPETITIVE WIRES ESAB DUAL SHIELD 70 LINCOLN OUTERSHIELD 70 HOBART FABCO TR70 TRI-MARK TM-11, TM-72	CROSS-REFERENCE TO COMPETITIVE WIRES ESAB DUAL SHIELD T-5 LINCOLN OUTERSHIELD 75H HOBART FABCO 85 TRI-MARK TM-55	CROSS-REFERENCE TO COMPETITIVE WIRES ESAB DUAL SHIELD II-71 ULTRA LINCOLN OUTERSHIELD 1M-H HOBART XL-550, EXCEL ARC 71 TRI-MARK TRIPLE 7, TM-711M, 771, 772



FLUX AND METAL CORED WIRES

For Mild Steel

USA E71T-1 LF AWS A5.20 CLASSES E 71T-1C/E71T-1M

DESCRIPTION

USA E71T-1 LF is a special formulation flux cored wire for single or multi-pass all position welds on mild steels and 490N/mm² (71,000 psi) class high strength steels. USA E71T-1 LF is noted for its low fume generation, low spatter, and ease of slag removal. USA E71T-1 LF has been designed to provide excellent feed ability when used for all position welds of light, medium and heavy thickness plates using 100% CO₂ or 75-80% Ar + balance CO₂ shield gas.

TYPICAL APPLICATIONS:

USA E71T-1 is used extensively in the fabrication of bridge structures, pressure vessels, earth moving equipment, general construction, shipbuilding and whenever welds are required to meet structural and nuclear codes.

TYPICAL WELD METAL CHEMISTRY

(% - tested with 100% CO₂ Shield Gas)

C	0.03
Mn	1.45
Si	0.30
P	0.015
S	0.010

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT

(As welded - tested with 100% CO₂ Shield Gas)

Yield Point (psi)	74,000 psi
Tensile Strength (psi)	80,000 psi
% Elongation in 2"	28%
Charpy V-Notch Impact	60J (44 Ft.Lbs. at -18°C)

AVAILABLE SIZES AND RECOMMENDED CURRENTS (DCEP)

Reverse Polarity - 100%CO₂ Shield Gas

SIZE Diameter (in.)	FLAT	HORIZ. FILLETS	VERT.
.045"	120-300	120-300	120-250
.063" (1/16")	200-450	200-400	180-220

A wire stick-out of 5/8" to 1" should be used.

PACKAGING:

.045"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP*
.063"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP*
*Pail-Pac Drum

CROSS-REFERENCE TO COMPETITIVE WIRES

ESAB DUAL CORE WELD 70, 71
LINCOLN OUTERSHIELD 70, 70-h, HD70
HOBART FABCO 81, 90, RXR, 86
TRI-MARK TM-11, TM1 HE, TM 72, TMEX7

USA E71T-1M AWS A5.20 CLASSES E 71T-1C/E71T-1M

DESCRIPTION

USA E71T-1M is a special formulation flux cored wire for single or multi-pass welds on mild steels and 490N/mm² class (71,000 psi) high strength steels. USA E71T-1M is noted for its low spatter, smooth arc and ease of slag removal. USA E71T- 1M has been designed to provide excellent feed ability when used for all position welds of light, medium and heavy thickness plates using 100% CO₂ or 75-80% Argon + balance CO₂ mixed shield gas.

TYPICAL APPLICATIONS:

USA E71T-1M is used extensively in the fabrication of bridge structures, pressure vessels, earth moving equipment, general construction, shipbuilding and whenever welds are required to meet structural and nuclear codes.

TYPICAL WELD METAL CHEMISTRY

(% - tested with 100% CO₂ Shield Gas)

C	0.03
Mn	1.45
Si	0.30
P	0.015
S	0.010

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT

(As welded - tested with 100% CO₂ Shield Gas)

Yield Point (psi)	72,000 psi
Tensile Strength (psi)	80,000 psi
% Elongation in 2"	28%
Charpy V-Notch Impact	75J (55 Ft.Lbs. at -18°C)

AVAILABLE SIZES AND RECOMMENDED CURRENTS (DCEP)

Reverse Polarity - 100% CO₂ Shield Gas

SIZE Diameter (in.)	FLAT	HORIZ. FILLETS	VERT.
.045"	120-300	120-300	120-250
.063" (1/16")	200-450	200-400	180-220

A wire stick-out of 5/8" to 1" should be used.

PACKAGING:

.045"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP*
.063"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP*
*Pail-Pac Drum

CROSS-REFERENCE TO COMPETITIVE WIRES

ESAB DUAL SHIELD 7000, 7100.1170, 1171, 1170T-12
LINCOLN OUTERSHIELD 71, 71M, 71M-H, 712C, 71HYC
HOBART FABCO 802, 825. XL-525
TRI-MARK TM71, 71-M, 711, 711M, 771, RX71

USA E71T-GS AWS A5.20 CLASS E 71T-GS

DESCRIPTION

USA E71T-GS is self-shielding flux cored wire for single pass all-position welds on mild steels used for field construction, erection and repair. It is often used for fabrication of mild steel sheet metal where secondary shielding gas is not practical. USA E71T-GS is used to weld mild steels and it finds acceptance for use in fabrication and repair welds on thin mild steel and galvanized steel. USA E71T- GS is noted for its smooth, stable arc, full slag coverage, low spatter generation, ease of slag removal and excellent weld bead appearance. It has relatively light penetration and tolerates rust, dirt, and oil on the work piece. The weld deposit resembles that of E6011 Electrodes.

TYPICAL APPLICATIONS:

USA E71T-GS is used extensively in maintenance for the fabrication, erection and repair of mild steel sheetmetal and is used in applications where secondary shield gas is not practical. The weld deposits are smooth and have light penetration helping to eliminate burn-throughs. The use of USA E71T-GS should be limited to non-structural applications only. USA E71T-GS is noted for its smooth arc and low spatter.

TYPICAL WELD METAL CHEMISTRY

(% - tested with 100% CO₂ Shield Gas)

C	0.16
Mn	0.82
Si	0.31
Al	1.3
P	0.014
S	0.005

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT

(As welded)

Traverse Tension Test	75,000 psi
Longitudinal Guided Bend Test	No Defects
% Elongation in 2"	22%

AVAILABLE SIZES AND RECOMMENDED CURRENTS (DCEP)

Reverse Polarity

SIZE Diameter (in.)	FLAT	HORIZ. FILLETS	VERT.
.035"	60-180	60-180	50-140
.045"	80-200	80-200	80-160
.063" (1/16")	160-270	160-270	120-220

A wire stick-out of 5/8" to 1" should be used.

PACKAGING:

.035"x10 Lb., 33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP*
.045"x10 Lb., 33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP*
.063"x10 Lb., 33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP*
*Pail-Pac Drum

CROSS-REFERENCE TO COMPETITIVE WIRES

ESAB CORE SHIELD 15
LINCOLN INNERSHIELD NR151, NR 152
HOBART FABSHIELD 23
TRI-MARK TM-123

FLUX AND METAL CORED WIRES

For Mild Steel

USA E71T-11 AWS A5.20 CLASSES E 71T-11	USA E71T-W AWS A5.29 CLASS E 71T-W																													
DESCRIPTION USA E71T-11 is a self-shielding flux cored wire for single or limited multi-pass all-position welds on mild steels used for field construction, erection and fabrication of bridges and shipbuilding where secondary shielding gas is not practical. USA E71T-11 is used to weld mild steels and it finds acceptance for use in construction, bridges, structural fabrication, and ship building. USA E71T-11 is noted for its smooth, stable arc, full slag coverage, low spatter generation, ease of slag removal and excellent weld bead appearance.	DESCRIPTION USA E71T1-W is a titania slag formulation flux cored wire for single or multi-pass all-position welds on high tensile strength weathering steels and used for field construction, erection and fabrication of bridges and shipbuilding where post-weld painting is not done. USA E71T1-W is used to weld ASTM A588 and A242 grade weathering steels. It finds acceptance for use in construction, bridges, structural fabrication, offshore oil rig fabrication and shipbuilding. USA E71T1-W is noted for its smooth, stable arc, low spatter generation, ease of slag removal and excellent weld bead appearance. The shield gas can be either 100% CO ₂ or 75% Argon + 25% CO ₂ .																													
TYPICAL APPLICATIONS: USAE71T-11 is used extensively in the fabrication, erection and repair of structural fabrication of mild steels used in applications where secondary shield gas is not practical. The weld deposits are smooth and have good penetration. The use of USA E71T-11 should be designated for multi-pass welds on plate up to 3/8" (9.5mm) only. Welds above this thickness should not be contemplated, as the weld deposit chemistry does not maintain its mechanical properties when used for more than three passes. USA E71T-11 is noted for its smooth arc and minimum spatter. When used for horizontal fillet joints the weld bead has equal leg lengths, flat-faced fillets with fine ripples.	TYPICAL APPLICATIONS: USA E71T1-W is used extensively in the fabrication, erection and repair of structural fabrication of higher strength low alloy weathering steels used in unpainted post weld service. The weld deposits are smooth and have deep penetration. USA 71T1-W is noted for its smooth arc and minimum spatter. When used for horizontal fillet joints the weld bead has equal leg lengths, flat faced fillets with fine ripples.																													
TYPICAL WELD METAL CHEMISTRY (%) <table><tr><td>C</td><td>0.10</td></tr><tr><td>Mn</td><td>1.55</td></tr><tr><td>Si</td><td>0.10</td></tr><tr><td>Al</td><td>1.2</td></tr><tr><td>P</td><td>0.016</td></tr><tr><td>S</td><td>0.006</td></tr></table>	C	0.10	Mn	1.55	Si	0.10	Al	1.2	P	0.016	S	0.006	TYPICAL WELD METAL CHEMISTRY (% - tested with 100% CO ₂ Shield Gas) <table><tr><td>C</td><td>0.05</td></tr><tr><td>Mn</td><td>1.25</td></tr><tr><td>Si</td><td>0.54</td></tr><tr><td>Ni</td><td>0.45</td></tr><tr><td>Cr</td><td>0.55</td></tr><tr><td>Cu</td><td>0.42</td></tr><tr><td>P</td><td>0.013</td></tr><tr><td>S</td><td>0.010</td></tr></table>	C	0.05	Mn	1.25	Si	0.54	Ni	0.45	Cr	0.55	Cu	0.42	P	0.013	S	0.010	
C	0.10																													
Mn	1.55																													
Si	0.10																													
Al	1.2																													
P	0.016																													
S	0.006																													
C	0.05																													
Mn	1.25																													
Si	0.54																													
Ni	0.45																													
Cr	0.55																													
Cu	0.42																													
P	0.013																													
S	0.010																													
TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (As welded) <table><tr><td>Yield Point (psi)</td><td>72,000 psi</td></tr><tr><td>Tensile Strength (psi)</td><td>77,000 psi</td></tr><tr><td>% Elongation in 2"</td><td>22%</td></tr></table>	Yield Point (psi)	72,000 psi	Tensile Strength (psi)	77,000 psi	% Elongation in 2"	22%	TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (As welded - tested with 100% CO ₂ Shield Gas) <table><tr><td>Yield Point (psi)</td><td>75,000 psi</td></tr><tr><td>Tensile Strength (psi)</td><td>90,000 psi</td></tr><tr><td>% Elongation in 2"</td><td>28%</td></tr><tr><td>Charpy V-Notch Impact</td><td>50J (37 Ft.Lbs. at -30°C)</td></tr></table>	Yield Point (psi)	75,000 psi	Tensile Strength (psi)	90,000 psi	% Elongation in 2"	28%	Charpy V-Notch Impact	50J (37 Ft.Lbs. at -30°C)															
Yield Point (psi)	72,000 psi																													
Tensile Strength (psi)	77,000 psi																													
% Elongation in 2"	22%																													
Yield Point (psi)	75,000 psi																													
Tensile Strength (psi)	90,000 psi																													
% Elongation in 2"	28%																													
Charpy V-Notch Impact	50J (37 Ft.Lbs. at -30°C)																													
AVAILABLE SIZES AND RECOMMENDED CURRENTS (DCEP) Reverse Polarity <table><tr><td>SIZE Diameter (in.)</td><td>FLAT</td><td>HORIZ. FILLETS</td><td>VERT.</td></tr><tr><td>.035"</td><td>60-180</td><td>60-180</td><td>50-140</td></tr><tr><td>.045"</td><td>80-200</td><td>80-200</td><td>80-160</td></tr><tr><td>.063" (1/16")</td><td>160-270</td><td>160-270</td><td>120-220</td></tr></table> A wire stick-out of 5/8" to 1" should be used. PACKAGING: .035"x10 Lb., 33 Lb., 44 Lb. Spool 60 Lb. Coil, 500 Lb. PP* .045"x10 Lb., 33 Lb., 44 Lb. Spool 60 Lb. Coil, 500 Lb. PP* .063"x10 Lb., 33 Lb., 44 Lb. Spool 60 Lb. Coil, 500 Lb. PP* *Pail-Pac Drum	SIZE Diameter (in.)	FLAT	HORIZ. FILLETS	VERT.	.035"	60-180	60-180	50-140	.045"	80-200	80-200	80-160	.063" (1/16")	160-270	160-270	120-220	AVAILABLE SIZES AND RECOMMENDED CURRENTS (DCEP) Reverse Polarity - 100% CO ₂ Shield Gas <table><tr><td>SIZE Diameter (in.)</td><td>FLAT</td><td>HORIZ. FILLETS</td><td>VERT.</td></tr><tr><td>.045"</td><td>120-350</td><td>120-320</td><td>120-250</td></tr><tr><td>.063" (1/16")</td><td>200-450</td><td>200-400</td><td>180-220</td></tr></table> A wire stick-out of 5/8" to 1" should be used. PACKAGING: .045"x25 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP* .063"x25 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP* *Pail-Pac Drum	SIZE Diameter (in.)	FLAT	HORIZ. FILLETS	VERT.	.045"	120-350	120-320	120-250	.063" (1/16")	200-450	200-400	180-220	
SIZE Diameter (in.)	FLAT	HORIZ. FILLETS	VERT.																											
.035"	60-180	60-180	50-140																											
.045"	80-200	80-200	80-160																											
.063" (1/16")	160-270	160-270	120-220																											
SIZE Diameter (in.)	FLAT	HORIZ. FILLETS	VERT.																											
.045"	120-350	120-320	120-250																											
.063" (1/16")	200-450	200-400	180-220																											
CROSS-REFERENCE TO COMPETITIVE WIRES ESAB CORESHIELD 11 LINCOLN INNERSHIELD NR211 MP HOBART FABSHIELD 21B TRI-MARK TM-121	CROSS-REFERENCE TO COMPETITIVE WIRES ESAB DUAL SHIELD 88W, 8100-W LINCOLN OUTERSHIELD HOBART TRI-MARK																													



FLUX CORED WIRES

For Low Alloy Steel

USA E80T1-K2 AWS A5.29 CLASS E 80T1-K2

DESCRIPTION

USA E80T1-K2 is a titania slag formulation flux cored wire for single or multi-pass flat and horizontal fillet welds on 1% nickel or aluminum-killed steels used for low-temperature high-strength usage. USA E80T1-K2 wire is specially formulated to provide excellent low temperature impact properties when used to weld ASTM A302, A533 Class 1 and A537 steels. It finds acceptance for use in construction, bridges, structural fabrication, heavy equipment manufacture, offshore oil rig fabrication and shipbuilding. USA 80T1-K2 is noted for its smooth, stable arc, low spatter generation, ease of slag removal and excellent weld bead appearance. The shield gas recommended is 100% CO₂.

TYPICAL APPLICATIONS:

USA E80T1-K2 is used extensively in the fabrication, erection and repair of structural fabrication of higher strength low alloy steels used for low temperature service. The weld deposits are smooth and have deep penetration. USA E80T1-K2 is noted for its smooth arc and minimum spatter. When used for horizontal fillet joints the weld bead has equal leg lengths, flat faced fillets with fine ripples.

TYPICAL WELD METAL CHEMISTRY (% - tested with 100% CO₂ Shield Gas)

C	0.03
Mn	1.45
Si	0.45
Ni	1.54
P	0.013
S	0.010

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT

(As welded - tested with 100% CO₂ Shield Gas)

Yield Point (psi)	80,000 psi
Tensile Strength (psi)	93,000 psi
% Elongation in 2"	25%
Charpy V-Notch Impact	110J (81 Ft.Lbs. at -20°C)

AVAILABLE SIZES AND RECOMMENDED CURRENTS (DCEP)

Reverse Polarity - 100%CO₂ Shield Gas

SIZE	FLAT	HORIZ.	VERT.
Diameter (in.)	FILLETS	FILLETS	FILLETS
.045"	120-320	120-320	
.063" (1/16")	200-450	200-450	

A wire stick-out of 5/8" to 1" should be used.

PACKAGING:

.045"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP*
.063"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP*
*Pail-Pac Drum

CROSS-REFERENCE TO COMPETITIVE WIRES

ESAB DUAL SHIELD II 81-K2, DUAL SHIELD II 101-TM
LINCOLN OUTERSHIELD 81K2-H
HOBART-NA
TRI-MARKTM881K2

USA E81T1-K2 AWS A5.29 CLASS E81T1-K2

DESCRIPTION

USA E81T1-KW is a titania slag formulation flux cored wire for single or multi-pass flat and horizontal fillet welds on 1% nickel or aluminum-killed steels used for low-temperature high-strength usage. USA E81T1-KW wire is specially formulated to provide excellent low temperature impact properties when used to weld ASTM A302, A533 Class 1 and A537 steels. It finds acceptance for use in construction, bridges, structural fabrication, heavy equipment manufacture, offshore oil rig fabrication and shipbuilding. USA E81T1-K2 is noted for its smooth, stable arc, low spatter generation, ease of slag removal and excellent weld bead appearance. The shield gas recommended is 100% CO₂.

TYPICAL APPLICATIONS:

USA E81T1-K2 is used extensively in the fabrication, erection and repair of structural fabrication offhigher strength low alloy steels used for low temperature service. The weld deposits are smooth and have deep penetration. USA E81T1-K2 is noted for its smooth arc and minimum spatter. When used for horizontal fillet joints the weld bead has equal leg lengths, flat faced fillets with fine ripples.

TYPICAL WELD METAL CHEMISTRY (% - tested with 100% CO₂ Shield Gas)

C	0.03
Mn	1.45
Si	0.45
Ni	1.54
P	0.013
S	0.010

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT

(As welded - tested with 100% CO₂ Shield Gas)

Yield Point (psi)	81,000 psi
Tensile Strength (psi)	90,000 psi
% Elongation in 2"	25%
Charpy V-Notch Impact	74J (55 Ft.Lbs. at -30°C)

AVAILABLE SIZES AND RECOMMENDED CURRENTS (DCEP)

Reverse Polarity - 100% CO₂ Shield Gas

SIZE	FLAT	HORIZ.
Diameter (in.)	FILLETS	FILLETS
.045"	120-320	120-320
.063" (1/16")	200-450	200-450

A wire stick-out of 5/8" to 1" should be used.

PACKAGING:

.045"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP*
.063"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP*
*Pail-Pac Drum

CROSS-REFERENCE TO COMPETITIVE WIRES

ESAB DUAL SHIELD II 81-K2, DUAL SHIELD II 101-TM
LINCOLN OUTERSHIELD 81K2-H
HOBART-NA
TRI-MARK-NA

USA E81T1-Ni1 AWS A5.29 CLASS E 81T1-Ni1

DESCRIPTION

USA E81T1-Ni1 is a titania slag formulation flux cored wire for single or multi-pass flat or fillet welds on medium and heavy thickness 1% nickel steel plate used in petro-chemical construction, mining and earth-moving equipment, and for weathering steels where color-match is not required. USA E81T1-Ni1 is noted for its high disposition rates, low spatter generation, ease of slag removal and excellent weld bead appearance. The shield gas recommended is 100% CO₂.

TYPICAL APPLICATIONS:

USA E81T1-Ni is used extensively in the fabrication, erection and repair of structural fabrication of higher strength. Steels having a 70,000-80,000 psi tensile strength. The weld metal analysis of the deposit is similar to E8018-C3 low hydrogen electrodes. The weld deposits are smooth and have deep penetration. USA E81T1-Ni1 is noted for its smooth arc and minimum spatter. When used for horizontal fillet joints the weld bead has equal leg lengths, flat faced fillets with fine ripples.

TYPICAL WELD METAL CHEMISTRY (% - tested with 100% CO₂ Shield Gas)

C	0.145
Mn	1.17
Si	0.35
Ni	1.00
Mo	0.22
P	0.014
S	0.011

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT

(As welded - tested with 100% CO₂ Shield Gas)

Traverse Tension Test	82,000 psi
Tensile Strength (psi)	91,000 psi
% Elongation in 2"	21%
Charpy V-Notch Impact	68J (50 Ft.Lbs. at - 18°C)
	42J (31 Ft.Lbs. at - 29°C)

AVAILABLE SIZES AND RECOMMENDED CURRENTS (DCEP)

Reverse Polarity - 100% CO₂ Shield Gas

SIZE	FLAT	HORIZ.	VERT.
Diameter (in.)	FILLETS	FILLETS	FILLETS
.045"	120-320	120-320	120-250
.063" (1/16")	200-450	200-450	180-230

A wire stick-out of 5/8" to 1" should be used.

PACKAGING:

.045"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP*
.063"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP*
*Pail-Pac Drum

CROSS-REFERENCE TO COMPETITIVE WIRES

ESAB DUAL SHIELD 88-C3, DUAL SHIELD II 80 Ni1
LINCOLN OUTERSHIELD 81 Ni1H
HOBART XL-8Ni1
TRI-MARK TM-811NI

FLUX CORED WIRES

For Low Alloy Steel

USA E81T1-B2 AWS A5.29 CLASS E 81T1-B2

DESCRIPTION

USA E81T1-B2 is a titania slag formulation flux cored wire for single or multi-pass welds on 1.25% Cr 0.5% Mo steels used for high pressure steam pipes of boilers, oil refining processing equipment, pressure vessels and castings of the same alloy content. The weld deposits are designed to operate at high temperature service. The shield gas recommended is 100% CO₂.

PREHEAT AND POST WELD HEAT TREATMENT

A preheat of 200-350°C and a post-weld heat treatment of 680-730°C for 1 hour per inch of thickness followed by air cooling to ambient temperature is required.

TYPICAL APPLICATIONS:

USA E81T1-B2 is used extensively in the fabrication and repair of pressure vessels, petrochemical processing equipment, and piping systems. The weld metal analysis of the deposit is similar to E8018-B2 Low Hydrogen Electrodes. USA E81T1-B2 is also used to weld 0.5% Cr - 0.5% Mo, 1.0% Cr - 0.5% Mo, and 1.25% Cr - 0.5% Mo steels. The weld deposits are smooth and have deep penetration. USA E81T1-B2 is noted for its smooth arc and minimum spatter. When used for horizontal fillet joints the weld bead has equal leg lengths, flat faced fillets with fine ripples. This is an all-position wire and can also be used with Argon-CO₂ mixed shield gas.

TYPICAL WELD METAL CHEMISTRY (% - tested with 100% CO₂ Shield Gas)

C	0.04
Mn	1.08
Si	0.44
Cr	1.25
Mo	0.53
P	0.014
S	0.011

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT

(As welded - tested with 100% CO₂ Shield Gas)

Yield Point (psi)	77,000 psi
Tensile Strength (psi)	87,000 psi
% Elongation in 2"	29%

AVAILABLE SIZES AND RECOMMENDED CURRENTS (DCEP)

Reverse Polarity - 100%CO₂ Shield Gas

SIZE	FLAT	HORIZ. FILLETS	VERT.
Diameter (in.)			
.045"	120-340	120-340	120-250
.063" (1/16")	200-450	200-450	180-220

A wire stick-out of 5/8" to 1" should be used.

PACKAGING:

.045"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP*
.063"x33 Lb., 44 Lb. Spool, 60 Lb. Coil., 500 Lb. PP*
*Pail-Pac Drum

CROSS-REFERENCE TO COMPETITIVE WIRES

ESAB DUAL SHIELD ARC 88-CM, 8000-B2
LINCOLN OUTERSHIELD 81-B2H
HOBART-NA
TRI-MARK TM-811B2

USA E91T1-B3 AWS A5.29 CLASS E 91T1-B3

DESCRIPTION

USA E91T1-B3 is a titania slag formulation flux cored wire for single or multi-pass welds on 2.25% Cr 1.0% Mo steels used for high pressure steam pipes of boilers, power generation plant equipment, oil refining processing equipment, pressure vessels and castings of the same alloy content. The weld deposits are designed to operate at high temperature service. The shield gas recommended is 100% CO₂.

PREHEAT AND POST WELD HEAT TREATMENT:

A preheat of 200-350°C and a post-weld heat treatment of 680-730° C for 1 hour per inch of thickness followed by air cooling to ambient temperature is required.

TYPICAL APPLICATIONS:

USA E91T1-B3 is used extensively in the fabrication, erection and repair of pressure vessels, petrochemical processing equipment, and piping systems. The weld metal analysis of the deposit is similar to E9018-B3 Low Hydrogen Electrodes. The weld deposits are smooth and have deep penetration. USA E91T1-B3 is noted for its smooth arc and minimum spatter. When used for horizontal fillet joints the weld bead has equal leg lengths, flat faced fillets with fine ripples. This is an all-position wire and can also be used with Argon-CO₂ mixed shield gas.

TYPICAL WELD METAL CHEMISTRY (% - tested with 100% CO₂ Shield Gas)

C	0.045
Mn	1.18
Si	0.51
Cr	2.25
Mo	1.0
P	0.014
S	0.011

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT

(As welded - tested with 100% CO₂ Shield Gas)

Yield Point (psi)	77,000 psi
Tensile Strength (psi)	87,000 psi
% Elongation in 2"	24%

AVAILABLE SIZES AND RECOMMENDED CURRENTS (DCEP)

Reverse Polarity - 100% CO₂ Shield Gas

SIZE	FLAT	HORIZ. FILLETS	VERT.
Diameter (in.)			
.045"	120-340	120-340	120-250
.063" (1/16")	200-450	200-450	180-220

A wire stick-out of 5/8" to 1" should be used.

PACKAGING:

.045"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP*
.063"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP*
*Pail-Pac Drum

CROSS-REFERENCE TO COMPETITIVE WIRES

ESAB DUAL SHIELD ARC 98-CM, 9000-B3
LINCOLN OUTERSHIELD- NA
HOBART-NA
TRIMARK TM91B3, TM-911B3

USA E4140T-1 AISI/SAE 4140 (NO AWS CLASS)

DESCRIPTION

Washington Alloy USA 4140T-1 is a flux cored AISI 4140 type heat treatable low alloy steel wire with exceptionally good operating characteristics. USA4140T-1 produces dense, heat-treatable deposits with high tensile strength properties. USA 4140T-1 weld deposits match the hardening characteristics of AISI 4140 base metal. Weld deposits are approximately 44 Rockwell C as applied, and can be heat-treated producing a hardening up to Rockwell C55 with proper procedures.

TYPICAL MECHANICAL PROPERTIES

PWHT: Fully annealed, welded, post weld re-heat, oil quenched at 1600°F, then:

Yield Point (psi)	127,000	165,000
Tensile Strength (psi)	140,000	180,000
% Elongation in 2"	18%	16%
% Reduction of Area	32%	36%
Mo	0.22	
P	0.014	
S	0.011	

TYPICAL WELD METAL ANALYSIS (%) (% - tested with 100% Argon Shield Gas)

C	0.35
Mn	0.80
Si	0.50
P	0.012
S	0.014
Cr	0.75
Mo	0.33

TYPICAL APPLICATIONS:

USA 4140T-1 is commonly used to weld low-alloy heat-treatable AISI/SAE 4140 steel as well as steel castings with comparable hardening properties where the weld must match the heat-treating characteristic of the base metal. Typical applications are for build-up and repair of dies, forgings, and castings made from medium carbon, low alloy base metals such as AISI 4140 steel, when post-weld heat treatment or flame hardening is required.

AVAILABLE SIZES AND RECOMMENDED CURRENTS

100% CO₂ or 75% Argon/25% CO₂ Shield Gas

SIZE	.045"	1/16"	3/32"
Amps	160-200	200-250	375-425
Volts	24-28	23-25	26-29
Stickout	1/2"	3/4"	1"

RECOMMENDED PROCEDURE:

(As welded - tested with 100% CO₂ Shield Gas)

Preheat of 400-600°F with inter-pass temperature held at 400-600°F to prevent cracking. Use as short an arc as possible and deposit stringer beads. Peening the warm deposit while it is still forgeable is helpful to reduce stress build-up.

PACKAGING:

10 lb., 33 lb. Spool, 60 lb. Coil

FLUX AND METAL CORED WIRES

For Stainless Steel

USA E308T-1 AWS A5.22 CLASS E 308T1-1/-4	USA E308LT-1 AWS A5.22 CLASS E 308LT1-1/-4	USA E309T-1 AWS A5.22 CLASS E 309T1-1/-4
DESCRIPTION UUSA E308T-1 is a flux cored wire for single or multi-pass welds on stainless steels. USA E308T-1 is noted for its low spatter generation, excellent bead shape and appearance and ease of slag removal. It has very good deposit efficiency when used for flat and fillet welds of medium and heavy thickness plates. It has been designed to be used with 100% CO ₂ or 75-80% Argon + balance CO ₂ mixed shield gas. USA E308T-1 provides weld deposits with optimum ferrite content in its austenitic structure resulting in low susceptibility to cracking.	DESCRIPTION USA E308LT-1 is a flux cored wire for single or multi-pass welds on stainless steels. USA E308LT-1 is noted for its low spatter generation, excellent bead shape and appearance and ease of slag removal. It has very good deposit efficiency when used for flat and fillet welds of medium and heavy thickness plates. It has been designed to be used with 100% CO ₂ or 75-80% Argon + balance CO ₂ mixed shield gas. USA E308LT-1 provides weld deposits with optimum ferrite content in its austenitic structure resulting in low susceptibility to cracking. The extra low carbon content of USA E 308LT-1 provides excellent resistance to intergranular corrosion and stress corrosion cracking.	DESCRIPTION USA E309T-1 is a flux cored wire for single or multi-pass welds on stainless steels. USA E309T-1 is noted for its low spatter generation, excellent bead shape and appearance and ease of slag removal. It has very good deposit efficiency when used for flat and fillet welds of medium and heavy thickness plates. It has been designed to be used with 100% CO ₂ or 75-80% Argon + balance CO ₂ mixed shield gas. The high chromium and nickel content of USA E309T-1 provides weld deposits with scaling and heat resistance in addition to corrosion resistance.
TYPICAL APPLICATIONS: USA E308T-1 is used extensively in the fabrication of stainless steel structures, pressure vessels, tanks used in food processing, chemical, refinery and restaurant equipment. USA E308T-1 can be used to weld stainless steels of similar alloy composition including AISI 201, 202, 301, 302, 304, 305 and 308..	TYPICAL APPLICATIONS: USA E308LT-1 is used extensively in the fabrication of stainless steel structures, pressure vessels, tanks used in dairy, pulp and paper, textile dyeing, refinery and chemical equipment. The extra low carbon content reduces carbide precipitation. USA E308LT-1 can be used to weld stainless steels of similar alloy composition including AISI 304L, 308L, 321 and 347 and whenever welds are required to meet structural and intergranular corrosion resistance requirements	TYPICAL APPLICATIONS: USA E309T-1 is used extensively in the fabrication of type 309 stainless steel structures, furnace parts, high temperature containers, and aircraft heaters. USA E309T-1 may be used to weld straight chromium type stainless steels (ie: 12Cr 410) when pre-heat and post-heat treatment is not possible. USA E309T-1 may also be used to join stainless steels to mild steel and for stainless cladding of mild and low alloy steels.
TYPICAL WELD METAL CHEMISTRY (Tested with 80% Argon + 20%CO ₂ Shield Gas)	TYPICAL WELD METAL CHEMISTRY (% - Tested with 80% Argon+20% CO ₂ Shield Gas)	TYPICAL WELD METAL CHEMISTRY (% - Tested with 80% Argon + 20% CO ₂ Shield Gas)
C 0.04 Mn 1.08 Si 0.44 Cr 1.25 Ni 0.53	C 0.04 Mn 1.87 Si 0.75 Cr 19.50 Ni 10.30	C 0.04 Mn 1.93 Si 0.78 Cr 23.70 Ni 13.40
TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (As welded - tested with 80% Argon + 20% CO ₂ Shield Gas)	TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (As welded - tested with 80%Argon + 20% CO ₂ Shield Gas)	TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (As welded - tested with 80%Argon + 20% CO ₂ Shield Gas)
Tensile Strength (psi) 88,500 psi % Elongation in 2" 36%	Tensile Strength (psi) 88,500 psi % Elongation in 2" 36%	Tensile Strength (psi) 95,000 psi % Elongation in 2" 36%
AVAILABLE SIZES AND RECOMMENDED CURRENTS (DCEP) Reverse Polarity - 80% Argon 20% Shield Gas	AVAILABLE SIZES AND RECOMMENDED CURRENTS (DCEP) Reverse Polarity - 80% Argon 20% CO ₂ Shield Gas	AVAILABLE SIZES AND RECOMMENDED CURRENTS (DCEP) Reverse Polarity – 80% Argon 20% CO ₂ Shield Gas
SIZE FLAT HORIZ. Diameter (in.) FILLETS .045" 100-220 100-220 Electrode extension: 3/8"-5/8" .063" (1/16") 180-320 180-320 Electrode extension: ½"-1"	SIZE FLAT HORIZ. Diameter (in.) FILLETS .045" 100-220 100-220 Electrode extension: 3/8"-5/8" .063" (1/16") 180-320 180-320 Electrode extension: ½"-1"	SIZE FLAT HORIZ. Diameter (in.) FILLETS .045" 100-220 100-220 Electrode extension: 3/8"-5/8" .063" (1/16") 180-320 180-320 Electrode extension: ½"-1"
PACKAGING: .045"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP* .063"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP* *Pail-Pac Drum	PACKAGING: .045"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP* .063"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP* *Pail-Pac Drum Once opened, store in a dry place or rebake before reuse.	PACKAGING: .045"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP* .063"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP* *Pail-Pac Drum Once opened, store in a dry place or rebake before reuse.
CROSS-REFERENCE TO COMPETITIVE WIRES ESAB SHIELD-BRIGHT 308T-1 LINCOLN-N/A McKAY 308T-1 HARRIS WELCO 410NiMo SANDVIK 308T-1AP KOBELCO-N/A	CROSS-REFERENCE TO COMPETITIVE WIRES ESAB SHIELD-BRIGHT 308L, SHIELD-BRIGHT X-TRA 308L LINCOLN BLUE MAX FC-308L McKAY IN-FLUX STERLING 308L, IN FLUX 308L HARRIS WELCO 308L SANDVIK 308LT1AP KOBELCO DW-308L DW-308LP TECHALLOY-N/A NAT'L STANDARD 308L	CROSS-REFERENCE TO COMPETITIVE WIRES ESAB – N/A LINCOLN – N/A McKAY – N/A HARRIS WELCO – N/A SANDVIK – N/A KOBELCO - N/A TECHALLOY - N/A NAT'L STANDARD - N/A

FLUX AND METAL CORED WIRES

For Stainless Steel

USA EC309L AWS A5.9 CLASS EC309L

DESCRIPTION

USA EC309L is a metal cored wire for single pass welds on thin stainless steel sheet. USA EC 309L is noted for its low spatter generation, excellent bead shape and appearance and freedom from slag removal. It has very good deposit efficiency when used for flat and fillet welds of medium and heavy thickness plates. It has been designed to be used with 100% CO₂ or Argon + 2% Oxygen mixed shield gas. USA EC 309L provides weld deposits with excellent corrosion and porosity resistance along with superior heat resistance. The extra low carbon content of USA EC309L provides excellent resistance to intergranular corrosion and stress corrosion cracking.

TYPICAL WELD METAL CHEMISTRY (Tested with Argon + 2% O₂ Shield Gas)

C	0.03
Mn	1.57
Si	0.48
Cr	23.95
Ni	12.40

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT

(As welded - tested with Argon + 2% CO₂ Shield Gas)

Tensile Strength (psi)	81,500 psi
% Elongation in 2"	40%

AVAILABLE SIZES AND RECOMMENDED CURRENTS (DCEP)

Reverse Polarity - Argon + 2% O₂ Shield Gas

SIZE	FLAT	HORIZ. FILLET
Diameter (in.)		
.045"	140-220	140-220
Electrode extension: 3/8"-5/8"		
.063" (1/16")	180-260	180-260
Electrode extension: 1/2"-1"		

PACKAGING:

.045"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP*
.063"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP*
*Pail-Pac Drum

CROSS-REFERENCE TO COMPETITIVE WIRES

ESAB SHIELD BRIGHT 309L, SHIELD BRIGHT X-TRA 309L
LINCOLN BLUE MAX FC-309L
McKAY IN-FLUX STERLING 309L TO-4/1, 309LT1-1/4
HARRIS WELCO 309LT1-1
KOBELCO DW-309L
SANDVIK 309L TO-1/4, 309LT1AP
KOBELCO DW-309L
TECHALLOY - N/A
NAT'L STANDARD 309LT0-1

USA E309LMo AWS A5.22 CLASS E309LMoT0-1/-4

DESCRIPTION

USA E309LMoT0-1/-4 is a flux cored wire for single or multi-pass welds when joining dissimilar steels including those containing Molybdenum, to carbon steels. USA E309LMoT0-1/-4 is also used for the first pass deposits in cladding operations using AISI type 316 and 316L filter metals. USA E309LMoT0-1/-4 may also be used to provide a low carbon 22% Cr-12% Ni, 2% Mo all-weld deposit. USA E309LMoT0-1/-4 is noted for its low spatter generation, excellent bead shape and appearance and ease of slag removal. It has very good deposit efficiency when used for flat and fillet welds of medium and heavy thickness plates. It has been designed to be used with 100% CO₂ shield gas. USA E309LMoT0-1/-4 provides weld deposits with excellent corrosion and porosity resistance along with superior heat resistance. The extra low carbon content of USA E309LMoT0-1/-4 provides excellent resistance to intergranular corrosion and stress corrosion cracking.

TYPICAL APPLICATIONS:

USA E309LMoT0-1/-4 is used extensively in the fabrication of stainless steel automobile muffler and exhaust systems made of AISI stainless types 409 and 436. USA E309LMoT0-1/-4 may be used to weld straight chromium type stainless steels (ie: 12Cr 410) when pre-heat and post-heat treatment is not possible. USA E309LMoT0-1/-4 may also be used to join stainless steels to mild steel and for stainless cladding of mild and low alloy steels. Because of its low spatter generation, this wire is an excellent choice for robotic welding applications.

TYPICAL WELD METAL CHEMISTRY (% - Tested with 100% CO₂ Shield Gas)

C	0.03
Mn	1.30
Si	0.45
Cr	23.70
Ni	13.00
Mo	2.70

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT

(As welded - tested with 100% CO₂ Shield Gas)

Tensile Strength (psi)	97,500 psi
% Elongation in 2"	32%

AVAILABLE SIZES AND RECOMMENDED CURRENTS (DCEP)

Reverse Polarity - 100% CO₂ Shield Gas

SIZE	FLAT	HORIZ. FILLET
Diameter (in.)		
.045"	100-220	100-220
Electrode extension: 3/8"-5/8"		
.063" (1/16")	180-320	180-320
Electrode extension: 1/2"-1"		

PACKAGING:

.045"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP*
.063"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP*
*Pail-Pac Drum

CROSS-REFERENCE TO COMPETITIVE WIRES

ESAB - N/A
LINCOLN - N/A
McKAY - N/A
HARRIS WELCO - N/A
SANDVIK 309MoLT0-1, 309MoLT1-1
TECHALLOY - N/A, NAT'L STANDARD - N/A

USA E312T-1 AWS A5.22 CLASS E312T1-1/-4

DESCRIPTION

USA E312T-1 is a flux cored AISI 312 type stainless steel alloy wire with exceptionally good operating characteristics. USA E312T-1 produces dense, tough deposits having the highest tensile strength of any of the austenitic stainless steels. USA E312T-1 weld deposits match the characteristics and mechanical properties of AISI 312 base metal. Weld deposits are approximately 23 Rockwell C as applied. Machining should be done with slow feed rates as the weld deposits will work-harden up to 38 RC. USA E312T-1 deposits are resistant to heat, corrosion and wear. The unique metallurgical structure of USA E312T-1 is that of ferrite suspended in an austenite matrix. This makes the deposits extremely resistant to cracking.

TYPICAL APPLICATIONS:

USA E312T-1 is used to weld base metals of similar analysis as well as dissimilar steels. USA E312T-1 performs well on abrasion-resisting steels, manganese steels, hardening steels, spring steels, armor plate, high-yield steels and for joining high temperature steels to carbon and low alloy steels. USA E312T-1 is also an excellent choice as an underlayer (buffer layer) for hard facing deposits.

TYPICAL WELD METAL ANALYSIS (%) (Tested with DCRP, 100% CO₂ Shield Gas)

C	0.12
Mn	1.70
Si	0.50
Cr	29.50
Ni	9.50

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT

Yield Point (psi)	90,000
Tensile Strength (psi)	122,000
% Elongation in 2"	35%
Hardness (RC)	23 RC

AVAILABLE SIZES AND RECOMMENDED CURRENTS

100%CO₂or 75% Ar - 25% CO₂ Shield Gas

Size:	.045"	1/16"
Amps	130-180	160-250
Volts	25-30	24-29
Stick-out	1/2"	3/4"

RECOMMENDED PROCEDURE

Preheat is generally not required. On high carbon or high alloy steels a pre-heat of 350-400°F with inter-pass temperature held at the same heat helps to prevent under-bead cracking. Use as short an arc as possible and deposit stringer beads. Peening the warm deposit while it is still forgeable is helpful to reduce stress build-up.

PACKAGING:

10lb., 33lb. Spool, 60 lb. Coil



FLUX AND METAL CORED WIRES

For Stainless Steel

USA E316T-1 AWS A5.22 CLASS E 316T1-1/-4

DESCRIPTION

USA E316T-1 is a flux cored wire for single or multi-pass welds on stainless steels. USA E316T-1 is noted for its low spatter generation, excellent bead shape and appearance and ease of slag removal. It has very good deposit efficiency when used for flat and fillet welds of medium and heavy thickness plates. It has been designed to be used with 100% CO₂ or 75-80% Argon + balance CO₂ mixed shield gas. USA E316T-1 provides weld deposits with optimum ferrite content in its austenitic structure resulting in low susceptibility to cracking.

TYPICAL APPLICATIONS:

USA E316T-1 is used extensively in the fabrication of stainless steel structures, pressure vessels, tanks used in food processing, chemical, refinery, photographic and restaurant industries. USA E316T-1 may be used to weld stainless steels of similar alloy composition where the higher corrosion resistance and higher creep strength of this alloy comprised of 18% Cr, 12% Ni and 2.5% Mo are required.

TYPICAL WELD METAL CHEMISTRY

(Tested with 80% Argon+20% CO₂ Shield Gas)

C	0.05
Mn	1.47
Si	0.60
Cr	18.40
Ni	11.50
Mo	2.50

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT

(As welded - tested with 80% Argon + 20% CO₂ Shield Gas)

Tensile Strength (psi)	88,500 psi
% Elongation in 2"	37%

AVAILABLE SIZES AND RECOMMENDED CURRENTS (DCEP)

Reverse Polarity-80% Argon 20% CO₂Shield Gas

SIZE Diameter (in.)	FLAT	HORIZ. FILLETS
.045"	100-220	100-220
Electrode extension: 3/8"-5/8"		
.063" (1/16")	180-320	180-320
Electrode extension: 1/2"-1"		

PACKAGING:

.045"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP*
.063"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP*
*Pail-Pac Drum

CROSS-REFERENCE TO COMPETITIVE WIRES

ESAB - N/A
LINCOLN - N/A
McKAY - N/A
HARRIS WELCO - N/A
SANDVIK - N/A
TECHALLOY - N/A
NAT'L STANDARD 316TO-1

USA E316LT-1 AWS A5.22 CLASS E 316LT1-1/-4

DESCRIPTION

USA E316LT-1 is a flux cored wire for single or multi-pass welds on stainless steels. USA E316LT-1 is noted for its low spatter generation, excellent bead shape and appearance and ease of slag removal. It has very good deposit efficiency when used for flat and fillet welds of medium and heavy thickness plates. It has been designed to be used with 100% CO₂ or 75-80% Argon + balance CO₂ mixed shield gas. USA E316LT-1 provides weld deposits with optimum ferrite content as its austenitic structure resulting in low susceptibility to cracking. The extra low carbon content of USA E316LT-1 provides excellent resistance to inter- granular corrosion and stress corrosion cracking caused by carbide precipitation.

TYPICAL APPLICATIONS:

USA E316LT-1 is used extensively in the fabrication of 18% Cr 12% Ni 2% Mo stainless steel structures, pressure vessels, tanks in dairy, pulp and paper, textile dyeing, refinery and chemical equipment. The extra low carbon content reduces carbide precipitation. USA E316LT-1 can be used to weld stainless steels of similar compositions when welds are required to meet higher corrosion resistance and higher creep strength requirements along with intergranular corrosion resistance requirements.

TYPICAL WELD METAL CHEMISTRY

(Tested with 80% Argon + 20% CO₂ Shield Gas)

C	0.30
Mn	1.85
Si	0.75
Cr	18.70
Ni	11.40
Mo	2.50

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT

(As welded - tested with 80% Argon + 20% CO₂ Shield Gas)

Tensile Strength (psi)	90,000 psi
% Elongation in 2"	36%

AVAILABLE SIZES AND RECOMMENDED CURRENTS (DCEP)

Reverse Polarity -80%Argon 20% CO₂ Shield Gas

SIZE Diameter (in.)	FLAT	HORIZ. FILLETS
.045"	100-220	100-220
Electrode extension: 3/8"-5/8"		
.063" (1/16")	180-320	180-320
Electrode extension: 1/2"-1"		

PACKAGING:

.045"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP*
.063"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP*
*Pail-Pac Drum
Once opened, Store in a dry place or rebake before reuse.

CROSS-REFERENCE TO COMPETITIVE WIRES

ESAB SHIELD BRITE 316L SHIELD-BRIGHT X-TRA 316L
LINCOLN BLUE MAX FC-316L
McKAY IN-FLUX STERLING 316LT1-1/4
HARRIS WELCO 316LT-1
KOBELCO DW-316L DW316LT-1
SANDVIK 316LT0-1/4 316LT1-1/4
TECHALLOY-N/A
NAT'L STANDARD 316LT-1

USA E317LT-1 AWS A5.22 CLASS E 317LT1-1/-4

DESCRIPTION

USA E317LT-1 is a flux cored wire for single or multi-pass welds on stainless steels. USA E317LT-1 is noted for its low spatter generation, excellent bead shape and appearance and ease of slag removal. It has very good deposit efficiency when used for flat and fillet welds of medium and heavy thickness plates. It has been designed to be used with 100% CO₂ shield gas. USA E317LT-1 provides weld deposits with optimum ferrite content as its austenitic structure resulting in low susceptibility to cracking. The extra low carbon content of USA E317LT-1 provides excellent resistance to inter- granular corrosion and stress corrosion cracking caused by carbide precipitation. USA E317LT-1 also provides excellent resistance to pitting corrosion due to its higher Molybdenum content compared to USA316LT-1

TYPICAL APPLICATIONS:

USA E317LT-1 is used extensively in the fabrication of AISI type 317 stainless steel structures, pressure vessels, and tanks in dairy, pulp and paper, textile dyeing, refinery and chemical equipment. The extra low carbon content reduces carbide precipitation. USA E317LT-1 can be used to weld stainless steels of similar compositions when welds are required to meet higher resistance requirements. One key advantage of USA E317LT-1 is its excellent resistance to pitting corrosion in chlorine environments. It is also used for pollution control equipment where the corrosive attack is too severe for USA E316LT-1 filler metal.

TYPICAL WELD METAL CHEMISTRY

(Tested with 100% CO₂ Shield Gas)

C	0.30
Mn	1.85
Si	0.75
Cr	18.70
Ni	11.40
Mo	2.50

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT

(As welded - tested with 100% CO₂ Shield Gas)

Tensile Strength (psi)	88,500
% Elongation in 2"	33%

AVAILABLE SIZES AND RECOMMENDED CURRENTS (DCEP)

Reverse Polarity - 100% CO₂Shield Gas

SIZE Diameter (in.)	FLAT	HORIZ. FILLETS
.045"	100-220	100-220
Electrode extension: 3/8"-5/8"		
.063" (1/16")	180-320	180-320
Electrode extension 1/2" - 1"		

PACKAGING:

.045"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP*
.063"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP*
*Pail-Pac Drum

Once opened, Store in a dry place or rebake before reuse

CROSS-REFERENCE TO COMPETITIVE WIRES

ESAB SHIELD BRITE 317L
LINCOLN - N/A
McKAY IN-FLUX 317L-T1
HARRIS WELCO - N/A
SANDVIK 317LT0-1/4 317LT1-1/4
TECHALLOY - N/A
NAT'L STANDARD 317LT1-1/4

FLUX AND METAL CORED WIRES

For Stainless Steel

USA E347T0-1 AWS A5.22 CLASS E 347T0-1

DESCRIPTION

USA E347T0-1 is a flux cored wire for single or multi-pass welds on AISI types 304, 304L, 321 and 347 stainless steels. USA E347T0-1 is noted for its low spatter generation, excellent bead shape and appearance and ease of slag removal. It has very good deposit efficiency when used for flat and fillet welds of medium and heavy thickness plates. It has been designed to be used with 100% CO₂ shield gas. The columbium content of USA E347T0-1 provides weld deposits with improved resistance to chromium carbide precipitation and improved corrosion resistance as well as improved strength at higher temperatures.

TYPICAL APPLICATIONS:

USA E347T0-1 is used extensively in the fabrication of AISI types 321 and 347 stainless steel structures, pressure vessels, tanks in dairy, pulp and paper, textile dyeing, refinery and chemical equipment. The extra low carbon content reduces carbide precipitation. USA E347T0-1 can be used to weld stainless steels of similar compositions when welds are required to meet higher corrosion resistance and higher creep strength requirements along with intergranular corrosion resistance requirements

TYPICAL WELD METAL CHEMISTRY (Tested with 100% CO₂ Shield Gas)

C	0.05
Mn	1.75
Si	0.83
Cr	19.50
Ni	10.50
Cb	0.54

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT

(As welded - tested with 100%CO₂ Shield Gas)

Tensile Strength (psi)	98,500
% Elongation in 2"	34%

AVAILABLE SIZES AND RECOMMENDED CURRENTS (DCEP)

Reverse Polarity – 100% CO₂Shield Gas

SIZE	FLAT	HORIZ.
Diameter (in.)	FILLETS	
.045"	100-220	100-220
	Electrode extension: 3/8"-5/8"	
.063" (1/16")	180-320	180-320
	Electrode extension: 1/2"-1"	

PACKAGING:

.045"x25 Lb., 33 Lb. Spool, 60 Lb. Coil, 500 Lb. PP*
.063"x25 Lb., 33 Lb. Spool, 60 Lb. Coil, 500 Lb. PP*
*Pail-Pac Drum

CROSS-REFERENCE TO COMPETITIVE WIRES

ESAB CORE-BRIGHT347
LINCOLN – N/A
McKAY – N/A
HARRIS WELCO – N/A
SANDVIK 347T0-1/4, 347T1-1/4
TECHALLOY – N/A
NAT'L STANDARD 347

USA EC409TiT AWS A5.9 CLASS EC409

DESCRIPTION

USA EC409TiT is a metal cored wire for single pass welds on thin stainless steel sheet. USA EC409TiT is noted for its low spatter generation, excellent bead shape and appearance and freedom from slag removal. It has very good deposit efficiency when used for flat and fillet welds of medium and heavy thickness plates. It has been designed to be used with 100% Argon or Argon + 2% Oxygen mixed shield gas. USA EC409TiT provides weld deposits with excellent corrosion and porosity resistance along with superior heat resistance.

TYPICAL APPLICATIONS:

USA EC409TiT is used extensively in the fabrication of stainless steel automobile muffler and exhaust systems made of AISI stainless types 409 and 436. USA EC409TiT may be used as a low cost hard surfacing alloy for mild and low alloy steels. The addition of Titanium to the alloy formulation acts as a de-oxidizer which smoothes and flattens the weld bead. Because of its low spatter generation, this wire is an excellent choice for robotic welding applications.

TYPICAL WELD METAL CHEMISTRY (Tested with Argon + 2% O₂ Shield Gas)

C	0.05
Mn	0.45
Si	0.50
Cr	12.10
Ti	0.70

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT

(As welded - tested with Argon + 2% O₂ Shield Gas)

Tensile Strength (psi)	81,500 psi
% Elongation in 2"	17%

AVAILABLE SIZES AND RECOMMENDED CURRENTS (DCEP)

Reverse Polarity–Argon 2% O₂ Shield Gas

SIZE	FLAT	HORIZ.
Diameter (in.)	FILLETS	
.045"	140-220	140-220
	Electrode extension: 3/8"-5/8"	
.063" (1/16")	180-250	180-250
	Electrode extension: 1/2"-1"	

PACKAGING:

.045"x25 Lb., 33 Lb. Spool, 60 Lb. Coil, 500 Lb. PP*
.063"x25 Lb., 33 Lb. Spool, 60 Lb. Coil, 500 Lb. PP*
*Pail-Pac Drum
Once opened, Store in a dry place or rebake before reuse.

CROSS-REFERENCE TO COMPETITIVE WIRES

ESAB – N/A
LINCOLN – N/A
McKAY – N/A
HARRIS WELCO – N/A
SANDVIK – N/A
TECHALLOY – N/A
NAT'L STANDARD – N/A

USA E410T0-1 AWS A5.22 CLASS E410T0-1/-4

DESCRIPTION

USA E410T0-1 is a flux cored wire for single or multi-pass welds on stainless steels. USA E410T0-1 is noted for its low spatter generation, excellent bead shape and appearance and ease of slag removal. It has very good deposit efficiency when used for flat and fillet welds of medium and heavy thickness plates. It has been designed to be used with 100% CO₂ or 75-80% Argon + balance CO₂ mixed shield gas. USA E410T0-1 provides hard as- welded deposits with optimum abrasion resistance. When used as a overlay material cross-check cracking is to be expected as this is how the deposit stress relieves itself.

TYPICAL APPLICATIONS:

USA E410T0-1 is used extensively in the fabrication of 12% Cr stainless steel structures, pressure vessels, tanks used in dairy, pulp and paper, textile dyeing, refinery and chemical equipment. When used to weld AISI types 404, 405, and 410 pre-heat and post-weld heat treatment is required.

TYPICAL WELD METAL CHEMISTRY (Tested with 80% Argon + 20% CO₂ Shield Gas)

C	0.70
Mn	0.69
Si	0.32
Cr	13.20

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT

(As welded – tested with 80% Argon + 20% CO₂ Shield Gas)

Tensile Strength (psi)	82,500
% Elongation in 2"	28%

AVAILABLE SIZES AND RECOMMENDED CURRENTS (DCEP)

Reverse Polarity – 80% Argon 20% CO₂Shield Gas

.045"	100-220	100-220
	Electrode extension: 3/8"-5/8"	
.063" (1/16")	180-270	180-270
	Electrode extension 1/2" – 1"	

PACKAGING:

.045"x25 Lb., 33 Lb. Spool, 60 Lb. Coil, 500 Lb. PP*
.063"x25 Lb., 33 Lb. Spool, 60 Lb. Coil, 500 Lb. PP*
*Pail-Pac Drum
Once opened, Store in a dry place or rebake before reuse.

CROSS-REFERENCE TO COMPETITIVE WIRES

ESAB – N/A
LINCOLN – N/A
McKAY – N/A
HARRIS WELCO – N/A
SANDVIK – N/A
TECHALLOY – N/A
NAT'L STANDARD 410NiMo



FLUX AND METAL CORED WIRES

For Stainless Steel

USA E410NiMoT0-4 AWS A5.22 CLASS E410NiMoT0-4

DESCRIPTION

USA E410NiMoT0-4 is a flux-cored wire for single or multi-pass welds on multi-pass welds on AISI types 403, 405, 410 and 420 and for welding CA-6NM castings stainless steels. USA E410NiMoT0-4 is noted for its low spatter generation, excellent bead shape and appearance and ease of slag removal. It has very good deposit efficiency when used for flat and fillet welds of medium and heavy thickness plates. It has been designed to be used with 80% Argon + 20% CO₂ mixed shield gas. USA E410NiMoT0-4 provides hard as-welded deposits with optimum abrasion resistance. When used as an overlay material cross-check cracking is to be expected as this is how the deposit stress relieves itself.

TYPICAL APPLICATIONS:

USA E410NiMoT0-4 is used extensively in the fabrication of 12% Cr, 4.5% Ni, and 0.5% Mo stainless steel structures. Typically, this alloy is used in fabricating and repairing hydroelectric turbines. When used to weld AISI types 404, 406 and 410 pre-heat and post-weld heat treatment is required. With correct procedures, hardness levels of less than 23 Rockwell C are possible. The deposit is fully martensitic and the hardness and tensile strength depend on the post-weld heat treatment procedures used. A stress relief of 600°C (1,115°F) for one hour is recommended to obtain maximum tensile strength.

TYPICAL WELD METAL CHEMISTRY

(Tested with 80% Argon + 20% CO₂ Shield Gas)

C	0.70
Mn	0.69
Si	0.32
Cr	13.20

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT

(As welded - tested with 80% Argon + 20% CO₂ Shield Gas)

Tensile Strength (psi)	125,500
% Elongation in 2"	25%

AVAILABLE SIZES AND RECOMMENDED CURRENTS (DCEP)

Reverse Polarity – 80% Argon 20% CO₂ Shield Gas

SIZE	FLAT	HORIZ. FILLETS
Diameter (in.)		
.045"	100-220	100-220
Electrode extension: 3/8"-5/8"		
.063" (1/16")	180-270	180-270
Electrode extension: 1/2"-1"		

PACKAGING:

.045"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP*

.063"x33 Lb., 44 Lb. Spool, 60 Lb. Coil, 500 Lb. PP*

*Pail-Pac Drum

Once opened, store in dry place or rebake before reuse.

CROSS-REFERENCE TO COMPETITIVE

WIRES

ESAB - N/A
LINCOLN - N/A
McKAYIN-FLUX STERLING 410NiMo-T1
HARRIS WELCO 410NiMo
SANDVIK - N/A
TECHALLOY - N/A
NAT'L STANDARD 410NiMo

USA E630T0-1/-4 (17-4 PH) AWS A5.22 CLASSES E630T0-1/-4 (Formerly 17-4 PH)

DESCRIPTION

USA E630T0-1/-4 (17-4 PH) is a flux-cored AISI 17-4 type precipitation hardening stainless steel alloy wire with exceptionally good operating characteristics. The chemistry of USA E630T0-1/-4 is equivalent to the chemistry and mechanical requirements of AWS specifications for ER630 solid wire. USA E630T0-1/-4 is designed for welding materials of similar composition including ASTM A-564 type 17-4, 15-5, 15-7, and 17-7 precipitation hardening stainless steels

TYPICAL APPLICATIONS:

USA E630T0-1/-4 is extensively used for welding stainless steels of similar analysis including types 15-5 PH and 17-4 PH. Typical applications include welding of components for aerospace applications such as landing gear covers, fuel tanks, flexible bellows joints and for shipbuilding applications including pump parts, shafts, and rudder mounting brackets.

TYPICAL WELD METAL CHEMISTRY

(Tested with DCRP, 80% Argon + 20% CO₂ Shield Gas)

C	0.035
Mn	0.450
Si	0.400
P	0.012
S	0.011
Cr	17.250
Ni	4.210
Mo	0.550

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT

PWHT: 1875-1925°F for 30 minute solution anneal, followed by rapid cooling in air to room temperature. Reheat to aging temperature 900-1100°F then cool to room temperature.

Yield Point (psi)	178,000
Tensile Strength (psi)	200,000
% Elongation in 2"	10%

AVAILABLE SIZES AND RECOMMENDED CURRENTS

100% CO₂ or 75-80% Ar/20-25% CO₂ Shield Gas

Size:	.045"	1/16"
Amps	140-180	200-250
Volts	24-28	23-25
Stickout	1/2"	3/4"

PACKAGING:

10 lb., 25 lb. Spool, 60 lb. Coil

USA 2553T0-3 AWS A5.22 CLASSES E2553T0-3

DESCRIPTION

USA 2553T0-3 is a flux-cored super-duplex stainless steel alloy wire with exceptional resistance to pitting and crevice corrosion. It is used in joining process piping and equipment in the chemical and petrochemical industries. Washington Alloy 2553 FC is designed for joining Cabot Ferralium 255® when a minimum PREN (Pitting Resistance Equivalent Number) of 40 is required. USA 2553T0-3 is also used to join Carpenter 7-Mo-Plus® or Sandvik 2507® and other duplex and super-duplex stainless steels.

TYPICAL APPLICATIONS:

USA 2553T0-3 is designed to weld wrought, forged or cast super-duplex and duplex stainless steels in the solution treated condition. When welding any duplex or super-duplex stainless steel, it is important to insure that the material is cooled sufficiently rapidly after welding, particularly through the 1750°F to 1120°F range to avoid embrittlement. To insure that cooling takes place rapidly enough it is recommended that heat inputs be kept moderately low, and the inter-pass temperature between successive passes must be at no more than 250°F

TYPICAL WELD METAL CHEMISTRY

(Tested with DCRP)

(Tested with 80% Argon + 20% CO₂ Shield Gas)

C	0.035
Mn	1.000
Si	0.500
P	0.015
S	0.011
Cr	26.000
Ni	8.800
Mo	3.300
Cu	1.700
N	0.230

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT

Yield Point (psi)	100,000
Tensile Strength (psi)	130,000
% Elongation in 2"	18%
Charpy V-Notch @ -58°F	25 ft. lbs.

AVAILABLE SIZES AND RECOMMENDED CURRENTS

USA 2553T0-3 is a self-shielding (gasless) flux cored wire.

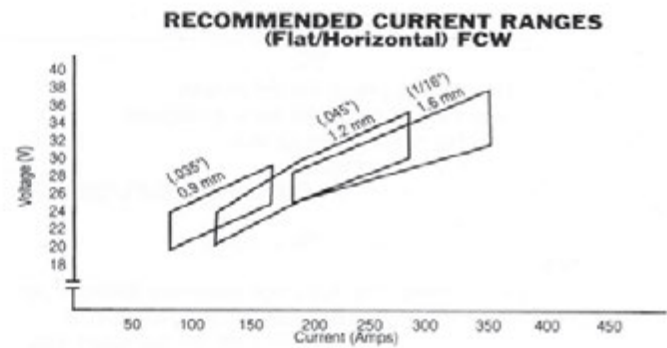
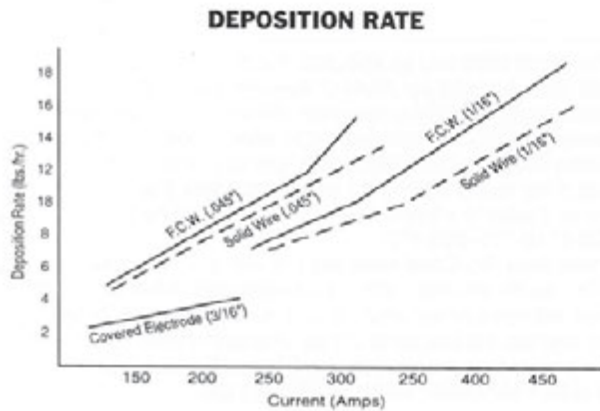
Size	.045"	1/16"
Amps	130-180	160-250
Volts	24-29	25-30
Stickout	1/2"	3/4"

PACKAGING:

10 lb., 25 lb. Spool, 60 lb. Coil

Ferralium 255® is a registered trademark of Cabot Corporation. Carpenter 7-Mo-Plus® is a registered trademark of Carpenter Technologies. Sandvik 2507® is a registered trademark of Sandvik Steel Co.

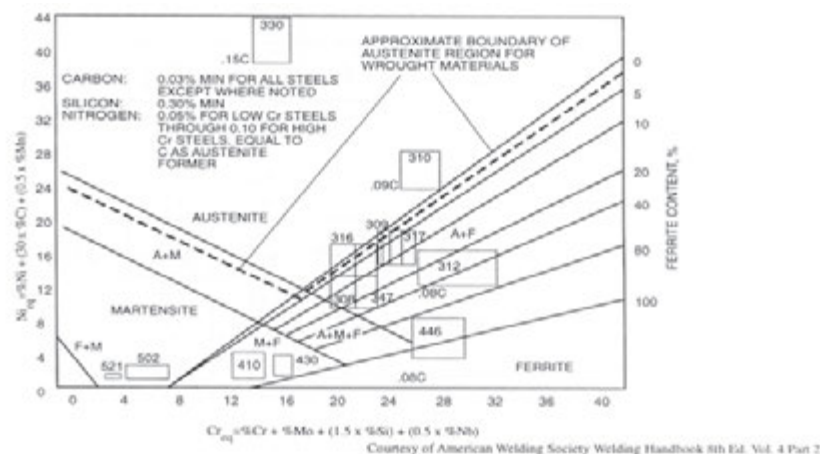
Stainless Steel Flux Cored Wire



AVAILABLE SIZES AND WELDING PARAMETERS (DC REVERSE POLARITY)¹

Diameter (mm)		.035" (0.9 mm)		.045" (1.2 mm)		1/16" (1.6 mm)	
Shielding Gas		CO ₂	80% Ar+20% CO ₂	CO ₂	80% Ar+20% CO ₂	CO ₂	80% Ar+20% CO ₂
Flat	Amp. Volt	120-130 29-31	120-130 27-29	180-200 30-32	180-200 28-30	220-240 30-32	220-240 28-30
Vertical-Up	Amp. Volt	60-80 26-28	60-80 25-27	110-140 22-24	110-140 21-23	— —	— —
Gas Flow Rate]		(20L/min)	42 ft ³ /hr				
Electrode Stickout		(10-20 mm)	1/2 - 3/4"				

SCHAEFFLER DIAGRAM FOR ESTIMATING THE MICROSTRUCTURE OF STAINLESS STEEL WELD METAL



Washington Alloy Company believes that the information and data contained in this catalog is correct. However, all technical information, data and applications are provided to assist you in making your own evaluations and decisions and should not be mistaken as expressed or implied warranties. Chemical and mechanical properties are typical or average values that have been obtained by testing and comparing many heats of the same material. Minimum or maximum values are noted accordingly and are not intended for specification purposes. Washington Alloy assumes no liability for results for damages incurred from the use of any information contained herein, in whole or in part.



Stainless Steel Flux Cored Wires

Selector Chart

FEATURES

- Increased efficiency through greater deposition rates
- All-Position welding using standard MIG welding machines
- Smoother and more beautiful bead appearance
- Better arc stability yields minimal spatter
- Thin slag is virtually self-peeling revealing a beautiful and bright stain less steel color weld deposit
- X-ray quality weld deposits. No pinholes or cracks

DESCRIPTION

Washington Alloy Stainless Steel Flux Cored wires were developed for use with 100% CO₂ or 80% Ar/20%CO₂ shielding gas. The ability of operating over a wide range of current settings permits deposition rates that are nearly A times greater than covered electrodes and up to 50% greater than solid MIG wire. Although the cost per pound of Stainless

Stainless Steel Flux Cored wires that end with a "-4", such as E308LT1-4 are de-signed for use with a 20-25% CO₂/Balance Argon mixtures. Washington Alloy recom-mends 80% Ar/20% CO₂ (although you can use 75% Ar/25% CO₂) for this specifi-cation. An 80/20 mixture will give a much softer arc, resulting in virtually no spatter. The softer arc also enhances vertical welding. Weld deposits of "-4"

Stainless Steel

Flux Cored wires exhibit less carbon pick up and less chromium loss, which pushes up the ferrite level of the weld deposit. Keep this fact in mind when examining the desired ferrite level or considering which gas to use. Greater weld deposit toughness can be achieved by choosing an 80/20 mixture over 100% CO₂.

Steel Flux Cored wires may be more than that of coated electrodes or solid MIG wire, your cost per pound of deposited weld metal is greatly reduced because of the higher deposition efficiency and lower opera-tional costs. The true stainless steel sheath used in manufacturing Washington Alloy Flux Cored Stainless is your guar-antee of smooth per-formance, x-ray quality welds and a beautiful stainless steel bead appearance. Spatter is extremely low and slag is self-peeling.

"T1-1/T0-1" VS "T1-4/T0-4"?

Stainless Steel Flux Cored wires that end with a "-1", such as E308LT1-1 are for use with 100% CO₂ shielding gas. When using 100% CO₂, there will be a savings since CO₂ is a much cheaper gas, however the weld deposits will lose some of their oxidizable characteristics and will even pick up more carbon from the CO₂ gas. The upside is that you will get greater penetration using CO₂ shielding gas

SPECIFICATION AWS/SFA 5.22 ALLOY	TYPICAL MECHANICAL PROPERTIES - AS WELDED		*UNDILUTED WELD METAL CHEMICAL ANALYSIS RANGES					
	Tensile Strength Minimum	Elongation Minimum	C	Cr	Ni	Mo	Mn	Si
E308T-1/-4 UNS W30831	80,000 psi	35%	0.04 -0.08	18.0 -21.0	9.0 -11.0	0.5	0.5 -2.5	0.4
E308LT1-1/-4 UNS W30835	75,000 psi (avg. 90,200 psi)	35% (avg.39.4%)	0.4	18.0 -21.0	9.0 -11.0	0.5	0.5 -2.5	0.4
E309T-1/-4 UNS W30931	80,000 psi	30%	0.10	22.0 -25.0	12.0 -14.0	0.5	0.5 -2.5	0.4
EC309L UNS W30935	81,500 psi (avg. 83,500 psi)	40%	0.03	22.0 -25.0	12.0 -14.0	0.5	0.5 -2.5	0.4
E309IMoT0-1/-4 UNS W30938	75,000 psi (avg. 95,200 psi)	25% (avg.32%)	0.04	21.0 -25.0	12.0 -16.0	2.0 -3.0	0.5 -2.5	0.4
E316T-1 UNS W31631	75,000 psi	30%	0.08	11.0 -20.0	2.0 -14.0	0.5 -3.0	-2.5	0.4
E316LT1-1/-4 UNS W31635	70,000 psi (avg. 93,500 psi)	30% (avg.38%)	0.04	17.0 -20.0	11.0 -14.0	2.0 -3.0	0.5 -2.5	0.4
E317LT0-1/-4 UNS W31735	75,000 psi (avg. 87,000 psi)	20% (avg.28.2%)	0.04	18.0 -21.0	12.0 -14.0	3.0 -4.0	0.5 -2.5	0.4
E347T0-1/-4' UNS W34731	75,000 psi (avg. 96,800 psi)	30% (avg.32%)	0.08	18.0 -21.0	9.0 -11.0	0.5	0.5 -2.5	0.4
E410T0-1/-4 UNS W41031	82,500 psi (1562°F x2 hrs. + *F.C.to 1094°F + **A.C.)	28%	0.70	11.0 -13.5	0.60	0.5	0.69	0.4
E410NiMoT0-1/-4 UNS W41036	146000 psi	8%	0.06	11.0 -12.5	4.0 -5.0	0.40 -0.70	1.0	0.4
	127,000 ~,si	22%						
	1112°F)(1hr,t"A.C,							
EC409TiTa UNS W40931	81,500 psi	17%	0.05	10.5 -13.5	Ti • 0.70	0.5	0.45	0.4

*F.C.:Furnace Cooling

**A.C.:Air Cooling

*Single values shown are maximums.

*All of the above contain P: 0.04 max., S:0.03 max and Cu: 0.5max.

a. Contains Titanium (Ti) in the amount of 10 x C min., 1.5 max

b. Contains: Cb+Ta(Nb): 8 x C min., 1.0 max.

Stainless Steel Flux Cored wires that end with a “-4”, such as E308LT1-4 are designed for use with a 20-25% CO₂/Balance Argon mixtures. Washington Alloy recommends 80% Ar/20% CO₂ (although you can use 75% Ar/25% CO₂) for this specification. An 80/20 mixture will give a much softer arc, resulting in virtually no spatter. The softer arc also enhances vertical welding. Weld deposits of “-4” Stainless Steel Flux Cored wires exhibit less carbon pick up and less chromium loss, which pushes up the ferrite level of the weld deposit. Keep this fact in mind when examining the desired ferrite level or considering which gas to use. Greater weld deposit toughness can be achieved by choosing an 80/20 mixture over 100% CO₂.

WELDING RECOMMENDATIONS FOR OPTIMUM RESULTS

- Be sure that the wire feed drive rolls are not too tight, so as to not “crush” the flux-cored wire.
- Make sure the conduit and liner are as short as possible and that they are the correct I.D.
- Welding should be done from left to right. This will reduce spatter even further.

- The torch angle should be 10-20° from vertical to the base metal.
- Preheating is generally not needed for 300 series (austenitic) Stainless Steel, however, 400 series does require preheating.
- Changing the length of the wire stick-out does have a profound effect. The wire stick-out length influences arc stability, penetration, bead appearance and deposition rates. Basically you can increase the deposition rate by welding with a longer wire stick-out.

SPECIFICATIONS

AWS: A5.22

ASME:SFA5.22

ABS American Bureau of Shipping

PACKAGE OPTIONS

10 lb. (4.54 kg) spool - 8" flange .035 (0.9 mm), .045 (1.2 mm), 1/16 (1.6mm) 25 lb. (11.34 kg) spool -12" flange .035 (0.9 mm), .045 (1.2 mm), 1/16 (1.6 mm)
All 1 spool per carton Standard Pallets are 2100 lbs. (84 spools x 25 lbs./spool)

APPLICATIONS

All position welding of AISI 301, 302, 304, and 308. Produces an austenitic (non-magnetic) 19% Chromium - 9% Nickel weld deposit with a controlled ferrite.

Similar to 308HT0-1/-4 but the lower carbon content in the weld deposit greatly reduces the possibility of intergranular corrosion caused by carbide precipitation. Commonly used on AISI 301, 302, 304, 304L and 308L

All-position welding of 25% Chromium -12% Nickel Stainless Steel. Commonly used on dissimilar metals such as joining stainless steel to carbon or low alloy steel and for welding the clad side of 18-8 stainless clad steels.

Better corrosion resistance than 309T0-1/-4, due to the lower carbon content of the weld deposit. Excellent crack resistance and oxidation resistance at extreme temperatures. Typical applications include furnaces, kiln linings, 309 wrought or cast parts.

For joining dissimilar metals of stainless steel to carbon and low alloy steels. Most commonly used as a buffer layer when cladding mild steel with 316 austenitic stainless.

For welding 18% Chromium -12% Nickel - 2.5% Molybdenum Stainless Steel. The addition of Molybdenum gives added creep resistance at elevated temperatures and corrosion resistance against “pitting” that may be caused by sulfuric and sulfurous acids, phosphoric acids and acetic acids.

An all-position wire similar to 316T0-1/-4, however the lower carbon content of the weld metal provides protection against intergranular corrosion due to carbide precipitation. Commonly used in industries that manufacture rayon, dyes, paper, ink, rubber, bleaches, photographic chemicals.

All-position welding of austenitic 18% Chromium -12% Nickel - 3.5% Molybdenum Stainless Steel which is subjected to severely corrosive acids such as sulfuric or sulfurous acids and their salts. Excellent resistance to corrosion and pitting.

For Columbium stabilized grades of AISI 347 and 321 or 18/8 grades of austenitic stainless subjected to temperatures above 750°F but less than 1550°F. Also available in low carbon grade (E347LT0-1/-4) with a carbon level average of .03.

For welding AISI 403, 405, and 410 Chromium Steel. Primarily used as an overlay on carbon steel to give added resistance against corrosion, erosion or abrasion on valve seats and parts. Preheat and Postheat treatment is required for most applications.

All-position welding of 409, 410, 410S and 405 Stainless Steel. Less crack sensitive than 410T0-1/-4. Primarily used for repairing and welding CA6NM castings such as found in fluid handling equipment, valves and pump parts. Postweld heat treatment required.

For welding base metals of similar analysis. 11% Chromium with 0.70% Titanium as a stabilizer. Used extensively in the automotive industry for the fabrication of mufflers, catalytic converters and exhaust systems.



Build-Up And Hardsurfacing Flux Cored Wires

BUILD-UP AND HARDSURFACING FLUX CORED WIRES

FEATURES:

All-Position
100% CO₂ Gas Shielded
Superior Operator Appeal
Excellent Circumferentially to Thin Sections and Edges
.045" and 1/16" Diameters
High Deposition Rates
Easy Application

DESCRIPTION:

Washington Alloy small diameter Build-up and Hardsurfacing Flux cored Wires offer much greater deposition efficiency and are easier to use than coated electrodes. No stub loss. Greatly reduced "Down Time." Faster travel speed reduces base metal fatigue, thereby producing stronger, more durable welds than coated electrodes. Developed for use on conventional wire feed equipment and

with 100% CO₂ shielding gas, these wires offer outstanding operator appeal in any position. Circumferential welding of idlers, rollers, sprockets and wheels can be done easily when using .045". Excellent arc stability, very low spatter and a beautiful weld deposit that outlasts other brands. Slag removal is so easy and your "cost per pound" of deposited weld metal is greatly reduced.

TYPES AND DESCRIPTIONS

TYPES	DESCRIPTION
USA 250 HT (Build-up)	For building-up mild and low alloy steel parts to within 3/16"-3/8" of their original size. Weld deposits will be part ferritic - part martensitic in structure. USA 250 HT weld deposits have good compressive strength and resistance to plastic deformation. Weld deposits are easily machined in the "as welded" position. An excellent underlayment prior to hardsurfacing.
USA 300 HT (Build-up and Hardfacing Heavy Impact and Mild Abrasion)	Similar to USA 250 HT in weld deposit structure and uses. USA 300 HT offers a slightly harder weld deposit than USA 250 HT and subsequently it is often used in applications where a hardsurfacing layer is not applied over the USA 300 HT deposit. Excellent on carbon steel shovel pads, repairing battered rail and tractor parts.
USA 350 HT (Build-up and Hardfacing - Heavy Impact and Mild Abrasion)	USA 350 HT is our "general purpose" build-up and hardsurfacing wire. The weld deposit of USA 350 HT is a low alloy deposit with a martensitic structure. It is machinable and forgeable. A good balance of impact resistance and abrasion resistance as well as hardness make USA 350 HT an excellent choice where only one wire is desired for build-up and hardsurfacing. (Not to be used as an underlayment prior to subsequent hardfacing). Excellent for overlaying carbon steel shafts, gear teeth and sprockets.
USA 450 HT (Hardfacing-Metal to Metal Abrasion and Mild Impact)	USA 450 HT is designed for metal to metal abrasion involving impact such as rolling or sliding parts in earth moving equipment where lubrication is not possible. The weld deposits of USA 450 HT are martensitic in structure. Common uses would include printing and paper mill rolls, power shovel tumblers, mine car wheels, brake drums, tractor rollers, etc.
USA 600 HT (Hardfacing- Heavy Abrasion, Heavy Impact and Corrosion Resistant)	USA 600 HT offers high abrasion and heavy impact resistance on carbon, low alloy and manganese steel. Weld deposits are martensitic and corrosion resistant. USA 600 HT is designed for metal to metal and metal to earth abrasion. Weld deposits will work harden when put to service. Typical applications would include tillage tools, bucket lips, extruder screws, tamper feet, dredge cutter teeth and wherever high abrasion and heavy pounding is encountered.
USA 700 HT (Hardfacing-Heavy Abrasion and Heavy Impact)	USA 700 HT offers a harder weld deposit than USA 600 HT, but lacks the corrosion resistance. Primarily used for high metal to metal abrasion. Weld deposits are martensitic in structure and will work harden when put into service. Typical applications would include the hardsurfacing of rollers, conveyor screws, crusher rolls and mill hammers. Carbon, silicon, manganese, chromium, iron base.

Build-Up and Hardsurfacing Flux-Cored Wires

CHARACTERISTICS AND APPLICATIONS

PRODUCT	ALL-WELD-METAL COMPOSITION	HARDNESS ROCKWELL C	IMPACT RESISTANCE	ABRASION RESISTANCE	APPLICATIONS
USA 250 HT (Build-up)	Carbon Silicon Manganese Chromium Iron Base	20-26	Very Good	Poor	Underlaying for Hardsurfacing, Steelmill Wobblers and Pods, Shafting, Small Rolls, Pump Parts
USA 300 HT (Build-up)	Carbon Silicon Manganese Chromium Iron Base	28-32	Very Good	Poor	Build-up of Power Shovels and Tractor Parts, Repairing Battered Rail, Hammers
USA 350 HT (Build-up & Hardsurfacing)	Carbon Silicon Manganese Chromium Molybdenum Iron Base	34-39	Very Good	Fair	Overlaying Carbon Steel Shafts, Gear Teeth, Sprockets, Steel Shovel Pads
USA 450 HT (Hardsurfacing)	Carbon Silicon Manganese Chromium Molybdenum Iron Base	43-48	Very Good	Good	Mine Car Wheels, Tractor Rollers, Undercarriage Parts, Shovel Idlers, Rollers, and Hook Rolls
USA 600 HT (Hardsurfacing)	Carbon Silicon Manganese Chromium Molybdenum Iron Base	53-56	Excellent	Excellent	Extruder Screws, Bucket Lips, Tamper Feet, Tillage Tools, Dredge Parts, Ore Drag Lines, Muller Tires
USA 700 HT (Hardsurfacing)	Carbon Silicon Manganese Chromium Iron Base	58-61	Excellent	Excellent	Rollers, Conveyor Screws, Crusher Rolls, Mill Hammers

WELDING PARAMETRES AND DATA*

Use DC Reverse Polarity (electrode positive). The shielding gas should be 100% CO₂ welding grade, however a 75% CO₂ mixture will increase the hardness slightly. Superior properties are achieved if an interpass temperature of 300°-480°F (480 °-580 °F for USA 600 HT) is maintained.

WIRE DIAMETER	ELECTRODE STICKOUT	AMPS	VOLTS*
.045 (1.2 mm) 1/16 (1.6 mm)	3/4" - 1-1/2" 1" - 2"	150-250 250-350	21-26 23-28
3/32" (2.4 mm) AND 7/64" (2.8 mm) AVAILABLE UPON REQUEST			

*Ideal procedure is to set the wire feed speed and find the voltage setting that will yield the smoothest performance.

PACKAGE OPTIONS

10 lb. (4.44 kg) spool—8" flange 33 lb. (11.35 kg) spool—12" flange 44 lb. (20.00 kg) spool—12" flange 60 lb. (27.20 kg) spool—12" I/D	.045 (1.2 mm) .045 (1.2 mm) .045 (1.2 mm) .045 (1.2 mm)	1/16 (1.6 mm) 1/16 (1.6 mm) 1/16 (1.6 mm) 1/16 (1.6 mm)	3/32 (2.4 mm)	7/64 (2.8 mm)
---	--	--	---------------	---------------



STAINLESS STEEL ELECTRODES AND SOLID WIRES

Washington Alloy stainless steel electrodes and wires are manufactured under the same strict quality control standards that are characteristic of all Washington Alloy products. An in-line process of manufacturing permits frequent testing of chemical composition, mechanical properties and weldability to assure that all heats of stainless steel conform

to AWS and ASTM specifications. All spooled and coiled wire is further tested to make sure that cleanliness, temper, cast and helix meet Washington Alloy standards as well as AWS and ASTM requirements. There is a Washington Alloy stainless steel product for all your welding needs. MIG wires are available on 2 lb., 10 lb. and 25 lb. precision

level-layer wound spools for easy, trouble-free use on all automatic or semi-automatic wire feeding units. Submerged arc welding can be achieved with Washington Alloy 60 lb. level-layer wound coils. TIG or oxyacetylene welding can be accomplished using Washington Alloy stainless steel cut lengths.

Stainless Steel Solid Wire

Stainless steel welding differs from mild or carbon steel welding in that the stainless steel has low thermal conductivity and high expansion characteristics. Stainless steel expands approximately 50% more, but conducts heat 50% slower than mild or carbon steel making it much more susceptible to warping caused by temperature changes. Stainless steel is broken down into three major groups which we will briefly explain.

AUSTENITIC STAINLESS STEEL

Austenitic stainless steels include the chromium-nickel, AISI 200 and 300 series. This is the most common stainless steel group encountered and it is further divided into 7 smaller grades.

1. The 18/8 grades consist of 18% chromium and 8% nickel. These grades are the most common and include AISI types 301, 302, 304, 305 and 308.
2. The Manganese grades consist of the AISI 200 series (AISI 201, 202, etc.)
3. The Extra Low Carbon (L) grades, which include AISI 304L and 308L, contain .03% maximum carbon to eliminate damaging carbide precipitation.
4. The Stabilized grades such as AISI 321, 347, 348 contain small amounts of titanium, columbium or a tantalum-columbium combination to provide protection in severe corrosive conditions.
5. The Molybdenum grades include AISI 316, 316L, 317 and 317L. These grades have a higher molybdenum content to provide greater corrosion resistance against "pitting" caused by chemical corrosion.
6. The High Temperature grades, (AISI 302B, 309, 309S, 310, 310S) maintain their strength and scaling resistance at temperatures up to 2000°F.
7. The Free-Machining grades include AISI 303, 303SE. These grades contain sulfur, selenium and phosphorus, making them very susceptible to porosity and cracking during welding.
8. Carbide Precipitation Carbide precipitation is a common problem encountered when welding with austenitic stainless steel. It occurs when the stainless

steel is heated to temperatures in the 800°-1500°F range. At these temperatures, the carbon in the steel precipitates to the grain boundaries and unites with the chromium to form chromium carbides. When this happens, the stainless steel loses its corrosion resistance and eventually succumbs to intergranular corrosion. There are several ways to prevent or control this breakdown of corrosion resistance. The first method would be to use an electrode or wire from the Extra Low Carbon (L) grades such as USA 303L or USA 316L. The lower the carbon content of the electrode or wire, the less likely carbide precipitation will occur. The second method of controlling carbide precipitation would be to select an electrode or wire from the stabilized grades such as USA 347. The columbium in USA 347 combines with the carbon before the chromium does, thereby preventing the formation of chromium carbides and preserving the corrosion resistance of the stainless steel.

MARTENSITIC STAINLESS STEEL

Martensitic stainless steel is considered a straight chromium steel that remains stable overall temperature ranges, retaining its good strength and scaling resistance at temperatures up to 1100°F. Martensitic stainless steels do not undergo carbide precipitation, however they are affected by rapid temperature changes and will produce brittle, hard and crack sensitive welds if the base metal is not preheated to at least 400°F. Preheating will minimize the temperature gradient and preserve the quality of the weld. USA 410 and 502 would be considered martensitic stainless steels.

FERRITIC STAINLESS STEEL

Ferritic stainless steel is another type of straight chromium steel. This group becomes extremely brittle and crack sensitive when subjected to the higher temperatures of welding. Therefore it is extremely important to pre-heat the base metal at a low temperature, use the lowest possible welding currents and the smallest diameter of electrode or wire. This should help to decrease the possibility of embrittlement of cracking caused by excessive grain growth. USA 430 would be considered a ferritic stainless steel.

USA 253 MA®

UNS S30815 NO AWS CLASSIFICATION

DESCRIPTION AND APPLICATIONS

USA 253 MA® is a heat-resisting austenitic stainless steel alloy wire modified with the rare earth element Cerium (Ce). USA 253 MA® is a unique alloy designed for welding 21% Cr-10% Ni grades of stainless steel including Avesta Sheffield 153 MA® (UNS S30415) and 253 MA® (UNS S30815). These special purpose 21% Cr- 10% Ni grades are now being used in petrochemical, refinery and power generating plants for fabricating and repairing tube hangers for steam super-heaters, furnace fans, ducting, dampers, muffles, retorts and pulverized coal burners in power boilers. USA 253 MA® provides weld deposits that offer excellent resistance to oxidation and scaling for service temperatures up to 2000°F (air), resistance to thermal shock, and for high creep-rupture strength. Currently, there is no AWS classification for this alloy.

TYPICAL WIRE CHEMISTRY (%)

C	0.090 max.
Mn	1.000 max.
Si	1.0-2.0
N	0.250 max.
Cr	20.0-22.0
Ni	9.00-11.00
Ce	0.08 max.
Fe	Balance

253 MA® is a registered trademark of Avesta Sheffield Steel

USA 307

AWS A5.9 Class ER307

DESCRIPTION AND APPLICATIONS

USA 307 is a high manganese austenitic stainless steel used for joining and surfacing applications involving work-hardenable steels, armour plate, heat resistant steels subjected to temperatures up to 1560°F and dissimilar steels such as austenitic manganese steels to carbon steel forgings and castings. Weld deposits are porosity free, crack and corrosion resistant.

TYPICAL WIRE CHEMISTRY (%)

C	0.12
Si	0.40
Mn	4.50
Cr	20.25
Ni	8.00
Mo	1.00

Stainless Steel Solid Wire

USA 308 AWS A5.9 Class ER308	USA 308L AWS A5.9 Class ER308L	USA 308LSi AWS A5.9 Class ER308LSi
DESCRIPTION AND APPLICATIONS USA 308 is used to weld all stainless steel AISI 200 and 300 series up to and including 308. This wire is used where resistance to corrosion, impact and abrasion is required. Weld deposits will be equal or superior to the base metal.	DESCRIPTION AND APPLICATIONS USA 308L is similar to USA 308 but contains an average .02% carbon producing a weld deposit with good resistance against intergranular corrosion caused by carbide precipitation. USA 308L is commonly used for welding AISI types 304L, 308L, 321 and 347.	DESCRIPTION AND APPLICATIONS USA 308LSi has a higher silicon content along with a low carbon content. The increased silicon level provides better arc stability and a smoother bead appearance while an average .02% carbon level reduces carbide precipitation. USA 308LSi produces excellent quality fillet and butt welds. Typical applications would include those of USA 308 and USA 308L welding wires
TYPICAL WIRE CHEMISTRY (%) C 0.04 Mn 1.84 Si 0.30 Cr 19.83 Ni 10.24	TYPICAL WIRE CHEMISTRY (%) C 0.02 Mn 1.83 Si 0.35 Cr 19.70 Ni 9.82	TYPICAL WIRE CHEMISTRY (%) C 0.02 Mn 1.83 Si 0.74 Cr 19.70 Ni 9.82
USA 309 AWS A5.9 Class ER309	USA 309L AWS A5.9 Class ER309L	USA 309LSi AWS A5.9 Class ER309LSi
DESCRIPTION AND APPLICATIONS USA 309 is used for welding heat resistant AISI 309 and other straight chromium grades of stainless steel where preheat and postheat treatment is not possible. USA 309 wire produces sound ductile weld deposits. Other applications would include joining stainless steel to mild or carbon steels, steel overlay work and for welding AISI 304 clad stainless.	DESCRIPTION AND APPLICATIONS USA 309L is similar to USA 309 but contains an average .02% carbon to provide a weld deposit that will offer good resistance against intergranular corrosion caused by carbide precipitation. USA 309L is excellent for buttered passes and overlay work. Typical applications include those of USA 309 welding wire.	DESCRIPTION AND APPLICATIONS USA 309LSi has a higher level of silicon than USA 309L combined with a carbon content lower than USA 309. The increased silicon level provides better arc stability and a smoother bead appearance while an average .02% carbon level reduces carbide precipitation. Typical applications would include those of USA 309 and USA 309L.
TYPICAL WIRE CHEMISTRY (%) C 0.06 Mn 2.03 Si 0.36 Cr 23.48 Ni 13.45	TYPICAL WIRE CHEMISTRY (%) C 0.02 Mn 2.03 Si 0.36 Cr 23.48 Ni 13.45	TYPICAL WIRE CHEMISTRY (%) C 0.02 Mn 2.03 Si 0.84 Cr 23.48 Ni 13.45

Stainless Steel Solid Wire

USA 309LMo AWS A5.9 Class ER309LMo	USA 310 AWS A5.9 Class ER310	USA 312 AWS A5.9 Class ER312
DESCRIPTION AND APPLICATION USA 309LMo offers greater corrosion resistance at elevated temperatures than USA 309L. The addition of molybdenum to the chemical analysis also gives the weld deposit improved crack resistance. USA 309LMo is commonly used for welding ferritic steel plates clad with AISI 316 stainless steel. Excellent for 317L stainless and dissimilar steel applications involving sulphuric and phosphoric acids.	DESCRIPTION AND APPLICATIONS USA 310 is used for welding types AISI 310, 304 clad stainless steel, ferritic and martensitic chromium steels, and for stainless steel overlay work on mild and carbon steels. USA 310 welding wire produces weld deposits of high strength and high resistance to scalling at elevated temperatures.	DESCRIPTION AND APPLICATIONS USA 312 stainless steel welding wire is used for high strength and high yield steels, stainless to mild steels and AISI 304 clad stainless steel. This wire produces weld deposits of very high strength.
TYPICAL WIRE CHEMISTRY (%) C 0.02 Si 0.40 Mn 1.50 Cr 24.00 Ni 12.50 Mo 2.70	TYPICAL WIRE CHEMISTRY (%) C 0.140 Mn 1.80 Si 0.50 Cr 27.00 Ni 21.10	TYPICAL WIRE CHEMISTRY (%) C 0.14 Mn 1.40 Si 0.50 Cr 29.90 Ni 9.00
USA 316 AWS A5.9 Class ER316	USA 316L AWS A5.9 Class ER316L	USA 316LSi AWS A5.9 Class ER316LSi
DESCRIPTION AND APPLICATIONS USA 316 is used for welding AISI 316 stainless subjected to high temperature service such as that found in gas turbines. The addition of molybdenum gives the weld deposit high resistance to pitting caused by corrosive liquids as well as improved creep resistance at elevated temperatures	DESCRIPTION AND APPLICATIONS USA 316L is similar to USA 316 but contains an average .02% carbon producing a weld deposit with excellent resistance against intergranular corrosion caused by carbide precipitation. USA 316L is used for welding AISI types 316L and 318 that may be exposed to organic and inorganic acids.	DESCRIPTION AND APPLICATIONS USA 316LSi has a higher silicon content along with a low carbon content, producing better arc stability, smoother bead appearance and excellent resistance to carbide precipitation. USA 316LSi is used for welding austenitic acid-resistant steels such as those containing 18% Cr - 8% Ni - 2-3% Mo
TYPICAL WIRE CHEMISTRY (%) C 0.04 Mn 1.54 Si 0.40 Cr 18.86 Ni 12.20 Mo 2.28	TYPICAL WIRE CHEMISTRY (%) C 0.02 Mn 1.70 Si 0.36 Cr 19.88 Ni 12.36 Mo 2.28	TYPICAL WIRE CHEMISTRY (%) C 0.02 Mn 1.70 Si 0.86 Cr 19.88 Ni 12.36 Mo 2.28

Stainless Steel Solid Wire

<div>USA 317L</div> <div>AWS A5.9 Class ER317L</div>	<div>USA 318</div> <div>AWS A5.9 Class ER318</div>	<div>USA 320</div> <div>AWS A5.9 Class ER320</div>																																												
<div>DESCRIPTION AND APPLICATION</div> <div>USA 317L stainless steel wire is used to weld austenitic acid-resistant steels such as those containing 18% Cr-8% Ni - 2-3% Mo. USA 317L produces weld deposits which exhibit excellent resistance to corrosion that may be caused by organic and inorganic acids as well as pitting caused by chloride solutions.</div> <div>TYPICAL WIRE CHEMISTRY (%)</div> <table><tr><td>C</td><td>0.02</td></tr><tr><td>Si</td><td>1.75</td></tr><tr><td>Mn</td><td>0.45</td></tr><tr><td>Cr</td><td>19.00</td></tr><tr><td>Ni</td><td>13.30</td></tr><tr><td>Mo</td><td>3.20</td></tr></table>	C	0.02	Si	1.75	Mn	0.45	Cr	19.00	Ni	13.30	Mo	3.20	<div>DESCRIPTION AND APPLICATIONS</div> <div>USA 318 is a stainless steel alloy wire designed for welding AISI 316 stabilized and 316Ti or 318 modified austenitic stainless steels. USA 318 is designed for use in applications with service temperatures up to 750°F. The addition of sufficient amounts of the element columbium (Cb) in the formula of this alloy wire eliminates the formation of chromium carbides. The absence of chromium carbides eliminates failures due to intergranular corrosion caused by carbide precipitation. USA 318 is preferred over 316 when a complete absence of chromium carbides is necessary.</div> <div>TYPICAL WIRE CHEMISTRY (%)</div> <table><tr><td>C</td><td>0.080 max.</td></tr><tr><td>Mn</td><td>1.000 max</td></tr><tr><td>Si</td><td>1.0-2.0</td></tr><tr><td>Cr</td><td>20.0-22.0</td></tr><tr><td>Ni</td><td>9.0-11.0</td></tr><tr><td>Mo</td><td>2.0-3.0</td></tr><tr><td>Cb</td><td>1.0 max.</td></tr><tr><td>Fe</td><td>Balance</td></tr></table>	C	0.080 max.	Mn	1.000 max	Si	1.0-2.0	Cr	20.0-22.0	Ni	9.0-11.0	Mo	2.0-3.0	Cb	1.0 max.	Fe	Balance	<div>DESCRIPTION AND APPLICATIONS</div> <div>USA 320 is used to weld similar base metals that are subjected to severe chemical corrosion. This wire provides exceptional resistance to carbide precipitation thereby preventing intergranular corrosion.</div> <div>TYPICAL WIRE CHEMISTRY (%)</div> <table><tr><td>C</td><td>0.02</td></tr><tr><td>Mn</td><td>0.45</td></tr><tr><td>Si</td><td>0.25</td></tr><tr><td>Cr</td><td>19.70</td></tr><tr><td>Ni</td><td>33.40</td></tr><tr><td>Mo</td><td>2.10</td></tr><tr><td>Cb & Ta</td><td>0.40</td></tr><tr><td>Cu</td><td>3.20</td></tr></table>	C	0.02	Mn	0.45	Si	0.25	Cr	19.70	Ni	33.40	Mo	2.10	Cb & Ta	0.40	Cu	3.20
C	0.02																																													
Si	1.75																																													
Mn	0.45																																													
Cr	19.00																																													
Ni	13.30																																													
Mo	3.20																																													
C	0.080 max.																																													
Mn	1.000 max																																													
Si	1.0-2.0																																													
Cr	20.0-22.0																																													
Ni	9.0-11.0																																													
Mo	2.0-3.0																																													
Cb	1.0 max.																																													
Fe	Balance																																													
C	0.02																																													
Mn	0.45																																													
Si	0.25																																													
Cr	19.70																																													
Ni	33.40																																													
Mo	2.10																																													
Cb & Ta	0.40																																													
Cu	3.20																																													
<div>USA 320LR</div> <div>AWS A5.9 Class ER320LR</div>	<div>USA 321</div> <div>AWS A5.9 Class ER 321</div> <div>AMS 5689D</div>	<div>USA 330</div> <div>AWS A5.9 Class ER330</div>																																												
<div>DESCRIPTION AND APPLICATIONS</div> <div>USA 320LR is basically a modified version of USA 320, where the “residuals” — carbon, silicon, phosphorus and sulphur are specified at lower maximum levels. The columbium and manganese content of USA 320LR is also maintained within a tighter range. These strict controls eliminate hot cracking and microfissuring frequently encountered in austenitic stainless steel.</div> <div>TYPICAL WIRE CHEMISTRY (%)</div> <table><tr><td>C</td><td>0.025</td></tr><tr><td>Cr</td><td>19.60</td></tr><tr><td>Ni</td><td>34.10</td></tr><tr><td>Mo</td><td>2.50</td></tr><tr><td>Cb & Ta</td><td>0.25</td></tr><tr><td>Mn</td><td>1.60</td></tr><tr><td>Cu</td><td>3.40</td></tr></table>	C	0.025	Cr	19.60	Ni	34.10	Mo	2.50	Cb & Ta	0.25	Mn	1.60	Cu	3.40	<div>DESCRIPTION AND APPLICATIONS</div> <div>USA 321 is a 19% chromium - 9% nickel - plus titanium stainless steel filler metal used for TIG welding base metals of similar analysis. The titanium content reduces intergranular chromium carbide precipitation thereby increasing resistance to intergranular corrosion.</div> <div>TYPICAL WIRE CHEMISTRY (%)</div> <table><tr><td>C</td><td>0.05</td></tr><tr><td>Cr</td><td>19.00</td></tr><tr><td>Ni</td><td>9.75</td></tr><tr><td>Mo</td><td>0.38</td></tr><tr><td>Mn</td><td>1.75</td></tr><tr><td>Si</td><td>0.48</td></tr><tr><td>Ti</td><td>0.65</td></tr></table>	C	0.05	Cr	19.00	Ni	9.75	Mo	0.38	Mn	1.75	Si	0.48	Ti	0.65	<div>DESCRIPTION AND APPLICATIONS</div> <div>USA 330 stainless steel welding wire is used for cast and wrought base metals of similar composition. USA 330 has excellent resistance to heat and scale at temperatures as high as 800°F.</div> <div>TYPICAL WIRE CHEMISTRY (%)</div> <table><tr><td>C</td><td>0.20</td></tr><tr><td>Mn</td><td>1.75</td></tr><tr><td>Si</td><td>0.35</td></tr><tr><td>Cr</td><td>16.00</td></tr><tr><td>Ni</td><td>35.00</td></tr></table>	C	0.20	Mn	1.75	Si	0.35	Cr	16.00	Ni	35.00						
C	0.025																																													
Cr	19.60																																													
Ni	34.10																																													
Mo	2.50																																													
Cb & Ta	0.25																																													
Mn	1.60																																													
Cu	3.40																																													
C	0.05																																													
Cr	19.00																																													
Ni	9.75																																													
Mo	0.38																																													
Mn	1.75																																													
Si	0.48																																													
Ti	0.65																																													
C	0.20																																													
Mn	1.75																																													
Si	0.35																																													
Cr	16.00																																													
Ni	35.00																																													

Stainless Steel Solid Wire

<div>USA 347</div> <div>AWS A5.9 Class ER347</div>	<div>USA 409 Cb</div> <div>AWS A5.9 Class ER409Cb</div>	<div>USA 410</div> <div>AWS A5.9 Class ER410</div>
<div>DESCRIPTION AND APPLICATION</div> <div>USA 347 is used for welding AISI types 304, 304L, 321 and 347 where maximum corrosion resistance is required. USA 347 contains columbium which acts as a stabilizer against carbide precipitation thereby eliminating intergranular corrosion.</div> <div>TYPICAL WIRE CHEMISTRY (%)</div> <div><div>C0.04</div><div>Mn1.64</div><div>Si0.40</div><div>Cr20.20</div><div>Ni9.85</div><div>Cb & Ta0.86</div></div>	<div>DESCRIPTION AND APPLICATIONS</div> <div>USA 409 Cb is a ferritic stainless steel alloy wire modified with the element columbium (Cb). USA 409 Cb is a special purpose heat-resisting alloy with excellent weld metal flow and smooth bead appearance designed for GMAW (MIG) welding of exhaust manifolds and catalytic converters in the automotive industry. This alloy wire can be used for many other applications for joining both AISI 409 and AIS 410 stainless steels using MIG, TIG or Submerged Arc processes.</div> <div>TYPICAL WIRE CHEMISTRY (%)</div> <div><div>C0.080 max.</div><div>Mn0.800 max</div><div>Si1.000 max</div><div>Ni0.600 max</div><div>Cr10.5-13.5</div><div>Cb0.750 max</div><div>FeBalance</div></div>	<div>DESCRIPTION AND APPLICATIONS</div> <div>USA 410 stainless steel welding wire is used to weld straight chromium steels such as AISI types 403, 405, 410, 414 and 416. It is also used as an overlay on carbon steels to give added resistance against corrosion and abrasion. Preheat and postheat treatment is required.</div> <div>TYPICAL WIRE CHEMISTRY (%)</div> <div><div>C0.08</div><div>Mn0.50</div><div>Si0.40</div><div>Cr12.90</div><div>Ni0.40</div><div>Mo0.15</div></div>
<div>USA 410NiMo</div> <div>AWS A5.9 Class ER410NiMo</div>	<div>USA 420</div> <div>AWS A5.9 Class ER420</div> <div>AMS 5621</div>	<div>USA 430</div> <div>AWS A5.9 Class ER430</div>
<div>DESCRIPTION AND APPLICATIONS</div> <div>USA 410 NiMo is designed for welding ASTM CA6NM castings as well as light gauge 405, 410 and 410S stainless steels. The increased nickel and molybdenum content of USA 410NiMo provides for improved corrosion resistance at elevated temperatures. Preheat and postweld heat treatment is recommended. Postweld heat treatment should not exceed 1150°F.</div> <div>TYPICAL WIRE CHEMISTRY (%)</div> <div><div>C0.03</div><div>Mn0.50</div><div>Si0.40</div><div>Cr12.10</div><div>Ni4.00</div><div>Mo0.60</div></div>	<div>DESCRIPTION AND APPLICATIONS</div> <div>USA 420 is a martensitic stainless steel similar to USA 410, but with a higher level of carbon. This increased carbon content gives the weld deposit greater hardness, providing for excellent abrasion resistance as well as moderate corrosion resistance. Weld deposits will work-harden when put into service and so this filler metal is commonly used for surfacing applications. Preheat and postweld heat treatment is recommended.</div> <div>TYPICAL WIRE CHEMISTRY (%)</div> <div><div>C0.28</div><div>Mn0.42</div><div>Ni0.40</div><div>Cr13.13</div><div>Si0.37</div><div>Mo0.15</div></div>	<div>DESCRIPTION AND APPLICATIONS</div> <div>USA 430 is used for welding AISI types 403 stainless steel where maximum corrosion resistance at temperatures up to 1600°F is required. Preheat and postheat treatment is recommended.</div> <div>TYPICAL WIRE CHEMISTRY (%)</div> <div><div>C0.07</div><div>Mn0.52</div><div>Si0.37</div><div>Cr16.76</div><div>Ni0.40</div><div>Mo0.15</div></div>

Stainless Steel Solid Wire

USA 17/4 PH (630) AWS A5.9 Class ER630	USA 17/7 PH	USA 80S-B2 (515) AWS A5.28 Class ER80S-B2 Formerly AWS A5.9 ER515
DESCRIPTION AND APPLICATION USA 17/4 (630) PH is a martensitic precipitation, age-hardening 17% chromium -4% nickel stainless steel designed for welding ASTM A564 Type 630 and other martensitic PH stainless steels such as 15-5. Weld deposits have excellent mechanical properties with high strength and hardness. USA 17/4 (630) can be used with all welding processes without preheating, however postweld heat treatment is recommended to produce weld properties comparable to the base metal. Commonly used in high temperature and abrasion resistant environments such as found in the petrochemical and aerospace industries.	DESCRIPTION AND APPLICATIONS USA 17/7 PH is a 17% chromium -7% nickel, precipitation-hardening stainless steel designed for MIG and TIG welding of corrosion resistant steels of similar composition where the weld deposit must have the same strength and corrosion resistance as that of the base metal. USA 17/7 PH is commonly used in cold heading and spring applications.	DESCRIPTION AND APPLICATIONS USA 80S-B2 is used for gas metal arc welding of 1-1/4% chromium, 1/2% molybdenum steels and type 515 stainless steels.
TYPICAL WIRE CHEMISTRY (%) C 0.04 Cr 16.50 Ni 4.50 Mn 0.60 Si 0.50 Cu 3.50 Cb & Ta 0.30	TYPICAL WIRE CHEMISTRY (%) C 0.09* Cr 17.00 Ni 7.00 Mn 1.00* Al 1.00 Si 0.50* *Maximum	TYPICAL WIRE CHEMISTRY (%) C 0.09 Mn 0.60 Cr 1.50 Mo 0.54 Si 0.45
USA 80S-B6 (502) AWS A5.28 Class ER80S-B6 Formerly AWS A5.9 ER502	USA 80S-B8 (505) AWS A5.28 Class ER80S-B8 Formerly AWS A5.9 ER505	USA 90S-B3 (521) AWS A5.28 Class ER90S-B3 Formerly AWS A5.9 ER521
DESCRIPTION AND APPLICATIONS USA 80S-B6 (502) is used for welding AISI type 502 stainless steels and 5% chrome moly steels.	DESCRIPTION AND APPLICATIONS USA 80S-B8 (505) is used for welding AISI type 505 stainless steels and 6-8% and 8-10% chrome moly steels.	DESCRIPTION AND APPLICATIONS USA 90S-B3 is used for gas metal arc welding of 2-1/4% Cr – 1% Mo chrome moly steels and type 521 stainless steel.
TYPICAL WIRE CHEMISTRY (%) C 0.09 Mn 0.46 Si 0.36 Cr 5.70 Mo 0.54	TYPICAL WIRE CHEMISTRY (%) C 0.10 Mn 1.00 Si 0.90 Cr 9.50 Ni 0.40 Mo 1.00 P 0.03 S 0.03	TYPICAL WIRE CHEMISTRY (%) C 0.08 Mn 0.57 Cr 2.41 Mo 0.98 Si 0.52

Stainless Steel Solid Wire

USA 90S-B9 AWS A5.28 Class ER90S-B9 AWS A5.23 Class EB9-B9	USA 904L (385) AWS A5.9 Class ER385 UNS N08904	USA 2209 AWS A5.9 Class ER2209 UNS W39209
DESCRIPTION AND APPLICATION Washington Alloy ER90S-B9 is a 9% Cr-1% Mo alloy wire modified with niobium (columbium) and vanadium. ER90S-B9 is designed to provide creep-rupture strength, toughness, fatigue life, oxidation and corrosion resistance at elevated service temperatures and pressures (up to 4,000 psi). The formula of ER90S-B9 is modified by the addition of vanadium, and niobium (columbium) and is manufactured with increased control of nitrogen. ER90S-B9, when subjected to proper welding procedures and post-weld heat treatment, yields deposits that result in a deposit structure of tempered martensite with precipitation of FeCr carbides (M22C6) and vanadium-rich carbon-nitrides. This allows higher operating steam temperatures and pressures and provides higher long-term creep- rupture properties. Weld deposits of ER90S-B9, unlike 12% Cr steels, can be cooled to room temperature without the risk of cold cracks. Applications for ER90S-B9 include welding many P-91 grade steels, ASTM-ASME A-213, A- 335, and A387-grade 91 martensitic steels used in fabrication of turbines, header systems, re- heat piping systems and for high temperature (1040-1112°F), high pressure (up to 4,000 psi) steam piping in electric power generating stations.	DESCRIPTION AND APPLICATIONS Washington Alloy USA 904L is a high alloy austenitic stainless steel with extra low carbon content intended for use in severe corrosive conditions. Residual elements C, Si, P, S and N are kept at much lower levels in order to keep the weld metal from not Cracking and fissuring. USA 904L is designed for joining 20% Cr-25% Ni-4.5% Mo-1.5% Cu stainless steels used to manufacture and repair processing equipment, tanks, vessels. and process piping handling acetic acids, sulphuric acid Solutions and many Chloride containing media. Other uses include cooling units for sea water and river water purification plants and for cladding lower alloy steels when used in many corrosive media environments. USA 904L is also used for joining AISI type 317 where improved corrosive resistance in specific media is required. A shield gas of 30% argon and 70% helium is recommended for GMAW (MIG) applications.	DESCRIPTION AND APPLICATIONS USA 2209 is a stainless steel alloy wire designed for welding AISI316 stabilized and 316Ti or 318 austenitic stainless steels. USA 2209 produces duplex stainless steel weld deposits with a nearly balanced austenite-ferrite microstructure. USA 2209 weld deposits exhibit high tensile strength, improved resistance to stress corrosion cracking and greater resistance to pitting than conventional austenitic grades of stainless steel. USA 2209 is designed for welding 22% chromium duplex stainless steels such as ASME-ASTM A-182, A-276, A-479, A-789, A- 790, and A-890. 3RE60®, 44LN® and Ferralium 255® are proprietary duplex stainless steel base metals in the 22% Cr category available commercially that can be joined successfully with USA 2209. Non-proprietary grades 2205 and 2304 duplex stainless steels are also readily available, and can be joined successfully with USA 2209.
TYPICAL WIRE CHEMISTRY (%) C 0.080 Mn 1.250 Si 0.500 P 0.010 S 0.010 Cr 9.500 Mo 1.200 V 0.150 Al 0.250 Nb 0.060 N 0.050 Ni 1.000	TYPICAL WIRE CHEMISTRY (%) C 0.025 max. Mn 1.0-2.5 Si 0.500 max. Ni 24.0-26.0 Cr 19.5-21.5 Mo 4.2-5.2 Cu 1.2-2.0 N 0.04	TYPICAL WIRE CHEMISTRY (%) C 0.030 max. Mn 0.5-2.0 Si 0.90 max. Cr 21.5-23.5 Ni 7.5-9.5 Mo 2.5-3.5 Cb 1.0 max. N 0.15 3RE60® is a registered trademark of Sandvik Steel Co. 44LN® is a registered trademark of Avesta Sheffield Steel Co. Ferralium 255® is a registered trademark of Cabot Corporation

STAINLESS STEEL SOLID WIRE

Available Sizes and Packaging

Precision level layer wound

Package	Wire Sizes (in.)	Spool Dimensions (in.)		
		O.D.	Width	Arbor Hole
2 lb. spools	.023-.045	4	2	5/8
11 lb. spools	.023-1/16	8	2	2
33 lb spools	.023-1/8	12	4	2

*2 lb. spools are packaged 40 lbs. (20 spools) per carton

Level layer wound coils

Package	Wire Sizes (in.)	Coil Dimensions (in.)		
		I.D.	Width	O.D.
60 lb. coils	.035-3/16	12	4	15

Straight and cut lengths

Package	Wire Sizes (in.)	Length (in.)	Standard Cartons
50 lb. bulk carton*	.030-3/16	36	(1) 50 lb. carton (50 lbs.)
10 lb. tubes.*	.030-3/16	36	5 tubes per carton (50 lbs.)

Flag-tagging is available-please inquire.

Standard wire diameters (in.): .023, .030, .035, .045, 1/16, 3/32, 1/8, 5/32, 3/16.



FLUX AND METAL CORED WIRES

GENERAL WELDING PROCEDURES

Since the cost of stainless steel is much more than that of mild steel, it is most important that errors do not occur. Therefore prior to welding, a stainless wire brush should be used to remove all foreign matter from the base metal edge. Preheating is not required when using any 300 series electrode, however preheating and an inter-pass temperature between 300-800°F is recommended when using any 400 or 500 series electrode. In stainless steel arc welding, you would use the electrode that will yield a weld deposit which is most comparable to the base metal. The arc length should be kept as small as possible without touching the electrode to the weld puddle. The welding current should be kept to a minimum or the welding speed at a maximum to reduce warping. Welding currents may be selected from the enclosed Chart. Titania coated (-16) electrodes can be used with AC or DC (reverse polarity) while the lime coated (-15) electrodes are used with DC (reverse polarity) only. Stringer beads should be used for welding in the flat, horizontal and overhead positions. Vertical welding should be done using the weaving technique, but not to exceed 2-3 times the electrode diameter.

ELECTRODE COATINGS

Washington Alloy stainless steel electrodes are available with two types of coating: AC-DC (-16) titania coated electrodes are the most popular because their "dual-current" usage allows for the stocking of one type for all needs. This electrode coating provides a smooth stable arc, with low spatter and complete penetration. The spray type metal transfer produces a smooth flat bead with very easy slag removal. Titania coated electrodes have exceptional starting characteristics and may be used in all positions. DC (-15) lime coated electrodes are used where a more convex bead is desirable. The lime coating allows for fast setup of weld metal making this electrode suitable for welding in all positions. This electrode produces a slag which completely covers the weld to provide fast wetting and low spatter. Slag removal is easy.

STAINLESS STEEL ELECTRODES

Washington Alloy stainless steel electrodes are clearly marked with the appropriate AWS Classification number as well as lot number. This service is designed to protect the welder from receiving or using the wrong electrode and meets with the approval of AWS.

USA 253MA-16® UNS S30815

DESCRIPTION:

USA 253 MA® austenitic stainless steel electrodes produce weld deposits that exhibit outstanding oxidation resistance at extreme temperatures up to 2000°F. The addition of the rare earth element cerium (Ce) and alkali oxides in the flux coating provide creep-rupture strength comparable to most nickel-chromium high temperature alloys. USA 253 MA® is a commonly used in petrochemical, refinery and steam superheater tube hangers, furnace fans, dampers, muffles, retorts, and pulverized coal burners in power boilers.

TYPICAL WIRE CHEMISTRY (%)

C	0.080
Mn	0.600
Si	1.700
Cr	21.000
Ni	11.000
Ce	0.040
N	0.170
Fe	Balance

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)

Yield Point (psi)	102,000
Tensile Strength -0.2% offset (psi)	54,000
% Elongation in 2"	55%
Hardness	90

253 MA® is a registered trademark of Avesta Sheffield Steel Co.

SIZES, PACKAGING AND RECOMMENDED CURRENT RANGES

Dia. (in.)	Length. (in.)	Approx. pcs. per lb.	Std. Packaging (ctn.)	300 series (Amps.)	400 series (Amps.)	500 series (Amps.)
5/64	9	65	6-10 lb. tubes in 60 lb. master	30-50	—	—
3/32	12	44	6-10 lb. tubes in 60 lb. master	45-70	50-75	50-80
1/8	14	16	6-10 lb. tubes in 60 lb. master	75-110	90-120	100-135
5/32	14	10	6-10 lb. tubes in 60 lb. master	100-140	110-150	120-180
3/16	14	8	6-10 lb. tubes in 60 lb. master	120-180	120-200	185-245
1/4	14	—	6-10 lb. tubes in 60 lb. master	220-290	250-310	300-350

1/16* Electrodes are available in certain alloys – please inquire

Stainless Steel Electrodes

USA 307-15, 16 AWS A5.4 Class E307-15, 16	USA 308-15, 16 AWS A5.4 Class E308-15, 16	USA 308L-15, 16 AWS A5.4 Class E308L-15, 16																																								
<p>DESCRIPTION AND APPLICATION</p> <p>USA 307 was developed for the welding of armour plate joints. This electrode produces a 18% Cr-8% Ni - 6% Mn stainless steel weld deposit that provides greater resistance to abrasion and Cracking. USA 307 electrodes are also used for welding dissimilar metals and difficult-to-weld steel. Preheat and postheat treatment is not required.</p>	<p>DESCRIPTION AND APPLICATION</p> <p>USA 308 electrodes are used for welding austenitic 18% Cr. - 8% Ni stainless steel types: AISI 301, 302, 304 and steel castings of similar composition such as rust-proof or ferritic steels. USA 308 electrodes provide sound weld deposits which exhibit physical properties and corrosion resistance equal to or greater than that of the base metal. This electrode provides good striking and smooth fusion, low spatter loss and easy slag removability. Ground and polished weld deposits cannot be distinguished from the base metal. USA 308 electrodes are typically used for joint welds in dairy distillary and restaurant equipment, chemical tanks, chemical engineering applications and as a build-up for sealing faces of valves and fittings for acid, gas, water and steam.</p>	<p>DESCRIPTION AND APPLICATIONS</p> <p>USA 308L electrodes contain extra low carbon for the welding of austenitic, low carbon 18% Cr-8% Ni stainless steels such as AISI- 304-ELC. The weld deposit of this electrode contains a maximum of 0.04% carbon, which greatly reduces the formation of chromium carbides, thereby protecting the corrosion resistant qualities of the base metal and weld. USA 308L electrodes have a high deposition rate resulting in excellent efficiency. This electrode may be used in all positions. In addition to 304-ELC, USA 308L electrodes may be used for stabilized stainless steels such as AISI 321 and 347, Joint welds in construction parts for chemical engineering and cryogenic applications.</p>																																								
<p>TYPICAL WIRE CHEMISTRY (%)</p> <table><tr><td>C</td><td>0.08</td></tr><tr><td>Mn</td><td>3.60</td></tr><tr><td>Si</td><td>0.50</td></tr><tr><td>Cr</td><td>20.20</td></tr><tr><td>Ni</td><td>9.40</td></tr><tr><td>Mo</td><td>1.15</td></tr></table>	C	0.08	Mn	3.60	Si	0.50	Cr	20.20	Ni	9.40	Mo	1.15	<p>TYPICAL WIRE CHEMISTRY (%)</p> <table><tr><td>C</td><td>0.060</td></tr><tr><td>Mn</td><td>1.530</td></tr><tr><td>Si</td><td>0.330</td></tr><tr><td>P</td><td>0.015</td></tr><tr><td>S</td><td>0.012</td></tr><tr><td>Cr</td><td>20.360</td></tr><tr><td>Ni</td><td>10.360</td></tr></table>	C	0.060	Mn	1.530	Si	0.330	P	0.015	S	0.012	Cr	20.360	Ni	10.360	<p>TYPICAL WIRE CHEMISTRY (%)</p> <table><tr><td>C</td><td>0.030</td></tr><tr><td>Si</td><td>0.400</td></tr><tr><td>Mn</td><td>1.030</td></tr><tr><td>P</td><td>0.018</td></tr><tr><td>S</td><td>0.010</td></tr><tr><td>Cr</td><td>19.580</td></tr><tr><td>Ni</td><td>10.200</td></tr></table>	C	0.030	Si	0.400	Mn	1.030	P	0.018	S	0.010	Cr	19.580	Ni	10.200
C	0.08																																									
Mn	3.60																																									
Si	0.50																																									
Cr	20.20																																									
Ni	9.40																																									
Mo	1.15																																									
C	0.060																																									
Mn	1.530																																									
Si	0.330																																									
P	0.015																																									
S	0.012																																									
Cr	20.360																																									
Ni	10.360																																									
C	0.030																																									
Si	0.400																																									
Mn	1.030																																									
P	0.018																																									
S	0.010																																									
Cr	19.580																																									
Ni	10.200																																									
<p>TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)</p> <table><tr><td>Tensile strength (psi)</td><td>90,000</td></tr><tr><td>Yield Strength (psi)</td><td>67,000</td></tr><tr><td>Elongation in 2"</td><td>44</td></tr></table>	Tensile strength (psi)	90,000	Yield Strength (psi)	67,000	Elongation in 2"	44	<p>TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)</p> <table><tr><td>Tensile strength (psi)</td><td>86,000</td></tr><tr><td>Yield Strength (psi)</td><td>61,000</td></tr><tr><td>Elongation in 2" (%)</td><td>46</td></tr></table>	Tensile strength (psi)	86,000	Yield Strength (psi)	61,000	Elongation in 2" (%)	46	<p>TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)</p> <table><tr><td>Tensile strength (psi)</td><td>80,000</td></tr><tr><td>Yield Strength (psi)</td><td>55,000</td></tr><tr><td>Elongation in 2" (%)</td><td>46</td></tr></table>	Tensile strength (psi)	80,000	Yield Strength (psi)	55,000	Elongation in 2" (%)	46																						
Tensile strength (psi)	90,000																																									
Yield Strength (psi)	67,000																																									
Elongation in 2"	44																																									
Tensile strength (psi)	86,000																																									
Yield Strength (psi)	61,000																																									
Elongation in 2" (%)	46																																									
Tensile strength (psi)	80,000																																									
Yield Strength (psi)	55,000																																									
Elongation in 2" (%)	46																																									

Stainless Steel Electrodes

USA 308Mo-15, 16 AWS A5.4 Class E308Mo-15, 16	USA 309-15, 16 AWS A5.4 Class E309-15, 16	USA 309-15, 16 AWS A5.4 Class E309L-15, 16
DESCRIPTION AND APPLICATION USA 308Mo electrodes are used to weld armour plate joints, dissimilar metals and difficult -to-weld steel. The weld deposit of USA 308Mo contains 18% Cr- 8% Ni -6% Mn to provide greater resistance against abrasion and cracking. Preheat and postheat treatment is not required.	DESCRIPTION AND APPLICATIONS USA 309 electrodes are used for welding heat resistant, austenitic 309 stainless steel as well as other Cr-Ni steels of similar analysis such as AISI 405, 410, 430, 442 and 446. This electrode yields weld deposits which exhibit high strength, crack resistance and oxidation resistance at temperatures up to 2000°F. USA 309 is also used for joining mild or carbon steels to stainless steels and for welding the clad side of 18-8 stainless clad steels. Typical applications would include furnace parts, kiln linings and heat treating boxes. USA 309 electrodes have a high deposition rate and may be used in all positions.	DESCRIPTION AND APPLICATIONS USA 309L electrodes are used for welding 22% Cr-12% Ni stainless steel, mild or carbon steel to stainless steel and stainless clad steel. This electrode will produce an austenitic-ferritic, ductile weld deposit that contains a maximum of 0.04% carbon, there-by providing good crack resistance and inter-granular corrosion resistance superior to that of USA 309 electrodes. Typical applications are similar to those of USA 309, but where stronger corrosion resistance is required.
TYPICAL WELD METAL CHEMISTRY (%) C 0.08 Mn 1.65 Si 0.45 Cr 20.00 Ni 9.50 Mo 2.10	TYPICAL WIRE CHEMISTRY (%) C 0.080 Mn 1.640 Si 0.430 P 0.015 S 0.012 Cr 24.180 Ni 13.230	TYPICAL WIRE CHEMISTRY (%) C 0.025 Si 0.440 Mn 1.640 P 0.020 S 0.009 Cr 24.000 Ni 13.000
TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded) Tensile strength (psi).....100,000 Yield Strength (psi).....73,000 Elongation in 2" (%).....37	TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded) Tensile strength (psi).....91,000 Yield Strength (psi).....53,000 Elongation in 2" (%).....40	TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded) Tensile strength (psi).....86,000 Yield Strength (psi).....64,000 Elongation in 2" (%).....38
USA 309Cb-15, 16 AWS A5.4 Class E309Cb-15, 16	*USA 309Mo-15, 16 AWS A5.4 Class E309Mo-15, 16	USA 310-15, 16 AWS A5.4 Class E310-15, 16
DESCRIPTION AND APPLICATIONS USA 309Cb electrodes are used where maximum corrosion and oxidation resistance at temperatures up to 2000°F is required. The addition of columbium gives the weld deposit excellent resistance to carbide precipitation and greater strength at higher temperatures. USA 309Cb is used for welding stainless clad steel containing Cb or Ti such as AISI 347 or 321, to mild steel. It is excellent for use on airplane exhaust Systems	DESCRIPTION AND APPLICATIONS USA 309Mo was developed for welding 22% Cr- 12% Mi - 2.5% Mo stainless steel, austenitic stainless steel containing molybdenum to mild or carbon steel and for welding ferritic steel plates clad with AISI 316 stainless steel. This electrode yields an austenitic ferritic, crack resistant weld deposit that will provide corrosion resistance against sulfuric acid, phosphoric acid, etc. USA 309Mo weld deposits have a tensile strength greater than that of USA 309 or USA 309L. It is typically used for overlaying carbon steel giving weld deposits analogous to 316 stainless steel.	DESCRIPTION AND APPLICATIONS USA 310 is considered a general purpose electrode used mainly for welding AISI 310 stainless steel but also for straight chromium stainless as well as almost any analysis of carbon and alloy steel. The weld deposit of this electrode will have an austenitic structure with a chemical analysis and oxidation resistance similar to that of the base plate. USA 310 provides easy slag removability and a flat regular bead with fine appearance. More common applications include 25% Cr - 20% Ni stainless steel, Cr-Mo stainless steel to mild steel, and the clad side of 18% Cr - 8% Ni stainless clad steel. USA 310 can be used in all positions.
TYPICAL WIRE CHEMISTRY (%) C 0.070 Mn 1.000 Si 0.500 P 0.012 S 0.012 Cr 23.000 Ni 13.000 Cb 0.850	TYPICAL WIRE CHEMISTRY (%) C 0.060 Mn 1.440 Si 0.380 P 0.012 S 0.012 Cr 23.780 Ni 13.440 Mo 2.310	TYPICAL WIRE CHEMISTRY (%) C 0.120 Si 0.400 Mn 1.860 P 0.020 S 0.011 Cr 26.500 Ni 21.000
TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded) Tensile strength (psi).....100,000 Yield Strength (psi).....80,000 Elongation in 2" (%).....34	TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded) Tensile strength (psi).....94,000 Yield Strength (psi).....74,000 Elongation in 2" (%).....37	TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded) Tensile strength (psi).....87,700 Yield Strength (psi).....52,000 Elongation in 2" (%).....41

Stainless Steel Electrodes

USA 308Mo-15, 16 AWS A5.4 Class E308Mo-15, 16	USA 310Cb-15, 16 AWS A5.4 Class E310Cb-15, 16	USA 312-15, 16 AWS A5.4 Class E312-15, 16																																																																
<p>DESCRIPTION AND APPLICATION</p> <p>USA 310Mo is similar to USA 310 but with molybdenum added for improved high tem-perature creep properties. The weld deposit is fully austenitic and corrosion resistantl. USA 310Mo electrodes are primarily intended for welding the clad side of 316, 316L and 317 clad steels as well as other grades of molybdenum bearing stainless steels. USA 310 Mo electrodes are used for the resurfacing of digesters in the paper industry.</p> <p>TYPICAL WELD METAL CHEMISTRY (%)</p> <table><tr><td>C</td><td>0.100</td></tr><tr><td>Mn</td><td>2.100</td></tr><tr><td>Si</td><td>0.450</td></tr><tr><td>P</td><td>0.012</td></tr><tr><td>S</td><td>0.012</td></tr><tr><td>Cr</td><td>26.000</td></tr><tr><td>Ni</td><td>21.000</td></tr><tr><td>Mo</td><td>2.250</td></tr></table> <p>TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)</p> <table><tr><td>Tensile strength (psi).....</td><td>90,000</td></tr><tr><td>Yield Strength (psi).....</td><td>65,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>39</td></tr></table> <p>USA 310Cb-15, 16 AWS A5.4 Class E310Cb-15, 16</p>	C	0.100	Mn	2.100	Si	0.450	P	0.012	S	0.012	Cr	26.000	Ni	21.000	Mo	2.250	Tensile strength (psi).....	90,000	Yield Strength (psi).....	65,000	Elongation in 2" (%).....	39	<p>DESCRIPTION AND APPLICATIONS</p> <p>USA 310Cb electrodes are similar to USA 310 but contain columbium for improved resistance against carbide precipitation at higher temperatures. USA 310Cb is used for welding AISI 304, 309, 310, 316, 321, and 347 stainless clad steels as well as for joining 25% Cr - 20% Ni - Cb stainless steels to mild or carbon steels.</p> <p>TYPICAL WIRE CHEMISTRY (%)</p> <table><tr><td>C</td><td>0.100</td></tr><tr><td>Mn</td><td>2.100</td></tr><tr><td>Si</td><td>0.450</td></tr><tr><td>P</td><td>0.012</td></tr><tr><td>S</td><td>0.012</td></tr><tr><td>Cr</td><td>26.000</td></tr><tr><td>Ni</td><td>21.000</td></tr><tr><td>Cb</td><td>0.850</td></tr></table> <p>TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)</p> <table><tr><td>Tensile strength (psi).....</td><td>90,000</td></tr><tr><td>Yield Strength (psi).....</td><td>65,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>35</td></tr></table>	C	0.100	Mn	2.100	Si	0.450	P	0.012	S	0.012	Cr	26.000	Ni	21.000	Cb	0.850	Tensile strength (psi).....	90,000	Yield Strength (psi).....	65,000	Elongation in 2" (%).....	35	<p>DESCRIPTION AND APPLICATIONS</p> <p>USA 312 electrodes produce a weld deposit (as welded) with the highest tensile and yield strength of any stainless arc electrode. As a result, it is one of the most widely used stainless steel electrodes for arc welding. It is used to weld dissimilar steels, abrasion resistant steels, high yield steels and for joining high temperature alloys to carbon or low alloy steels. USA 312 electrodes produce ductile, crack resistant, porosity-free, weld deposits with greater root penetration and better slag control in tight places. USA 312 is also used for Mn steels, hardening steels, armour steels, spring steels, and as a wear resistant build-up and buffer layer for hardfacing. This electrode may be used in all positions.</p> <p>TYPICAL WIRE CHEMISTRY (%)</p> <table><tr><td>C</td><td>0.120</td></tr><tr><td>Mn</td><td>1.700</td></tr><tr><td>Si</td><td>0.600</td></tr><tr><td>P</td><td>0.030</td></tr><tr><td>S</td><td>0.020</td></tr><tr><td>Cr</td><td>29.500</td></tr><tr><td>Ni</td><td>9.000</td></tr></table> <p>TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)</p> <table><tr><td>Tensile strength (psi).....</td><td>120,000</td></tr><tr><td>Yield Strength (psi).....</td><td>85,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>30</td></tr></table>	C	0.120	Mn	1.700	Si	0.600	P	0.030	S	0.020	Cr	29.500	Ni	9.000	Tensile strength (psi).....	120,000	Yield Strength (psi).....	85,000	Elongation in 2" (%).....	30
C	0.100																																																																	
Mn	2.100																																																																	
Si	0.450																																																																	
P	0.012																																																																	
S	0.012																																																																	
Cr	26.000																																																																	
Ni	21.000																																																																	
Mo	2.250																																																																	
Tensile strength (psi).....	90,000																																																																	
Yield Strength (psi).....	65,000																																																																	
Elongation in 2" (%).....	39																																																																	
C	0.100																																																																	
Mn	2.100																																																																	
Si	0.450																																																																	
P	0.012																																																																	
S	0.012																																																																	
Cr	26.000																																																																	
Ni	21.000																																																																	
Cb	0.850																																																																	
Tensile strength (psi).....	90,000																																																																	
Yield Strength (psi).....	65,000																																																																	
Elongation in 2" (%).....	35																																																																	
C	0.120																																																																	
Mn	1.700																																																																	
Si	0.600																																																																	
P	0.030																																																																	
S	0.020																																																																	
Cr	29.500																																																																	
Ni	9.000																																																																	
Tensile strength (psi).....	120,000																																																																	
Yield Strength (psi).....	85,000																																																																	
Elongation in 2" (%).....	30																																																																	

Stainless Steel Electrodes

USA 316-15, 16 AWS A5.4 Class E316-15, 16	USA 316L-15, 16 AWS A5.4 Class E316L-15, 16	USA 317-15, 16 AWS A5.4 Class E317-15, 16																																																																		
<p>DESCRIPTION AND APPLICATION</p> <p>USA 316 electrodes are used for welding corrosion resistant austenitic Cr-Ni stainless steels containing 2-3% molybdenum. The molybdenum content of this electrode gives the weld deposit excellent corrosion resistance at elevated temperatures against pitting that may be caused by sulfuric and sulfurous acids, phosphoric acids, and acetic acids. USA 316 electrodes have good deposition efficiency, producing weld deposits with smooth bead appearance and easy slag removability. This electrode can be used in any position, however it is best suited for flat and horizontal fillet welding. USA 316 electrodes are most commonly used in industries which manufacture rayon, dye, paper, ink, rubber, bleaches, dye stuffs, photographic chemicals and as a build-up on sealing faces of valves and fittings for acid, gas, water and steam made from unalloyed or low alloyed steels.</p> <p>TYPICAL WELD METAL CHEMISTRY (% - tested with 100% CO₂)</p> <table><tr><td>C</td><td>0.050</td></tr><tr><td>Mn</td><td>1.480</td></tr><tr><td>Si</td><td>0.330</td></tr><tr><td>P</td><td>0.021</td></tr><tr><td>S</td><td>0.011</td></tr><tr><td>Cr</td><td>18.320</td></tr><tr><td>Ni</td><td>12.850</td></tr><tr><td>Mo</td><td>2480</td></tr></table> <p>TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)</p> <table><tr><td>Tensile strength (psi).....</td><td>86,000</td></tr><tr><td>Yield Strength (psi).....</td><td>56,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>40</td></tr></table>	C	0.050	Mn	1.480	Si	0.330	P	0.021	S	0.011	Cr	18.320	Ni	12.850	Mo	2480	Tensile strength (psi).....	86,000	Yield Strength (psi).....	56,000	Elongation in 2" (%).....	40	<p>DESCRIPTION AND APPLICATION</p> <p>USA 316L electrodes produce weld deposits similar to that of USA 316, but with a maximum 0.04% carbon. This extra low carbon content gives the weld deposit excellent resistance against intergranular corrosion caused by carbide precipitation. USA 316L electrodes are used for welding 18% Cr – 12% Ni - 2.5% Mo stainless steels where the corrosion resistant qualities of AISI 316L are required. This electrode has a high deposition rate and produces a weld deposit with fine bead appearance and exceptional crack-resistance. USA 316L electrodes are most commonly used in the textile, paper, cellulose, and chemical equipment industries for the fabrication of 316L, 318 and 319L stainless steel products.</p> <p>TYPICAL WELD METAL CHEMISTRY (%)</p> <table><tr><td>C</td><td>0.030</td></tr><tr><td>Mn</td><td>1.250</td></tr><tr><td>Si</td><td>0.480</td></tr><tr><td>P</td><td>0.020</td></tr><tr><td>S</td><td>0.012</td></tr><tr><td>Cr</td><td>19.060</td></tr><tr><td>Ni</td><td>12.120</td></tr><tr><td>Mo</td><td>2.160</td></tr></table> <p>TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)</p> <table><tr><td>Tensile strength (psi).....</td><td>86,000</td></tr><tr><td>Yield Strength (psi).....</td><td>57,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>39</td></tr></table>	C	0.030	Mn	1.250	Si	0.480	P	0.020	S	0.012	Cr	19.060	Ni	12.120	Mo	2.160	Tensile strength (psi).....	86,000	Yield Strength (psi).....	57,000	Elongation in 2" (%).....	39	<p>DESCRIPTION AND APPLICATION</p> <p>USA 317 electrodes have a greater molybdenum content than USA 316. The increased molybdenum content results in a weld deposit with higher tensile strength at elevated temperatures, stronger resistance against pitting corrosion, and virtually immune from cracking as the deposit cools down from the molten stage. USA 317 weld deposits exhibit smooth bead appearance and easy slag removability. This electrode is typically used where strong corrosion resistance against sulfuric or sulfurous acids is required such as in the chemical, paper and textile industries.</p> <p>TYPICAL WIRE CHEMISTRY (%)</p> <table><tr><td>C</td><td>0.050</td></tr><tr><td>Mn</td><td>1.900</td></tr><tr><td>Si</td><td>0.390</td></tr><tr><td>P</td><td>0.020</td></tr><tr><td>S</td><td>0.010</td></tr><tr><td>Cr</td><td>19.190</td></tr><tr><td>Ni</td><td>13.470</td></tr><tr><td>Mo</td><td>3.300</td></tr></table> <p>TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)</p> <table><tr><td>Tensile strength (psi).....</td><td>95,000</td></tr><tr><td>Yield Strength (psi).....</td><td>70,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>33</td></tr></table>	C	0.050	Mn	1.900	Si	0.390	P	0.020	S	0.010	Cr	19.190	Ni	13.470	Mo	3.300	Tensile strength (psi).....	95,000	Yield Strength (psi).....	70,000	Elongation in 2" (%).....	33
C	0.050																																																																			
Mn	1.480																																																																			
Si	0.330																																																																			
P	0.021																																																																			
S	0.011																																																																			
Cr	18.320																																																																			
Ni	12.850																																																																			
Mo	2480																																																																			
Tensile strength (psi).....	86,000																																																																			
Yield Strength (psi).....	56,000																																																																			
Elongation in 2" (%).....	40																																																																			
C	0.030																																																																			
Mn	1.250																																																																			
Si	0.480																																																																			
P	0.020																																																																			
S	0.012																																																																			
Cr	19.060																																																																			
Ni	12.120																																																																			
Mo	2.160																																																																			
Tensile strength (psi).....	86,000																																																																			
Yield Strength (psi).....	57,000																																																																			
Elongation in 2" (%).....	39																																																																			
C	0.050																																																																			
Mn	1.900																																																																			
Si	0.390																																																																			
P	0.020																																																																			
S	0.010																																																																			
Cr	19.190																																																																			
Ni	13.470																																																																			
Mo	3.300																																																																			
Tensile strength (psi).....	95,000																																																																			
Yield Strength (psi).....	70,000																																																																			
Elongation in 2" (%).....	33																																																																			

Stainless Steel Electrodes

USA 317L-15,16 AWS A5.4 Class E317L-15,16	USA 318-15, 16 AWS A5.4 Class E318-15,16	USA 320-15, 16 AWS A5.4 Class E320-15, 16																																														
<p>DESCRIPTION AND APPLICATION</p> <p>USA 317L electrodes produce weld deposits similar to USA 317 but containing a maximum 0.04% carbon. This extra low carbon content offers increased resistance against intergranular corrosion from chloride ions. The weld deposits of USA 317L electrodes exhibit smooth bead appearance, easy slag removability and very good creep resistance at elevated temperatures. USA 317L electrodes are used mainly for the welding of 18% Cr-12% Ni - 3% Mo stainless steels. Typical applications include those similar to USA 317 electrodes,</p>	<p>DESCRIPTION AND APPLICATION</p> <p>USA 318 electrodes are similar to USA 316 but contain columbium to prevent the formation of chromium carbides, thereby eliminating intergranular corrosion. This electrode is used to weld AISI 318 stainless steel where a complete absence of chromium carbides is important.</p>	<p>DESCRIPTION AND APPLICATION</p> <p>USA 320 electrodes developed for the welding of Carpenter Stainless #20* and 20 Cb-3* stainless steels. This electrode will produce weld deposits which resist corrosion from sulfuric acid, phosphoric acid, and other chemicals. USA 320 offers resistance to pitting and cracking,</p>																																														
<p>TYPICAL WELD METAL CHEMISTRY (%)</p> <table><tr><td>C</td><td>0.030</td></tr><tr><td>Mn</td><td>1.900</td></tr><tr><td>Si</td><td>0.390</td></tr><tr><td>P</td><td>0.020</td></tr><tr><td>S</td><td>0.010</td></tr><tr><td>Cr</td><td>19.190</td></tr><tr><td>Ni</td><td>13.470</td></tr><tr><td>Mo</td><td>3.250</td></tr></table>	C	0.030	Mn	1.900	Si	0.390	P	0.020	S	0.010	Cr	19.190	Ni	13.470	Mo	3.250	<p>TYPICAL WELD METAL CHEMISTRY (%)</p> <table><tr><td>C</td><td>0.05</td></tr><tr><td>Mn</td><td>1.75</td></tr><tr><td>Si</td><td>0.40</td></tr><tr><td>Cr</td><td>19.50</td></tr><tr><td>Ni</td><td>12.50</td></tr><tr><td>Mo</td><td>2.30</td></tr><tr><td>Cb</td><td>0.55</td></tr></table>	C	0.05	Mn	1.75	Si	0.40	Cr	19.50	Ni	12.50	Mo	2.30	Cb	0.55	<p>TYPICAL WELD METAL CHEMISTRY (%)</p> <table><tr><td>C</td><td>0.04</td></tr><tr><td>Mn</td><td>2.25</td></tr><tr><td>Si</td><td>0.25</td></tr><tr><td>Cr</td><td>19.70</td></tr><tr><td>Ni</td><td>32.90</td></tr><tr><td>Mo</td><td>2.15</td></tr><tr><td>Cb & Ta</td><td>0.50</td></tr><tr><td>Cu</td><td>3.10</td></tr></table>	C	0.04	Mn	2.25	Si	0.25	Cr	19.70	Ni	32.90	Mo	2.15	Cb & Ta	0.50	Cu	3.10
C	0.030																																															
Mn	1.900																																															
Si	0.390																																															
P	0.020																																															
S	0.010																																															
Cr	19.190																																															
Ni	13.470																																															
Mo	3.250																																															
C	0.05																																															
Mn	1.75																																															
Si	0.40																																															
Cr	19.50																																															
Ni	12.50																																															
Mo	2.30																																															
Cb	0.55																																															
C	0.04																																															
Mn	2.25																																															
Si	0.25																																															
Cr	19.70																																															
Ni	32.90																																															
Mo	2.15																																															
Cb & Ta	0.50																																															
Cu	3.10																																															
<p>TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)</p> <table><tr><td>Tensile strength (psi).....</td><td>92,000</td></tr><tr><td>Yield Strength (psi).....</td><td>69,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>35</td></tr></table>	Tensile strength (psi).....	92,000	Yield Strength (psi).....	69,000	Elongation in 2" (%).....	35	<p>TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)</p> <table><tr><td>Tensile strength (psi).....</td><td>95,000</td></tr><tr><td>Yield Strength (psi).....</td><td>75,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>35</td></tr></table>	Tensile strength (psi).....	95,000	Yield Strength (psi).....	75,000	Elongation in 2" (%).....	35	<p>TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)</p> <table><tr><td>Tensile strength (psi).....</td><td>84,000</td></tr><tr><td>Yield Strength (psi).....</td><td>54,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>39</td></tr></table>	Tensile strength (psi).....	84,000	Yield Strength (psi).....	54,000	Elongation in 2" (%).....	39																												
Tensile strength (psi).....	92,000																																															
Yield Strength (psi).....	69,000																																															
Elongation in 2" (%).....	35																																															
Tensile strength (psi).....	95,000																																															
Yield Strength (psi).....	75,000																																															
Elongation in 2" (%).....	35																																															
Tensile strength (psi).....	84,000																																															
Yield Strength (psi).....	54,000																																															
Elongation in 2" (%).....	39																																															

Stainless Steel Electrodes

USA 320LR-15, 16 AWS A5.4 Class E320LR-15, 16	USA 330-15, 16 AWS A5.4 Class E330-15, 16	USA 347-15, 16 AWS A5.4 Class E347-15, 16																																						
<p>DESCRIPTION AND APPLICATION</p> <p>USA 320LR flux-coated electrodes are a modified version of USA 320 electrodes, where the “residuals” - carbon, silicon, phosphorus and sulphur are specified at lower maximum levels. Columbium and manganese are also maintained within tighter parameters. These strict controls eliminate hot cracking and microfissuring frequently encountered in austenitic stainless steel. Excellent corrosion resistance against sulfuric acid, phosphoric acid and other chemicals.</p>	<p>DESCRIPTION AND APPLICATION</p> <p>USA 330 electrodes have a high nickel content which gives the weld deposit the capability to provide excellent corrosion and oxidation resistance at extreme temperature ranges above 1800°F. The weld deposit of USA 330 will exhibit high creep strength, excellent thermal shock resistance and minimal embrittling. USA 330 electrodes are used for welding cast and wrought forms of AISI 330 stainless steel.</p>	<p>DESCRIPTION AND APPLICATION</p> <p>USA 347 electrodes are used to weld austenitic 18% Cr- 8% Ni stainless steels where maximum resistance to corrosion is required. USA 347 weld deposits contain columbium in the amount of 10 times the amount of carbon with a maximum of 1%), which prevents intergranular corrosion caused by carbide precipitation. USA 347 electrodes are commonly used for welding AISI 304, 321 and 347 stainless steels in the textile and cellulose industries for joint-welding mechanical parts exposed to chemical attack. Other uses include pressure vessels such as those found in chemical plants and oil refineries, dye works, and for sealing basis application in acid, gas, water, and steam valves and fittings. USA 347 produces weld deposits with smooth bead appearance and easy slag removability.</p>																																						
<p>TYPICAL WELD METAL CHEMISTRY (%)</p> <table><tr><td>C</td><td>0.012</td></tr><tr><td>Mn</td><td>1.640</td></tr><tr><td>Si</td><td>0.070</td></tr><tr><td>Cr</td><td>20.300</td></tr><tr><td>Ni</td><td>34.800</td></tr><tr><td>Mo</td><td>2.250</td></tr><tr><td>Cb & Ta</td><td>0.200</td></tr><tr><td>Cu</td><td>3.600</td></tr></table>	C	0.012	Mn	1.640	Si	0.070	Cr	20.300	Ni	34.800	Mo	2.250	Cb & Ta	0.200	Cu	3.600	<p>TYPICAL WELD METAL CHEMISTRY (%)</p> <table><tr><td>C</td><td>0.020</td></tr><tr><td>Mn</td><td>2.25</td></tr><tr><td>Si</td><td>0.50</td></tr><tr><td>Cr</td><td>14.50</td></tr><tr><td>Ni</td><td>34.00</td></tr></table>	C	0.020	Mn	2.25	Si	0.50	Cr	14.50	Ni	34.00	<p>TYPICAL WELD METAL CHEMISTRY (%)</p> <table><tr><td>C</td><td>0.05</td></tr><tr><td>Mn</td><td>1.63</td></tr><tr><td>Si</td><td>0.47</td></tr><tr><td>Cr</td><td>19.92</td></tr><tr><td>Ni</td><td>9.67</td></tr><tr><td>Cb & Ta</td><td>0.63</td></tr></table>	C	0.05	Mn	1.63	Si	0.47	Cr	19.92	Ni	9.67	Cb & Ta	0.63
C	0.012																																							
Mn	1.640																																							
Si	0.070																																							
Cr	20.300																																							
Ni	34.800																																							
Mo	2.250																																							
Cb & Ta	0.200																																							
Cu	3.600																																							
C	0.020																																							
Mn	2.25																																							
Si	0.50																																							
Cr	14.50																																							
Ni	34.00																																							
C	0.05																																							
Mn	1.63																																							
Si	0.47																																							
Cr	19.92																																							
Ni	9.67																																							
Cb & Ta	0.63																																							
<p>TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)</p> <table><tr><td>Tensile strength (psi).....</td><td>84,000</td></tr><tr><td>Yield Strength (psi).....</td><td>54,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>34</td></tr></table>	Tensile strength (psi).....	84,000	Yield Strength (psi).....	54,000	Elongation in 2" (%).....	34	<p>TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)</p> <table><tr><td>Tensile strength (psi).....</td><td>86,000</td></tr><tr><td>Yield Strength (psi).....</td><td>58,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>40</td></tr></table>	Tensile strength (psi).....	86,000	Yield Strength (psi).....	58,000	Elongation in 2" (%).....	40	<p>TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)</p> <table><tr><td>Tensile strength (psi).....</td><td>96,000</td></tr><tr><td>Yield Strength (psi).....</td><td>64,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>36</td></tr></table>	Tensile strength (psi).....	96,000	Yield Strength (psi).....	64,000	Elongation in 2" (%).....	36																				
Tensile strength (psi).....	84,000																																							
Yield Strength (psi).....	54,000																																							
Elongation in 2" (%).....	34																																							
Tensile strength (psi).....	86,000																																							
Yield Strength (psi).....	58,000																																							
Elongation in 2" (%).....	40																																							
Tensile strength (psi).....	96,000																																							
Yield Strength (psi).....	64,000																																							
Elongation in 2" (%).....	36																																							

Stainless Steel Electrodes

USA 410-15,16 AWS A5.4 Class E410-15,16	USA 410NiMo-15, 16 AWS A5.4 Class E410NiMo-15, 16	USA 430-15, 16 AWS A5.4 Class E430-15, 16																																																
<p>DESCRIPTION AND APPLICATION</p> <p>USA 410 electrodes are used for welding AISI 410 straight chromium steels where good strength and ductility, as well as corrosion and oxidation resistance at temperatures as high as 1500°F is a requirement. USA 410 electrodes contain 12% chromium thereby producing weld deposits that are martensitic and not subject to carbide precipitation. Utilization does require preheat and postheat treatment to achieve good ductility in the welds. USA 410 is also used for welding AISI 403, 405, 414, 416 and 420 stainless steels, for overlaying carbon steels to provide corrosion, erosion and abrasion resistance, and as a buildup on sealing faces of gas, water and steam fittings which are made from unalloyed or low-alloyed steels.</p> <p>TYPICAL WELD METAL CHEMISTRY (%)</p> <table><tr><td>C</td><td>0.09</td></tr><tr><td>Mn</td><td>0.50</td></tr><tr><td>Si</td><td>0.40</td></tr><tr><td>Cr</td><td>11.80</td></tr><tr><td>Ni</td><td>0.30</td></tr></table> <p>TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (stress-relieved)</p> <table><tr><td>Tensile strength (psi).....</td><td>80,000</td></tr><tr><td>Yield Strength (psi).....</td><td>44,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>28</td></tr></table>	C	0.09	Mn	0.50	Si	0.40	Cr	11.80	Ni	0.30	Tensile strength (psi).....	80,000	Yield Strength (psi).....	44,000	Elongation in 2" (%).....	28	<p>DESCRIPTION AND APPLICATION</p> <p>USA 410 NiMo electrodes are similar to USA 410 electrodes but contain molybdenum and a higher nickel content for improved corrosion resistance at elevated temperatures. USA 410NiMo electrodes are used for repair welding of large 410 castings as well as light gauge 405, 410 and 410S stainless steels.</p> <p>TYPICAL WELD METAL CHEMISTRY (%)</p> <table><tr><td>C</td><td>0.05</td></tr><tr><td>Mn</td><td>0.75</td></tr><tr><td>Si</td><td>0.40</td></tr><tr><td>Cr</td><td>11.70</td></tr><tr><td>Ni</td><td>4.50</td></tr><tr><td>Mo</td><td>0.50</td></tr></table> <p>TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (stress-relieved)</p> <table><tr><td>Tensile strength (psi).....</td><td>155,000</td></tr><tr><td>Yield Strength (psi).....</td><td>138,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>14</td></tr></table>	C	0.05	Mn	0.75	Si	0.40	Cr	11.70	Ni	4.50	Mo	0.50	Tensile strength (psi).....	155,000	Yield Strength (psi).....	138,000	Elongation in 2" (%).....	14	<p>DESCRIPTION AND APPLICATION</p> <p>USA 430 electrodes produce weld deposits that are martensitic in structure and highly resistant to chemical corrosion and oxidation at temperatures as high as 1600°F. USA 430 is used for welding AISI 430 stainless steel, however it is also used for welding AISI 410 that may have a chromium content on the high side. In order to obtain maximum results USA 430 electrodes require preheat and postheat treatment.</p> <p>TYPICAL WELD METAL CHEMISTRY (%)</p> <table><tr><td>C</td><td>0.07</td></tr><tr><td>Mn</td><td>0.95</td></tr><tr><td>Si</td><td>16.60</td></tr><tr><td>Cr</td><td>0.64</td></tr></table> <p>TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (stress-relieved)</p> <table><tr><td>Tensile strength (psi).....</td><td>78,000</td></tr><tr><td>Yield Strength (psi).....</td><td>44,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>28</td></tr></table>	C	0.07	Mn	0.95	Si	16.60	Cr	0.64	Tensile strength (psi).....	78,000	Yield Strength (psi).....	44,000	Elongation in 2" (%).....	28
C	0.09																																																	
Mn	0.50																																																	
Si	0.40																																																	
Cr	11.80																																																	
Ni	0.30																																																	
Tensile strength (psi).....	80,000																																																	
Yield Strength (psi).....	44,000																																																	
Elongation in 2" (%).....	28																																																	
C	0.05																																																	
Mn	0.75																																																	
Si	0.40																																																	
Cr	11.70																																																	
Ni	4.50																																																	
Mo	0.50																																																	
Tensile strength (psi).....	155,000																																																	
Yield Strength (psi).....	138,000																																																	
Elongation in 2" (%).....	14																																																	
C	0.07																																																	
Mn	0.95																																																	
Si	16.60																																																	
Cr	0.64																																																	
Tensile strength (psi).....	78,000																																																	
Yield Strength (psi).....	44,000																																																	
Elongation in 2" (%).....	28																																																	
USA 8018-B6 (502) AWS A5.4 Class E8018-B6	USA 8018-B8 (505) AWS A5.5 Class E8018-B8	USA 630-15, 16 AWS A5.4 Class E630-15, 16 AMS 5827																																																
<p>DESCRIPTION AND APPLICATION</p> <p>USA 8018-B6 electrodes are most commonly used in the oil and chemical industries for welding AISI stainless steel types 501 and 502 where high temperature resistance to corrosion and oxidation is necessary. The weld deposits of USA 8018-B6 are martensitic in grain structure and not subject to carbide precipitation. USA 8018-B6 is an air-hardenable material that requires preheat and postheat treatment if maximum results are to be achieved. Other applications would include joint welds in pipeline construction, joining low and medium alloyed quenched and tempered steel and case hardening steels containing 2-3% chromium.</p> <p>TYPICAL WELD METAL CHEMISTRY (%) (Welded with DCSP, 100% Argon Shield Gas)</p> <table><tr><td>C</td><td>0.06</td></tr><tr><td>Mn</td><td>0.57</td></tr><tr><td>Si</td><td>0.44</td></tr><tr><td>Cr</td><td>4.98</td></tr><tr><td>Ni</td><td>0.51</td></tr></table> <p>TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)</p> <table><tr><td>Tensile strength (psi).....</td><td>74,000</td></tr><tr><td>Yield Strength (psi).....</td><td>38,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>36</td></tr></table>	C	0.06	Mn	0.57	Si	0.44	Cr	4.98	Ni	0.51	Tensile strength (psi).....	74,000	Yield Strength (psi).....	38,000	Elongation in 2" (%).....	36	<p>DESCRIPTION AND APPLICATION</p> <p>USA 8018-B8 electrodes contain 9% chrome-1% molybdenum and are used for welding AISI type 505 stainless steels of the same composition. More specific applications would include welding grade P-91 pipes, tubes or castings subject to hot hydrogen service such as found in the petroleum industry. USA 8018-B8 is an air-hardened material that requires pre-heat and post-heat treatment to achieve maximum results.</p> <p>TYPICAL WELD METAL CHEMISTRY (%) (Welded with DCSP, 100% Argon Shield Gas)</p> <table><tr><td>C</td><td>0.06</td></tr><tr><td>Mn</td><td>0.48</td></tr><tr><td>Si</td><td>0.29</td></tr><tr><td>Cr</td><td>9.43</td></tr><tr><td>Mo</td><td>1.03</td></tr></table> <p>TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (after heat treatment at 1575°F)</p> <table><tr><td>Tensile strength (psi).....</td><td>74,000</td></tr><tr><td>Yield Strength (psi).....</td><td>38,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>36</td></tr></table>	C	0.06	Mn	0.48	Si	0.29	Cr	9.43	Mo	1.03	Tensile strength (psi).....	74,000	Yield Strength (psi).....	38,000	Elongation in 2" (%).....	36	<p>DESCRIPTION AND APPLICATION</p> <p>USA 630 is a martensitic precipitation, age-hardening 17% chromium - 4% nickel stainless steel flux-coated electrode designed for welding ASTM A564 Type 630 and other martensitic PH stainless steels such as 15-5. Weld deposits have excellent mechanical properties with high strength and hardness. Most commonly used in high temperature and abrasion resistant environments such as found in the petrochemical and aerospace industries.</p> <p>TYPICAL WELD METAL CHEMISTRY (%)</p> <table><tr><td>C</td><td>0.035</td></tr><tr><td>Mn</td><td>0.450</td></tr><tr><td>Si</td><td>0.400</td></tr><tr><td>Cr</td><td>16.350</td></tr><tr><td>Ni</td><td>4.750</td></tr><tr><td>Cb & Ta</td><td>0.200</td></tr><tr><td>Cu</td><td>3.300</td></tr></table> <p>TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded) Dependent on post-weld heat treatment</p>	C	0.035	Mn	0.450	Si	0.400	Cr	16.350	Ni	4.750	Cb & Ta	0.200	Cu	3.300		
C	0.06																																																	
Mn	0.57																																																	
Si	0.44																																																	
Cr	4.98																																																	
Ni	0.51																																																	
Tensile strength (psi).....	74,000																																																	
Yield Strength (psi).....	38,000																																																	
Elongation in 2" (%).....	36																																																	
C	0.06																																																	
Mn	0.48																																																	
Si	0.29																																																	
Cr	9.43																																																	
Mo	1.03																																																	
Tensile strength (psi).....	74,000																																																	
Yield Strength (psi).....	38,000																																																	
Elongation in 2" (%).....	36																																																	
C	0.035																																																	
Mn	0.450																																																	
Si	0.400																																																	
Cr	16.350																																																	
Ni	4.750																																																	
Cb & Ta	0.200																																																	
Cu	3.300																																																	

Stainless Steel Electrodes

USA E385-16 (904L-16) AWS A5.4 Class E385-16

DESCRIPTION AND APPLICATION

USA 904L is a high alloy austenitic stainless steel electrode with extra low carbon content intended for use in severe corrosive conditions. Residual elements C, Si, P, S and N are kept at much lower levels in order to keep the weld metal from hot cracking and fissuring. USA 904L is designed for joining 20% Cr-25% Ni-4.5% Mo-1.5% Cu stainless steels used to manufacture and repair processing equipment, tanks, vessels, and process piping handling acetic acids, sulphuric acid solutions and many chloride containing media. Other uses include cooling units for sea water and river water purification plants and for cladding lower alloy steels when used in many corrosive media environments. USA 904L is also used for joining AISI type 317 where improved corrosive resistance in specific media is required.

TYPICAL WELD METAL CHEMISTRY (%)

C	0.025 max.
Mn	1.0-2.5
Si	0.500 max.
Ni	24.0-26.0
Cr	16.5-21.5
Mo	4.2-5.2
Cu	1.2-2.0
N	0.04

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)

Tensile strength (psi).....	68,000
Yield Strength (psi).....	82,500
Elongation in 2" (%).....	36

USA 316L-15, 16 AWS A5.4 Class E2209-16

DESCRIPTION AND APPLICATION

USA 2209-16 duplex stainless steel electrodes are designed for welding 22% chromium duplex stainless steels such as 2209, 2205 and 2304.3RE60®, 44LN® and Ferralium 255® are proprietary duplex stainless steel base metals in the 22% Cr category that can also be joined successfully with USA 2209-16 electrodes. Weld deposits exhibit very high tensile strength, resistance to stress, corrosion, cracking and greater resistance to pitting. USA 2209-16 has excellent weldability with spatter-free arc, self-releasing slag and a very smooth bead appearance.

TYPICAL WELD METAL CHEMISTRY (%)

C	0.04 max.
Mn	0.5-2.0
Si	0.90 max.
Cr	21.5-23.5
Ni	8.5-10.5
Mo	2.5-3.5
Cb	1.0 max
N	0.08-0.20

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)

Tensile strength (psi).....	109,000
Yield Strength (psi).....	87,000
Elongation in 2" (%).....	25

3Re60® is a registered trademark of Sandvik Steel Co. 44LN® is a registered trademark of Avesta Sheffield Co. Ferralium 255® is a registered trademark of Cabot Corporation

Mechanical-Property Requirements for All-Weld Metal

AWS Classification	Tensile strength, min		Elongation in 2 in. gauge length, min. percent	Heat treatment
	Ksi	MPa		
E209	100	690	15	None
E219	90	620	15	None
E240	100	690	15	None
E307	85	590	30	None
E308	80	550	35	None
E308H	80	550	35	None
E308L	75	520	35	None
E308Mo	80	550	35	None
E308MoL	75	520	35	None
E309	80	550	30	None
E309L	75	520	30	None
E309Cb	80	550	30	None
E309Mo	80	550	30	None
E310	80	550	30	None
E310H	90	620	10	None
E310Cb	80	550	25	None
E310Mo	80	550	30	None
E312	95	660	22	None
E316	75	520	30	None
E316H	75	520	30	None
E316L	70	490	30	None
E317	80	550	30	None
E317L	75	520	30	None
E318	80	550	25	None
E320	80	550	30	None
E320LR	75	520	30	None
E330	75	520	25	None
E330H	90	620	10	None
E347	75	520	30	None
E349	100	690	25	None
E410	65	450	20	a
E410NiMo	110	750	15	b
E430	65	450	20	c
E502	60	420	20	a
E505	60	420	20	a
E630	135	930	7	d
E16-8-2	80	550	35	None
E7Cr	60	420	20	a

- Specimen shall be heated to between 1550° and 1600°F (840 and 870°C), held for 2 hours, furnace-cooled at a rate not exceeding 100°F (55°C) per hour to 1100°F (595°C) and air cooled to ambient.
- Specimen shall be heated to between 1100° and 1150°F (595° and 620°C), held for 1 hour, and air cooled to ambient.
- Specimen shall be heated to between 1400° and 1450°F (760° and 790°C), held for 2 hours, and furnace-cooled at a rate not exceeding 100°F (55°C) per hour to 100°F (55°C), and air cooled to ambient.
- Specimen shall be heated to between 1875° and 1925°F (1025° and 1050°C), held for 1 hour, air cooled to at least 60°F (15°C), and then precipitation hardened at 1135° to 1165°F (610° to 630°C), held for 4 hours, and air cooled to ambient.

Stainless Steel Electrode Selection Chart

Base Metal AISI Types	Common Designation		Recommended Washington Alloy Electrode	Alternate Washington Alloy Choices
Austenitic	201	17-4 Mn	308	308L, 347, 309, 309Cb, 309Mo, 310, 310Cb
	202	18-5 Mn		
	301	17-7		
	302	18-8		
	302B	18-8 Si		
	303	18-8 F.m.*		
	303Se	18-8 F.m.*		
	304	19-9	308	310Mo, 316, 316L, 316Cb
	305	18-10		
	308	20-10	308	310Mo, 316, 316L, 316Cb
	304L	19-9 L	308L	347, 309Cb, 310Cb, 316Cb, 316L
	309	24-12	309	309Cb, 310, 310Cb, 310Mo
	309S			
	310	25-20	310	
	310S			
	314			
Martensitic	25-20	310	310Cb	
	25-20			
	312		312	None
	316	18-12 Mo	316	316Cb, 316L, 309Mo, 317
	316L	18-12MoL	316L	None
	317	19-13 Mo	317	316, 316Cb, 309Mo, 310Mo
	321	18-8 Ti	347	308L, 309Cb, 310Cb, 316Cb
	330		330	None
	347	18-8Cb	347	308L, 309Cb, 310Cb, 316Cb
	348	18-8Cb		
	403		410	308, 308L, 347, 309
	410			
	414			
	416			
	416 Se			
	420		430	309Cb, 310, 310Cb, 308, 308L, 347, 309
	431		309	309Cb, 310, 310Cb, 330
	502		502	308, 308L, 347, 309, 309Cb, 310, 310Cb
	405		410	308, 308L, 347, 309
	430		430	309Cb, 310, 310Cb, 308, 308L, 347, 309
	430 F			
	430 F Se			
Ferritic	442		309	309Cb, 310, 310Cb, 330
	446			

Chemical Composition Requirements for All-Weld Metal,^{a,b} Weight Percent For Stainless Steel Coated Electrodes

Stainless Steel Solid Wire



AWS Classification	Cd	Cr	Ni	Mo	Cb plus Ta (Nb)	Mn	Si	P	S	N	Cu
E209c	0.06	20.5-24.0	9.5-12.0	1.5-3.0	—	4.0-7.0	0.90	0.03	0.03	0.10-0.30	0.75
E219	0.06	19.0-21.5	5.5-7.0	0.75	—	8.0-10.0	1.00	0.03	0.03	0.10-0.30	0.75
E240	0.06	17.0-19.0	4.0-6.0	0.75	—	10.5-13.5	1.00	0.03	0.03	0.10-0.20	0.75
E307	0.04-0.14	18.0-21.5	9.0-10.7	0.5-1.5	—	3.3-4.75	0.90	0.04	0.03	—	0.75
E308	0.08	18.0-21.0	9.0-11.0	0.75	—	0.5-2.5	0.90	0.04	0.03	—	0.75
E308H	0.04-0.08	18.0-21.0	9.0-11.0	0.75	—	0.5-2.5	0.90	0.04	0.03	—	0.75
E308L	0.04	18.0-21.0	9.0-11.0	0.75	—	0.5-2.5	0.90	0.04	0.03	—	0.75
E308Mo	0.08	18.0-21.0	9.0-12.0	2.0-3.0	—	0.5-2.5	0.90	0.04	0.03	—	0.75
E308MoL	0.04	18.0-21.0	9.0-12.0	2.0-3.0	—	0.5-2.5	0.90	0.04	0.03	—	0.75
E309	0.15	22.0-25.0	12.0-14.0	0.75	—	0.5-2.5	0.90	0.04	0.03	—	0.75
E309L	0.04	22.0-25.0	12.0-14.0	0.75	—	0.5-2.5	0.90	0.04	0.03	—	0.75
E309Cb	0.12	22.0-25.0	12.0-14.0	0.75	0.70-1.00	0.5-2.5	0.90	0.04	0.03	—	0.75
E309Mo	0.12	22.0-25.0	12.0-14.0	2.0-3.0	—	0.5-2.5	0.90	0.04	0.03	—	0.75
E310	0.08-0.20	25.0-28.0	20.0-22.5	0.75	—	1.0-2.5	0.75	0.03	0.03	—	0.75
E310H	0.35-0.45	25.0-28.0	20.0-22.5	0.75	—	1.0-2.5	0.75	0.03	0.03	—	0.75
E310Cb	0.12	25.0-28.0	20.0-22.0	0.75	0.70-1.00	1.0-2.5	0.75	0.03	0.03	—	0.75
E310Mo	0.12	25.0-28.0	20.0-22.0	2.0-3.0	—	1.0-2.5	0.75	0.03	0.03	—	0.75
E312	0.15	28.0-32.0	8.0-10.5	0.75	—	0.5-2.5	0.90	0.04	0.03	—	0.75
E316	0.08	17.0-20.0	11.0-14.0	2.0-3.0	—	0.5-2.5	0.90	0.04	0.03	—	0.75
E316H	0.04-0.08	17.0-20.0	11.0-14.0	2.0-3.0	—	0.5-2.5	0.90	0.04	0.03	—	0.75
E316L	0.04	17.0-20.0	11.0-14.0	2.0-3.0	—	0.5-2.5	0.90	0.04	0.03	—	0.75
E317	0.08	18.0-21.0	12.0-14.0	3.0-4.0	—	0.5-2.5	0.90	0.04	0.03	—	0.75
E317L	0.04	18.0-21.0	12.0-14.0	3.0-4.0	—	0.5-2.5	0.90	0.04	0.03	—	0.75
E318	0.08	17.0-20.0	11.0-14.0	2.0-3.0	6 x C, min. to 1.00 max.	0.5-2.5	0.90	0.04	0.03	—	0.75
E320	0.07	19.0-21.0	32.0-36.0	2.0-3.0	8 x C, min. to 1.00 max.	0.5-2.5	0.60	0.04	0.03	—	3.0-4.0
E320LR	0.035	19.0-21.0	32.0-36.0	2.0-3.0	8 x C, min. to 0.40 max.	1.5-2.5	0.30	0.02	0.015	—	3.0-4.0
E330	0.18-0.25	14.0-17.0	33.0-37.0	0.75	—	1.0-2.5	0.90	0.04	0.03	—	0.75
E330H	0.35-0.45	14.0-17.0	33.0-37.0	0.75	—	1.0-2.5	0.90	0.04	0.03	—	0.75
E347	0.08	18.0-21.0	9.0-11.0	0.75	8 x C, min. to 1.00 max.	0.5-2.5	0.90	0.04	0.03	—	0.75
E349f.g.	0.13	18.0-21.0	8.0-10.0	0.35-0.65	0.75-1.2	0.5-2.5	0.90	0.04	0.03	—	0.75
E410	0.12	11.0-13.5	0.70	0.75	—	1.0	0.90	0.04	0.03	—	0.75
E410NiMo	0.06	11.0-12.5	4.0-5.0	0.40-0.70	—	1.0	0.90	0.04	0.03	—	0.75
E430	0.10	15.0-18.0	0.60	0.75	—	1.0	0.90	0.04	0.03	—	0.75
E502	0.10	4.0-6.0	0.40	0.45-0.65	—	1.0	0.90	0.04	0.03	—	0.75
E505	0.10	8.0-10.5	0.40	0.85-1.20	—	1.0	0.90	0.04	0.03	—	0.75
E630	0.05	16.0-16.75	4.5-5.0	0.75	0.15-0.30	0.25-0.75	0.75	0.04	0.03	—	3.25-4.00
E16-8-2	0.10	14.5-16.5	7.5-9.5	1.0-2.0	—	0.5-2.5	0.60	0.03	0.03	—	0.75
E7Cr	0.10	6.0-8.0	0.40	0.45-0.65	—	1.0	0.90	0.04	0.03	—	0.75

- Analysis shall be made for the elements for which specific values are shown in the table. If, however, the presence of other elements is indicated in the course of routine analysis, further analysis shall be made to determine that the total of these other elements, except iron, is not present in excess of 0.50 percent.
- Single values shown are maximum percentages except where otherwise specified.
- Suffix-15 electrodes are classified with direct current, electrode positive. Suffix-16 electrodes are classified with alternating current and direct current, electrode positive. See Section A6 of the appendix. Electrodes up to and including 5/32 in. (4.0 mm) in size are usable in all positions. Electrodes 3/16 in. (4.8 mm) and larger are usable only in the flat and horizontal fillet positions.
- Carbon shall be reported to the nearest 0.01 percent except for the classification E320LR for which carbon shall be reported to the nearest 0.05 percent.
- Vanadium shall be 0.10 to 0.30 percent.
- Titanium shall be 0.15 percent max.
- Tungsten shall be from 1.25 to 1.75 percent. Courtesy: American Welding Society ANSI/AWS A5.4.

Cast Iron Electrodes

WASHINGTON ALLOY NICKEL 99 AWS/SFA 5.15 ENi-CI, AC-DC+ UNS W82001	WASHINGTON ALLOY NICKEL 55 AWS/SFA 5.15 ENiFe-CI, AC-DC+ UNS W82002	WASHINGTON ALLOY EST AWS/SFA 5.15 EST, AC-DC+ UNS K01520																																												
DESCRIPTION Washington Alloy Nickel 99 is recommended for all-position welding of thin cast iron sections where maximum machinability is required. Since the core wire is approximately 99% nickel, weld deposits are basically “soft” and can be shaped, milled, drilled, or tapped, while the color will match that of cast iron. Washington Alloy Nickel 99 Is specifically suited for repairing cracked or porous castings and to weld cast iron to itself or dissimilar metals such as low alloy and carbon steels.	DESCRIPTION Washington Alloy Nickel 55 is designed for all-position joining and surfacing of cast iron, malleable iron and ductile iron to itself or dissimilar metals such as mild steel, stainless steel, wrought alloys or high nickel alloys. A core wire chemistry of approximately 55% nickel and 45% iron produces weld deposits with much lower weld shrinkage stress which in turn reduces the possibility of weld or heat-affected zone cracking. Washington Alloy Nickel 55 produces high strength, ductile weld deposits even when welding low grade cast iron containing excessive levels of phosphorus or other contaminants.	DESCRIPTION Washington Alloy EST is a non-nickel, non-machinable cast iron electrode. It is the most economical way to go for repairing various kinds of cast iron precincts — providing that machinability of the weld deposit is not required and where weld shrinkage stress is not a concern. Since the core wire is steel, the weld deposits will have a higher tensile strength (65,000 psi) than Nickel 99, however a color match of the base metal should not be expected. Washington Alloy EST melts at relatively low temperatures which permit the use of low welding currents. This electrode may be used in any position utilizing AC or DC (reverse polarity).																																												
APPLICATIONS The weld deposits produced by Washington Alloy Nickel 99 have lower strength and ductility than those of 55% nickel cast iron electrodes. For this reason Washington Alloy Nickel 99 should only be used where maximum machinability of highly diluted weld metal is required or where weld stresses are not overly severe such as found in light and medium-sized castings. Common uses include thin plates, machinery parts, frames and housings.	APPLICATIONS Washington Alloy Nickel 55 is especially suited for welding heavy sections such as motor blocks, housings, machine parts, frames, defective castings and building-up worn sections. Weld deposits are machinable and the deposit color will approximate that of cast iron.	APPLICATIONS Commonly used on gears, motor housings, machine parts, farm equipment, large frames or any other cast iron part where appearance of the weld deposit is not important.																																												
TYPICAL WELD METAL CHEMISTRY (%) <table><tr><td>C</td><td>0.55</td></tr><tr><td>Si</td><td>0.46</td></tr><tr><td>Mn</td><td>0.33</td></tr><tr><td>P</td><td>0.017</td></tr><tr><td>S</td><td>0.007</td></tr><tr><td>Fe</td><td>0.850</td></tr><tr><td>Cu</td><td>0.160</td></tr><tr><td>Ni</td><td>Balance</td></tr></table>	C	0.55	Si	0.46	Mn	0.33	P	0.017	S	0.007	Fe	0.850	Cu	0.160	Ni	Balance	TYPICAL WELD METAL CHEMISTRY (%) <table><tr><td>C</td><td>0.058</td></tr><tr><td>Si</td><td>0.660</td></tr><tr><td>Mn</td><td>1.270</td></tr><tr><td>P</td><td>0.024</td></tr><tr><td>S</td><td>0.024</td></tr><tr><td>Fe</td><td>Balance</td></tr><tr><td>Cu</td><td>2.450</td></tr><tr><td>Ni</td><td>55.030</td></tr></table>	C	0.058	Si	0.660	Mn	1.270	P	0.024	S	0.024	Fe	Balance	Cu	2.450	Ni	55.030	TYPICAL WELD METAL CHEMISTRY (%) <table><tr><td>C</td><td>0.150</td></tr><tr><td>Si</td><td>0.550</td></tr><tr><td>Mn</td><td>0.370</td></tr><tr><td>P</td><td>0.015</td></tr><tr><td>S</td><td>0.003</td></tr><tr><td>Fe</td><td>Balance</td></tr></table>	C	0.150	Si	0.550	Mn	0.370	P	0.015	S	0.003	Fe	Balance
C	0.55																																													
Si	0.46																																													
Mn	0.33																																													
P	0.017																																													
S	0.007																																													
Fe	0.850																																													
Cu	0.160																																													
Ni	Balance																																													
C	0.058																																													
Si	0.660																																													
Mn	1.270																																													
P	0.024																																													
S	0.024																																													
Fe	Balance																																													
Cu	2.450																																													
Ni	55.030																																													
C	0.150																																													
Si	0.550																																													
Mn	0.370																																													
P	0.015																																													
S	0.003																																													
Fe	Balance																																													
TYPICAL MECHANICAL PROPERTIES OF WELD METAL (as welded) <table><tr><td>Tensile strength (psi).....</td><td>50,000</td></tr><tr><td>Yield Strength (psi).....</td><td>40,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>3-4%</td></tr><tr><td>Brinell Hardness.....</td><td>170</td></tr></table>	Tensile strength (psi).....	50,000	Yield Strength (psi).....	40,000	Elongation in 2" (%).....	3-4%	Brinell Hardness.....	170	TYPICAL MECHANICAL PROPERTIES OF WELD METAL (as welded) <table><tr><td>Tensile strength (psi).....</td><td>70,000</td></tr><tr><td>Yield Strength (psi).....</td><td>53,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>6-12%</td></tr><tr><td>Brinell Hardness.....</td><td>190</td></tr></table>	Tensile strength (psi).....	70,000	Yield Strength (psi).....	53,000	Elongation in 2" (%).....	6-12%	Brinell Hardness.....	190	TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded) <table><tr><td>Tensile strength (psi).....</td><td>65,000</td></tr><tr><td>Yield Strength (psi).....</td><td>50,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>33%</td></tr><tr><td>Brinell Hardness.....</td><td>350</td></tr></table>	Tensile strength (psi).....	65,000	Yield Strength (psi).....	50,000	Elongation in 2" (%).....	33%	Brinell Hardness.....	350																				
Tensile strength (psi).....	50,000																																													
Yield Strength (psi).....	40,000																																													
Elongation in 2" (%).....	3-4%																																													
Brinell Hardness.....	170																																													
Tensile strength (psi).....	70,000																																													
Yield Strength (psi).....	53,000																																													
Elongation in 2" (%).....	6-12%																																													
Brinell Hardness.....	190																																													
Tensile strength (psi).....	65,000																																													
Yield Strength (psi).....	50,000																																													
Elongation in 2" (%).....	33%																																													
Brinell Hardness.....	350																																													
TYPICAL MECHANICAL PROPERTIES OF WELD METAL (as welded) <table><tr><th>Sizes</th><th>Amperage</th></tr><tr><td>3/32 (2.4 mm) x 12"</td><td>30-70</td></tr><tr><td>1/8 (3.2 mm) x 14"</td><td>70-110</td></tr><tr><td>5/32 (4.0 mm) x 14"</td><td>90-130</td></tr><tr><td>3/16 (4.8 mm) x 14"</td><td>110-160</td></tr></table> <p>These settings are for flat or downhand positions. For overhead welding reduce 5-15 amps and for vertical welding reduce 10-20 amps</p> <p>Packaging: 10 lb. tubes / 60 lb. master carton</p>	Sizes	Amperage	3/32 (2.4 mm) x 12"	30-70	1/8 (3.2 mm) x 14"	70-110	5/32 (4.0 mm) x 14"	90-130	3/16 (4.8 mm) x 14"	110-160	SIZES AND RECOMMENDED CURRENT RANGES* (AC/DC+) <table><tr><th>Sizes</th><th>Amperage</th></tr><tr><td>3/32 (2.4 mm) x 12"</td><td>50-80</td></tr><tr><td>1/8 (3.2 mm) x 14"</td><td>80-120</td></tr><tr><td>5/32 (4.0 mm) x 14"</td><td>110-140</td></tr><tr><td>3/16 (4.8 mm) x 14"</td><td>130-170</td></tr></table> <p>*These settings are for flat or downhand positions. For overhead welding reduce 5-15 amps and for vertical welding reduce 10-20 amps.</p> <p>Packaging: 10 lb. tubes/60 lb. master carton</p>	Sizes	Amperage	3/32 (2.4 mm) x 12"	50-80	1/8 (3.2 mm) x 14"	80-120	5/32 (4.0 mm) x 14"	110-140	3/16 (4.8 mm) x 14"	130-170	SIZES AND RECOMMENDED CURRENT RANGES* (AC/DC) <table><tr><th>Sizes</th><th>Amperage</th></tr><tr><td>3/32 (2.4 mm) x 12"</td><td>60-90</td></tr><tr><td>1/8 (3.2 mm) x 14"</td><td>90-130</td></tr><tr><td>5/32 (4.0 mm) x 14"</td><td>120-160</td></tr><tr><td>3/16 (4.8 mm) x 14"</td><td>150-200</td></tr></table> <p>*These settings are for flat or downhand positions. For overhead welding reduce 5-15 amps and for vertical welding reduce 10-20 amps.</p> <p>Packaging: 10 lb. tubes/60 lb. master carton</p>	Sizes	Amperage	3/32 (2.4 mm) x 12"	60-90	1/8 (3.2 mm) x 14"	90-130	5/32 (4.0 mm) x 14"	120-160	3/16 (4.8 mm) x 14"	150-200														
Sizes	Amperage																																													
3/32 (2.4 mm) x 12"	30-70																																													
1/8 (3.2 mm) x 14"	70-110																																													
5/32 (4.0 mm) x 14"	90-130																																													
3/16 (4.8 mm) x 14"	110-160																																													
Sizes	Amperage																																													
3/32 (2.4 mm) x 12"	50-80																																													
1/8 (3.2 mm) x 14"	80-120																																													
5/32 (4.0 mm) x 14"	110-140																																													
3/16 (4.8 mm) x 14"	130-170																																													
Sizes	Amperage																																													
3/32 (2.4 mm) x 12"	60-90																																													
1/8 (3.2 mm) x 14"	90-130																																													
5/32 (4.0 mm) x 14"	120-160																																													
3/16 (4.8 mm) x 14"	150-200																																													

PROCEDURES FOR SMAW OF CAST IRON

Clean the work area. Preheating is not required, however it is useful in relieving stresses and to increase machinability of the weld deposit in parts greater than 1/2" thick. 200°F is an acceptable preheat temperature- Using AC or DC + (reverse polarity), hold the electrode 15° off vertical tilted toward the direction of travel. The arc length should be between 1/8" to 3/16". Use stringer beads or the weaving technique. Holding the arc over the molten deposited metal, follow the pool but do not allow the arc to lead or get ahead of the molten pool. If the part is less than 1/4" thick use a 1" bead, 1/4" to 1/2" use a 2" bead, over 1/2" use a 3" bead. Extinguish the electrode by whipping the arc back over the deposited metal. Peen the weld deposit with a blunt instrument to relieve stress and prevent the spread of cracks on the part. Re-strike the arc on the previously deposited weld metal. On thin or complex shaped parts use the skip weld technique. Always use an electrode diameter that is small enough to permit at least two passes. Note: if there is cracking of the part, make stopholes at both ends of the joint. Do not let the part become too hot during welding. Remove slag often. Gradual cooling of the weld metal is strongly recommended.

Cast Iron Wire

CASCADE 17T & 17M AWS A5.15 Class ERNi-CI UNS N022515

DESCRIPTION

High nickel alloy bare wire for TIG or MIG cast iron welding.

APPLICATIONS

Cascade 17T and 17M are the TIG (17T) or MIG (17M) equivalents to Cascade 17A. Developed primarily for automatic and semi-automatic welding of ductile, malleable or gray cast iron to itself or dissimilar metals such as low alloy and carbon steel, stainless steel, iron, copper Monel®, etc. Cascade 17T and 17M are excellent for the buildup of worn parts, repairing machining errors or detective castings where maximum machineability of the deposit is required.

FEATURES

Cascade 17T and 17M can be used in any position. Produces high quality welds with a minimal amount of effort. Weld deposits are strong, dense and fully machinable. Color will match that of cast iron.

SPECIFICATIONS

Tensile strength (psi)	Up to 70,000
Yield strength (psi)	Up to 46,000
Brinell Hardness	170
Elongation (%)	Approximately 12%
Reduction of area (%)	Approximately 20%

TYPICAL WIRE CHEMISTRY (%)

C	0.037
Si	0.440
Mn	0.240
Ni	Balance
Fe	0.010
Cu	0.020

PROCEDURES

Clean the joint area. Bevel heavy sections. Preheating is not required, however it is useful in relieving stresses and to increase machinability of the weld deposit in parts greater than 1/2" thick. 600°F is an acceptable preheat temperature. Use DC- (straight polarity) in TIG applications, with the oscillating technique and DC+ (reverse polarity) in MIG applications, with the stringer bead technique. The oscillating technique will produce the lowest weld metal dilution. When using the stringer bead technique, be sure to strike the arc on the edge of previously deposited weld metal. This will reduce dilution. Be sure to use flux. Do not let the part become too hot during welding. Remove slag often. Gradual cooling of the weld metal is recommended.

AVAILABLE DIAMETERS

(in.)	.035	.045	1/16	3/32	1/8
(mm)	0.9	1.2	1.6	2.4	3.2

PACKAGING

10 lb. and 30 lb. spools - 0.35, 0.45, 1/16.
36" straight lengths - .035, .045, 1/16, 3/32, 1/8.
(10 lb. tubes/50 lb. master carton)

Monel® is a registered trademark of the international Nickel Company (INCO)

CASCADE 18T & 18M AWS A5.15 Class ERNiFe-CI

DESCRIPTION

A premium quality 55% Nickel-45% Iron bare wire for TIG or MIG welding of cast iron components to themselves or to steel.

APPLICATIONS

Cascade 18T and 18M are the TIG and MIG equivalents of Cascade 18A (coated electrodes). Developed for high deposition and greater welding efficiency using automatic or semi-automatic equipment. Cascade 18T/18M is excellent when doing large scale production welding of ductile (nodular) cast iron, malleable cast iron or gray cast iron to themselves or to carbon and low alloy steel. Preheating is generally not needed unless welding heavier and thicker castings. More common uses include the repair of thick and highly restrained weldments, worn or broken parts and for salvaging defective castings that require the higher tensile strength of steel, such as found in castings containing phosphorus levels greater than 0.20%.

FEATURES

Cascade 18T and 18M contain sufficient levels of carbon which promote the formation of graphite in the weld deposit, thereby reducing shrinkage stresses and in turn, reducing the possibility of heat-affected zone cracking. Weld deposits are machinable using normal methods, but can be made easier by stress relieving the part at approximately 1100°F.

SPECIFICATIONS

Tensile strength (psi)	Up to 78,000
Yield strength (psi)	Up to 59,000
Brinell Hardness	190
Elongation (%)	Approximately 10%

TYPICAL WIRE CHEMISTRY (%)

C	0.005
Si	0.100
Mn	0.690
P	<0.002
S	<0.001
Ni	54.850
Fe	Balance
Cu	0.020
Cr	0.030
Ti	<0.100

PROCEDURES

Clean the work area. Preheating is not required, although it may be useful in relieving stresses and to increase the machinability of weld deposits in castings 1/2" or thicker. 600°F is an acceptable preheat temperature when welding gray cast Iron, but 1100 to 1200°F may be needed for very thick sections or high hardness cast Irons. Use DC- (straight polarity) in TIG applications with the oscillating technique and DC+ (reverse polarity) in MIG applications with the stringer bead technique. The oscillating technique will produce the lowest weld metal dilution. When using the stringer bead technique, be sure to strike the arc on the edge of previously deposited weld metal. This will reduce dilution. Be sure to use flux. Do not let the part become too hot during welding. Remove slag often. Gradual cooling of the weld metal is recommended.

(in.)	.035	.045	1/16	3/32	1/8
(mm)	0.9	1.2	1.6	2.4	3.2

PACKAGING

10 lb. and 30 lb. spools - 0.35, 0.45, 1/16.
36" straight lengths - .035, .045, 1/16, 3/32, 1/8.
(10 lb. tubes/50 lb. master carton)

Wire Diameter	Wire Feed	Travel Speed	Amperage A	Voltage V	Shielding Gas	Wire Diameter
0.062	mm/min in/min	mm/min in/min	240-350 235-320	26-31 26-30	100% Argon 75% Ar/25% CO ₂	1.6
0.045	mm/min in/min	mm/min in/min	190-310 180-280	26-32 26-32	100% Argon 75% Ar/25% CO ₂	1.1
0.035	mm/min in/min	mm/min in/min	150-225 150-225	24-28 24-28	100% Argon 75% Ar/25% CO ₂	0.9

GTAW Parameters: Use DC- (Straight polarity) 100% Argon
GMAW Parameters: Use DC+ (reverse polarity) 100% Ar or 75% Ar/25% CO₂
Gas Flow: 40-60 ft³/hr. (1.1-1.7 m³/h)

Cast Iron Electrodes

Cast Iron Rod

CASCADE 17A Arc AC/DC All Position	CASCADE 18A Arc Ac/DC+ (Reverse Polarity) All Position	RCI AWS A5.15 RCI	
DESCRIPTION Fully-machinable cast iron electrode for repair welding of thin sections.	DESCRIPTION Premium cast iron electrode for heavy sections.	DESCRIPTION RCI is a high-quality gray iron oxyacetylene welding rod, designed for gas welding of cast iron, general fabrication or building up new or worn surfaces on castings.	
APPLICATIONS Cascade 17A is a high nickel electrode used for cladding, buildup and joining all grades of cast iron to itself or dissimilar metals such as low alloy and carbon steels, stainless steels, iron, copper, Monel®, etc. Excellent for repairing and "cold welding" cracked or porous thin sections where maximum machinability of the weld deposit is required. Common uses include engine blocks, machinery parts, frames, gears and pulleys.	APPLICATIONS Cascade 18A is for general maintenance welding of cast iron, malleable iron and ductile (nodular) iron to themselves or dissimilar metals such as wrought alloys or high nickel alloys. Commonly used on motor blocks, gear housings, machine parts and frames. Excellent for filling holes and building up missing or worn heavy sections. Cascade 18A is recommended for "meehanite" and "Ni- Resist" alloys.	APPLICATIONS RCI is excellent for cast iron fabrication, repair of foundry defects, filling in or building up new or worn castings. RCI produces machinable weld deposits that have the same color, composition and granular structure as the base metal (gray iron). Properly made welds will be as strong as the original casting.	
FEATURES Cascade 17A is an all-position electrode which produces porosity-free, non-cracking weld deposits that will match the color of cast Iron. When properly used, the arc will penetrate through dirt and oil as well as over slag.	FEATURES Cascade 18A is an all-position electrode that produces machinable, high density and crack-resistant weld deposits, especially suited for welding dirty, oil-soaked castings of unknown composition.	FEATURES RCI has properly balanced and controlled levels of high silicon, low manganese and increased amounts of phosphorus and sulfur. This composition insures greater fusion and tensile strength of the weld deposit. Machinable weld deposits and color match to gray cast iron.	
SPECIFICATIONS Tensile strength (psi).....Up to 65,000 Yield Strength (psi)..... Up to 60,000 Elongation in 2" (%).....Up to 218 Brinell Hardness.....3-6% Color match..... Excellent on cast iron	SPECIFICATIONS Tensile strength (psi)...Up to 84,000 Yield strength (psi).....Up to 63,000 Brinell Hardness.....Up to 218 Elongation(%)......6-18% Color match.....Good	TYPICAL CHEMICAL ANALYSIS C 3.20-3.50 Mn 0.60-0.75 Si 2.70-3.00 P 0.50-0.75 S 0.10 Maximum Fe Balance	
AVAILABLE SIZES AND AMPERAGE (AC/DC) (in) 3/32 1/8 5/32 3/16 (mm) 2.4 3.2 4.0 4.8 Amps 50-70 70-100 100-130 130-160	AVAILABLE SIZES AND AMPERAGE (AD/AC) (in) 3/32 1/8 5/32 3/16 (mm) 2.4 3.2 4.0 4.8 Amps 50-70 70-100 100-130 130-160		
Copper-Base Welding Electrodes and Rods from AWS Specifications Suitable Welding Cast Irons			
Classification	Type	Specification	Characteristics and use
Cut Length Filler Metals (OFW)			
RBCuZn-A	Naval Bronze	A5.27	Naval Bronze – yellow; tin adds strength, corrosion resistance.
RBCuZn-B	Nickel Bronze	A5.27	Nickel Bronze-yellow; tin and manganese add strength, hardness and corrosion resistance.
RBCuZn-C	Low Fuming Bronze	A5.27	Low-Fuming Bronze - yellow; silicon inhibits oxidation (fuming) of zinc.
Covered Electrodes (SMAW)			
ECuSn-A	Phosphor Bronze	A5.6	5 percent tin, hardens to 70-85 Brinell.
ECuSn-C	Copper-Tin	A5.6	8 percent tin, hardens to 85-100 Brinell, Copper-aluminum electrodes deposit high strength, ductile weld metal; use for welding high-strength castings, surfacing.
ECuAl-A2	Copper-Aluminum	A5.6	
AVAILABLE SIZES 3/16" (4.8 mm) x 20" (500 mm) 1/4" (6.4 mm) x 20" (500 mm) 5/16" (7.9 mm) x 20" (500 mm) 3/8" (9.5 mm) x 20" (500 mm) All 50 lb. bulk boxes			
PROCEDURES Although not required, preheating at 800°F-1050°F will equalize the expansion and contraction strain as well as promote easy machinability of the weld deposit. For welding, use a neutral flame. Flux is recommended to cleanse the joint area. Puddle the molten metal with the flame to eliminate porosity. Back-track with the torch to relieve any strain on the weld deposit. Allow the part to cool slowly.			

Build-Up and Hardsurfacing Electrodes

<div>BUILDUP 300</div> <div>AD/DC+ (Electrode Positive)</div> <div>Rockwell C 26-31</div>	<div>OIL HARD 500</div> <div>Moderate Impact/ Severe Abrasion</div> <div>Rockwell C 44-47/</div> <div>Oil Quenched RC 59-62</div>	<div>CHROM-TUNG 600</div> <div>AC/DC+ (Electrode Positive)</div> <div>Hardness Rockwell C 58-62</div>																												
<div>APPLICATIONS</div> <p>Buildup 300 is commonly used for the buildup and overlaying of all ferrous metals subjected to moderate abrasion, severe impact and corrosion. Typical applications would include tractor rollers, sprockets, idlers, concrete mixer blades, bearing journals and other parts which require machinable weld deposits.</p>	<div>APPLICATIONS</div> <p>Oil Hard 500 is used in the repair and fabrication of oil hardening tool steel dies and as an overlay on mild and alloy steels subjected to severe abrasion and moderate impact. Common applications would include trimming dies, shearing edges, cutting dies and cold blanking dies.</p>	<div>DESCRIPTION</div> <p>Chrome-Tung 600 is a chromium-tungsten flux-coated hardsurfacing electrode designed to produce extremely hard weld metal deposits on parts exposed to severe mineral abrasion with low impact. The extreme hardness of Chrom-Tung 600 deposits is achieved through the formation of the chromium and tungsten carbides within the matrix of the weld deposit.</p>																												
<div>PROCEDURES</div> <p>Clean the weld area. Use AC or DC+ polarity. Preheating is not required, although heavier sections should be preheated to 200-300°F. Maintain a medium arc length and use a weaving technique or stringer beads up to twice the diameter of the electrode. Avoid the buildup of heat at any one location on the base metal. Remove slag between passes and allow the base metal to air cool. If severe abrasion is encountered, a final pass of Everwear 800 should be considered.</p>	<div>PROCEDURES</div> <p>Clean the area to be welded. Preheat large sections 200°F – 300°F. Use AC or DC+ polarity. Maintaining a short arc length use stringer beads. Try to avoid the weaving technique because of potential heat build-up in the base metal. Do not allow heat color in the base metal to appear. Peen the weld deposit while hot to relieve stress and remove all slag between passes.</p>	<div>FEATURES</div> <p>Chrom-Tung 600 can be used on both AC or DC machines, Excellent for hardsurfacing large surface areas using wide weave beads. Chrom-Tung 600 has good operator appeal and yields a very smooth weld bead with superb adherence. Deposition is fast and the weld deposits will last a long time.</p>																												
<div>CHARACTERISTICS</div> <p>Buildup 300 weld deposits are strong and tough, however with an average hardness of RC 26-31, they do remain machinable.</p>	<div>CHARACTERISTICS</div> <p>Oil Hard 500 produces very hard and ductile weld deposits. They can be heat treated, annealed, drawn or tempered. Average hardness is RC 46 and if oil quenched at 1600°F the average hardness increases to RC 59-62. Welded deposits have a mixed metal structure of austenite and martensite.</p>	<div>TYPICAL APPLICATIONS</div> <p>Chrom-Tung 600 is used on earth moving and rock crushing equipment, augers, asphalt feed screws, sand pumps, mixer blades and crushing or pulverizing mills. Chrom-Tung 600 is very popular in the sugar cane industry where it is used to increase the life and durability of the rotating mill.</p>																												
<div>RECOMMENDED AMPERAGE (AC OR DC+)</div> <div>AVAILABLE SIZES AND AMPERAGE (AC/DC)</div> <table><tr><td>Size</td><td>1/8</td><td>5/32</td><td>3/16</td><td>1/4</td></tr><tr><td>Amp.</td><td>60-130</td><td>120-180</td><td>170-240</td><td>240-300</td></tr></table>	Size	1/8	5/32	3/16	1/4	Amp.	60-130	120-180	170-240	240-300	<div>RECOMMENDED AMPERAGE (AC OR DC+)</div> <table><tr><td>Size</td><td>3/32</td><td>1/8</td><td>5/32</td><td>3/16</td><td>1/4</td></tr><tr><td>Amp.</td><td>60-90</td><td>80-100</td><td>110-170</td><td>180-230</td><td>220-300</td></tr></table>	Size	3/32	1/8	5/32	3/16	1/4	Amp.	60-90	80-100	110-170	180-230	220-300	<div>TYPICAL WELD METAL CHEMISTRY</div> <table><tr><td>C</td><td>4.00</td></tr><tr><td>Cr</td><td>26.00</td></tr><tr><td>W</td><td>4.00</td></tr></table>	C	4.00	Cr	26.00	W	4.00
Size	1/8	5/32	3/16	1/4																										
Amp.	60-130	120-180	170-240	240-300																										
Size	3/32	1/8	5/32	3/16	1/4																									
Amp.	60-90	80-100	110-170	180-230	220-300																									
C	4.00																													
Cr	26.00																													
W	4.00																													
<div>PACKAGING</div> <p>All Sizes are packaged in 10 lb. packs – 6 packs per 60 lb. master carton</p>	<div>PACKAGING</div> <p>All Sizes are packaged in 10 lb. packs – 6 packs per 60 lb. master carton</p>	<p>Hardness as welded: 58-62 RC</p> <div>AVAILABLE SIZES AND OPERATING RANGES (AC/DC+)</div> <table><tr><td>Size</td><td>3/32</td><td>1/8</td><td>5/32</td><td>3/16</td></tr><tr><td>Amp.</td><td>70-90</td><td>110-130</td><td>160-190</td><td>220-250</td></tr></table> <div>WELDING PROCEDURES</div> <p>Maintain a short arc length and hold the electrode verticle to the workpiece.</p>	Size	3/32	1/8	5/32	3/16	Amp.	70-90	110-130	160-190	220-250																		
Size	3/32	1/8	5/32	3/16																										
Amp.	70-90	110-130	160-190	220-250																										

BUILD-UP AND HARDSURFACING ELECTRODES

HARDFACE 700 Considerable impact/Severe Abrasion Rockwell C 58-62	EVERWEAR 800 Light Impact/Severe Abrasion/Corro- sion Resistance Rockwell C 62-65	Manganese 900 Heavy Impact/Severe Abrasion Rockwell C 50-55 (after workhardening)																														
APPLICATIONS Hardface 700 is our most popular hardsur- facing electrode used for severe abrasion and considerable impact. Weld deposits have a martensitic structure that resists wear even in Metal-to-metal mild steel contact. Hardface 700 is most commonly used on plowshares, cultivator shoes, bucket teeth and lips, well drilling bits, cement mixer blades, shovel tracks and screw conveyors.	APPLICATIONS Everwear 800 is a hardsurfacing electrode used for severe abrasion, light impact and corrosion resistance. This electrode produces an extremely hard martensite-structure weld deposit which is not machinable in the “as- welded” condition. Everwear 800 is commonly used on mill hammers, bucket teeth, valve seats, mixers, crusher rolls, tamper rollers and other mild steel, carbon or alloy steels as well as manganese steels.	APPLICATIONS Hardsurfacing overlay electrode used for the fabrication and build up of high manganese and alloy steels which are subjected to heavy impact and severe abrasion. This electrode is most commonly used for repairing railroad switches, frogs and tracks, bucket teeth and lips, rock crushers, mill hammers and bulldozer parts.																														
PROCEDURES Use AC or DC+. Preheating is generally not required. Using the weaving technique and keeping a short arc length, deposit up to 1/4” maximum. If more than two passes will be required, it is suggested that a “padding layer” of Buildup 300 or Tensileweld be used prior to depositing Hardface 700.	PROCEDURES Use AC or DC+. Preheating is not required except on alloy steels. Using a short gap and a weaving technique, deposit two layers. If more than two passes are required, use Ten- sileweld or Buildup 300 to provide a padding layer prior to using Everwear 800.	PROCEDURES When the base metal of 13% manganese steel is hardened, cut-off the hardened zone before welding. Welding should be done at the lowest possible temperature. Maintain a short to medium arc length using a slight weaving technique to make the deposit smooth and even. Water or air cool the weld metal during welding. Do not preheat manganese steels. Do not overheat the base metal. Peening is recommended to relieve stresses.																														
CHARACTERISTICS When used in the flat and horizontal positions, this electrode will exhibit a stable arc and produce weld deposits that are very smooth and finely rippled. Hardness as deposited: RC 58-62	CHARACTERISTICS Everwear 800 will lay down a smooth, corrosion resistant weld deposit which will remain extremely hard even at elevated temperatures. Hardness as deposited: RC 62-65.	CHARACTERISTICS Weld deposits have an austenitic structure and work harden although remaining extremely ductile. Weld deposits are machinable and forgeable.																														
RECOMMENDED AMPERAGE (AC OR DC+) <table><tr><td>Size</td><td>1/8</td><td>5/32</td><td>3/16</td><td>1/4</td></tr><tr><td>Amp.</td><td>110-130</td><td>140-170</td><td>180-210</td><td>220-300</td></tr></table>	Size	1/8	5/32	3/16	1/4	Amp.	110-130	140-170	180-210	220-300	RECOMMENDED AMPERAGE (AC OR DC+) <table><tr><td>Size</td><td>1/8</td><td>5/32</td><td>3/16</td><td>1/4</td></tr><tr><td>Amp.</td><td>90-130</td><td>140-170</td><td>190-240</td><td>220-300</td></tr></table>	Size	1/8	5/32	3/16	1/4	Amp.	90-130	140-170	190-240	220-300	<table><tr><td>Tensile strength</td><td>Up to 120,000 psi</td></tr><tr><td>Yield strength</td><td>Up to 75,000 psi</td></tr><tr><td>Elongation in 2"</td><td>45-60%</td></tr><tr><td>Hardness</td><td>RB88-92 as welded</td></tr><tr><td>RC50-55 after work hardening</td><td></td></tr></table>	Tensile strength	Up to 120,000 psi	Yield strength	Up to 75,000 psi	Elongation in 2"	45-60%	Hardness	RB88-92 as welded	RC50-55 after work hardening	
Size	1/8	5/32	3/16	1/4																												
Amp.	110-130	140-170	180-210	220-300																												
Size	1/8	5/32	3/16	1/4																												
Amp.	90-130	140-170	190-240	220-300																												
Tensile strength	Up to 120,000 psi																															
Yield strength	Up to 75,000 psi																															
Elongation in 2"	45-60%																															
Hardness	RB88-92 as welded																															
RC50-55 after work hardening																																
PACKAGING All Sizes are packaged in 10 lb. packs – 6 packs per 60 lb. master carton	PACKAGING All Sizes are packaged in 10 lb. packs – 6 packs per 60 lb. master carton.	RECOMMENDED AMPERAGE (AC OR DC+) <table><tr><td>Size</td><td>1/8</td><td>5/32</td><td>3/16</td><td>1/4</td></tr><tr><td>Amp.</td><td>75-130</td><td>125-190</td><td>175-240</td><td>230-380</td></tr></table> WELDING PROCEDURES All Sizes are packaged in 10 lb. packs – 6 packs per 60 lb. master carton	Size	1/8	5/32	3/16	1/4	Amp.	75-130	125-190	175-240	230-380																				
Size	1/8	5/32	3/16	1/4																												
Amp.	75-130	125-190	175-240	230-380																												
	NI-MANG 14 AC/DC+ Rockwell c 45-50 (after workhardening)	CHROME-CARB 60 AC/DC+ Rockwell C 58-60																														
	DESCRIPTION Ni-Mang 14 is used for rebuilding. It offers high crack resistance on austenitic manganese steels, high impact and compressive wear-resistance. Non-magnetic deposit. TYPICAL WELD METAL CHEMISTRY (%) <table><tr><td>C</td><td>1.0</td></tr><tr><td>Mn</td><td>14.0</td></tr><tr><td>Ni</td><td>4.0</td></tr></table> AVAILABLE SIZES 1/8", 5/32", 3/16"	C	1.0	Mn	14.0	Ni	4.0	DESCRIPTION Chrome-Carb 60 is for high impact and abrasion wear. This electrode produces a very hard deposit even at high temperatures. Excellent compressive strength on carbon, low alloy and manganese steels. TYPICAL WELD METAL CHEMISTRY (%) <table><tr><td>C</td><td>3.5</td></tr><tr><td>Mn</td><td>2.0</td></tr><tr><td>Si</td><td>0.6</td></tr><tr><td>Cr</td><td>30.0</td></tr><tr><td>Ni</td><td>0.2</td></tr><tr><td>Mo</td><td>0.2</td></tr></table> AVAILABLE SIZES 1/8", 5/32", 3/16"	C	3.5	Mn	2.0	Si	0.6	Cr	30.0	Ni	0.2	Mo	0.2												
C	1.0																															
Mn	14.0																															
Ni	4.0																															
C	3.5																															
Mn	2.0																															
Si	0.6																															
Cr	30.0																															
Ni	0.2																															
Mo	0.2																															

COBALT HARDSURFACING RODS AND ELECTRODES

<div><div><div><div><div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></</div></div></div></div></div></div>

Cobalt Hardsurfacing Rods and Electrodes

Typical Physical and Mechanical Properties

ALLOY	HARDNESS ROCKWELL C			WEAR RESISTANCE						Machinability	Density lbs/in ³	Melting Point	Tensile Strength
	Oxy-Fuel	TIG	Metal Arc	Metal to Metal	Impact	Erosion	Corrosion	Cold Abrasion	Hot Abrasion				
Cobalt No. 1 Bare Cobalt No. 1 FC	52-55 1 layer	54-54 2 layers	50-53 2 layers	Excellent	Not Recommended	Excellent	Excellent	Excellent	Excellent	Use Carbide Tools	0.312	2300°F	111,000 psi
Cobalt No. 6 Bare Cobalt No. 6 FC	42-45 1 layer	40-43 2 layers	39-42 2 layers	Excellent	Excellent	Excellent	Excellent	Good	Good	Use Carbide Tools	0.303	2350°F	134,000 psi
Cobalt No. 12 Bare Cobalt No. 12 FC	48-51 1 layer	46-49 2 layers	41-44 2 layers	Excellent	Good	Excellent	Excellent	Excellent	Excellent	Use Carbide Tools	0.308	2345°F	141,000 psi
Cobalt No. 21 Bare Cobalt No. 21 FC	NA	25-27 2 layers 45 work hardened	24-26 2 layers 45 work hardened	Excellent	Excellent	Excellent	Excellent	Good	Good	Use Carbide Tools	0.300	2460°F	117,000 psi
Cobalt F Bare Cobalt F FC	41-44 1 layer	39-42 2 layers	38-41 2 layers	Excellent	Excellent								

Cobalt Hardsurfacing Rods and Electrodes

Preheat and Postheat Treatment*

BASE METAL	PREHEAT TEMP.	POSTHEAT
Low Carbon Steel (up to 0.40%C) for thin sections only	Not Required	Air-Cool
Low Carbon Steel (up to 0.40% C) for thick sections only and High Carbon Steel (over 0.40%C) for thin sections only and Low Alloy Steels (up to 10% alloy) for thin sections only	200°-600°F	Slow-Cool
High Carbon Steels (over 0.40%C) for thick sections only and Low Alloy Steel (up to 10% alloy) for thick sections only	300°-600°F	Slow-Cool
Air-Quench Steels	1100°-1200°F	Slow-Cool
High Chromium-Nickel (Austenitic) Stainless Steels (304, 309, 316, etc.) thin sections only	Not Required	Air-Cool
High Chromium-Nickel (Austenitic) Stainless Steel (304, 309, 316, etc.) thick sections only	200°-500°F	Slow-Cool
High Chromium (Martensitic) Stainless Steel (410, 416, 420, etc.) thick sections only	400°-600°F	Maintain at 400°-600°F for 4 hrs. per 1 inch thickness, then reduce heat 90°F per hour till cool
High Chromium (Ferritic) Stainless Steel (430, 442, 446, etc.) thick sections only	200°-600°F	Maintain at 200°-600°F for 4 hrs. per inch thickness, then reduce heat 90°F per hour till cool
High Temperature Nickel Alloys (400, 600, 601, 625, 718, etc.)	200°-500°F	Stress-Relieve

• In many cases, preheating or postheat treatment is not necessary. However, it will reduce the chances of cracking in both the base metal and the weld deposit. The preheat or postheat temperatures will depend upon the carbon content of the base metal. The higher the carbon content the higher the preheat temperature.

Welding Parameters and Data

Recommended Current Settings (SMA)		
Diameter	DC+(reverse polarity)	AC
1/8 (coated)	85-100	90-120
5/32 (coated)	120-150	135-160
3/16 (coated)	150-175	160-180
1/4 (coated)	200-250	220-270

Approximate Coverage Per Pound of Cobalt Alloys		
Thickness of Deposit (in.)	Pounds Per Square Inch	
1/8	Bare	Coated
3/16	26	18
1/4	17	12
	13	9



MILD STEEL & LOW HYDROGEN/ LOW ALLOY ELECTRODES

Washington Alloy mild steel and low hydrogen electrodes are manufactured under strict quality control methods in which all heats of electrodes are tested for chemical composition, mechanical properties and weldability. This is done to ensure that all electrodes meet Washington Alloy standards as well as AWS and ASTM specifications. Washington Alloy offers more than 35 different mild steel and low hydrogen electrodes with tensile strengths of 60,000 psi to 120,000 psi. All electrodes yield good deposition efficiency and easy weldability thereby providing increased production and lower overall fabricating costs.

Washington Alloy electrodes are printed with the appropriate AWS classification number for easy identification.

AWS AND WASHINGTON ALLOY IDENTIFICATION

1. The "E" in Exxxx represents arc welding electrode.
2. The first two digits of a 4 digit number or the first three digits of a 5 digit number indicate the minimum tensile strength of the weld deposit expressed in thousands of pounds per square inch (psi). For example E70XX indicates that this electrode has a minimum tensile strength of 70,000 psi and E110XX indicates a minimum tensile strength of 110,000 psi.
3. The next-to-last digit indicates the position in which this electrode may be used. Exx1x represents all positions while Exx2x indicates that this electrode is used for flat or horizontal positions only. For example E7018 indicates that this electrode may be used in all positions while E7028 indicates that this electrode is for flat and horizontal positions only.
4. The last digit combined with the next-to-last digit indicates the type of coating on the electrode and the type of current that may be used. For example:

Electrode	Coating	Current
Exx10	High cellulose	DC reverse polarity only
Exx11	High cellulose	AC or DC reverse polarity
Exx12	High titania (rutile)	AC or DC straight polarity
Exx13	High titania (rutile)	AC or DC either polarity
Exx14	Rutile iron powder	AC or DC either polarity
Exx16	Low hydrogen	AC or DC reverse polarity
Exx18	Iron powder - low hydrogen	AC or DC reverse polarity
Exx24	Rutile-iron powder	AC or DC either polarity
Exx27	Iron powder-iron oxide	AC or DC either polarity
Exx28	Iron powder - low hydrogen	AC or DC reverse polarity

5. Finally: the suffix of the electrode indicates the estimated alloy content of the electrode. For example:

Suffix	Alloy Content
Exxx-A1	1/2% Mo
Exxx-B1	1/2% Cr, 1/2% Mo
Exxx-B2	1-1/4% Cr, 1/2% Mo
Exxx-B3	2-1/4% Cr, 1% Mo
Exxx-C1	2-1/2% Ni
Exxx-C3	1%Ni, .35%MO, .15%Cr
Exxx-G	.50% Ni, .30% Cr, .20% Mo, .10% Vn (all minimum pct and only one is required)
Exxx-M	1.3-1.8% Mn, 1.25-2.50% Ni, .40% Cr, .25-.50% Mo, .5% Max. Vn

Summary example: E7018-A1 would indicate an (a) arc welding electrode with a (b) minimum tensile strength of 70,000 psi (c) that can be used in any position (d) with AC or DC reverse polarity. This number also indicates that it is an iron powder- low hydrogen electrode which yields a weld deposit containing 1/2% Mo.

Mild Steel and Low Hydrogen/Low Alloy Electrodes

TIPS ON WELDING WITH MILD STEEL ELECTRODES

- Redrying electrodes at 200°-500°F for 10-30 minutes is recommended.
- DC current should be used whenever possible, however if arc blow persists then AC should be used.
- A medium-length arc of approximately 1/8", maintained ahead of the weld puddle, will yield good wetting action while allowing unwanted gases to escape. This will also permit the welder to shape the bead appearance.
- Flat and horizontal welding should be done by holding the electrode at an angle 10°-15° from 90°, staying ahead of the weld puddle and using a slight back and forth whipping motion.
- Overhead welding is similar to flat and horizontal but a slight circular motion should be used in the molten crater.
- Vertical-down welding should be performed with stringer beads or a slight weave. The weld puddle can be kept in place by pointing the electrode arc upward into the puddle. Use currents in the upper portion of the recommended range.
- Vertical-up welding should be done by using the shelf or step method where welding is done by adding layer on top of layer. Do not use the whipping motion, but move the electrode slowly while pointing the arc force upward. Use currents in the lower portion of the recommended range.

TIPS OF WELDING WITH LOW HYDROGEN ELECTRODES

- Redrying electrodes at 650°-500°F for 1-2 hrs. is recommended.
- DC current should be used whenever possible.
- Use a short steady arc to obtain maximum results. (The coating of the electrode should be touching the base plate.)
- Hold the electrode at a 15° angle into the direction of travel.
- Weaving may be used, but not to exceed 3 times the diameter of the electrode.
- Whipping should not be done since it will cause porosity in a weld metal.
- A straight-forward progression is recommended for all positions.

WASHINGTON ALLOY 4130FC*

DESCRIPTION

Washington Alloy 4130FC is a flux-coated electrode designed for shielded metal arc welding of heat-treatable, low alloy steels such as the SAE 4100 series and 8630.

PREHEATING AND POSTHEATIN

A preheat temperature of 400-600°F is required for some of the higher carbon grades in order to prevent cracking. Maintain the preheat temperature between passes. Oil quench at 1600°F, temper at 950°F.

TYPICAL WELD METAL CHEMISTRY (%)

C	0.21
Mn	1.24
Si	0.40
Cr	0.49
Mo	0.19
Ni	1.30

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT*

Proper heat treatment will produce a tensile strength of 150,000 to 160,000 psi.

AVAILABLE SIZES AND RECOMMENDED CURRENT

Dia. (in.)	3/32	1/8	5/32	3/16
Lgth. (in.)	14"	14"	14"	14"
Amps F	70-100	90-160	130-220	200-300
Amps V & O	70-100	90-135	110-160	—

* Other heat-treatable, low alloy electrodes (4140 FC and 4340 FC) are available.

USA 6010 AWS A5.1 Class E6010

DESCRIPTION

USA 6010 is a high cellulose coated electrode designed to provide a smooth stable arc forceful enough to achieve deep penetration into the base metal. This electrode exhibits high deposition efficiency and low spatter loss. It produces a weld puddle that wets and spreads well, yet sets up fast enough to make this electrode ideal for vertical up or vertical down welding techniques. USA 6010 electrodes produce a flat weld bead with coarse ripples and a thin easily removable slag. USA 6010 electrodes may be used in the flat, horizontal, vertical or overhead welding positions.

TYPICAL APPLICATIONS

USA 6010 electrodes are most commonly used for out-of-position welding such as field construction, ship yards, water towers, pressure vessels, pressure pipes, steel castings, plain and galvanized steel storage tanks, etc.

TYPICAL WELD METAL CHEMISTRY (%)

DESCRIPTION

USA 6010 is a high cellulose coated electrode designed to provide a smooth stable arc forceful enough to achieve deep penetration into the base metal. This electrode exhibits high deposition efficiency and low spatter loss. It produces a weld puddle that wets and spreads well, yet sets up fast enough to make this electrode ideal for vertical up or vertical down welding techniques. USA 6010 electrodes produce a flat weld bead with coarse ripples and a thin easily removable slag. USA 6010 electrodes may be used in the flat, horizontal, vertical or overhead welding positions.

TYPICAL APPLICATIONS

USA 6010 electrodes are most commonly used for out-of-position welding such as field construction, ship yards, water towers, pressure vessels, pressure pipes, steel castings, plain and galvanized steel storage tanks, etc.

TYPICAL WELD METAL CHEMISTRY (%)

C	0.100
Mn	0.470
Si	0.200
P	0.014
S	0.012

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)

Yield strength (psi).....	61,000
Tensile strength (psi).....	70,000
Elongation in 2" (%).....	30
Charpy V-notch at - 20°F (ft. lbs.).....	36
Reduction in area (%).....	60

AVAILABLE SIZES AND RECOMMENDED CURRENT (DC+)

Dia. (in.)	3/32	1/8	5/32	3/16	7/32	1/4
Lgth. (in.)	14	14	14	14	14	14
Amps F	60-85	80-120	110-160	150-200	160-210	190-240
Amps						
V & O	50-70	70-110	110-150	130-170	130-190	



Mild Steel and Low Hydrogen/Low Alloy Electrodes

USA 6011 AWS A5.1 CLASS E6011

DESCRIPTION

USA 6011 electrodes have the same characteristics as USA 6010; however unlike the USA 6010, this electrode may be used with small AC welders as well as DC types. USA 6011 high cellulose coated electrodes provide excellent arc stability, increased ductility, high deposition efficiency and low spatter. This electrode combines a strong arc force with fast solidification of weld metal, thereby permitting vertical or overhead as well as flat and horizontal welding positions. USA 6011 is especially suited for welding where poor groove fit-up and rusty or oily steel is present.

TYPICAL APPLICATIONS

USA 6011 is commonly used as an all purpose electrode for automobile body shops and mild steel farm equipment. Other uses would include shipbuilding, bridges, boilers, barges, railroad cars, pipes, truck frames, pressure vessels, storage tanks and galvanized steel.

TYPICAL WELD METAL CHEMISTRY (%)

C	0.100
Mn	0.580
Si	0.370
P	0.015
S	0.013

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)

Yield strength (psi).....	63,000
Tensile strength (psi).....	72,000
Elongation in 2" (%).....	29.2
Charpy V-notch at -20°F (ft. lbs.).....	36
Reduction in area(%).....	60

AVAILABLE SIZES AND RECOMMENDED CURRENTS (AC or DC+)

Dia. (in.)	3/32	1/8	5/32	3/16	7/32	1/4
Lgth. (in.)	14	14	14	14	14	14
Amps F	65-90	80-120	130-170	170-210	170-220	200-250
Amps V & O	50-75	70-110	110-150	130-170	140-200	

USA 6012 AWS A5.1 Class E6012

DESCRIPTION

USA 6012 high titania coated electrodes were developed for usage on thin sections and poor fit-up joints where shallow penetration is required. This electrode produces a quiet arc forceful enough to prevent slag build-up during vertical down welding. USA 6012 electrodes produce smooth, uniform weld deposits with low spatter and low porosity. Maximum deposition efficiency is attained even at increased currents and travel speeds on thick and thin base plates. USA 6012 electrodes may be used in any position.

TYPICAL APPLICATIONS

USA 6012 is used for welding steel window frames, sheet steel, metal furniture, railway freight cars, automobiles, ships, barges, rolling stocks, pipes, castings and tanks. It is an excellent electrode to use for lap fillet joint welding on bottom plates in tanks.

TYPICAL WELD METAL CHEMISTRY (%)

C	0.090
Mn	0.460
Si	0.260
P	0.014
S	0.013

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)

Yield strength (psi).....	61,000
Tensile strength (psi).....	70,000
Elongation in 2" (%).....	26
Charpy V-notch at -32°F (ft. lbs.).....	65
Reduction in area(%).....	40

AVAILABLE SIZES AND RECOMMENDED CURRENTS (AC or DC+)

Dia. (in.)	3/32	1/8	5/32	3/16	7/32	1/4
Lgth. (in.)	14	14	14	14	14	14
Amps F	65-100	85-130	110-160	160-220	200-260	210-280
Amps V & O	65-100	85-130	100-150	120-190	140-190	

USA 6013 AWS A5.1 Class E6013

DESCRIPTION

USA 6013 high titania coated electrodes produce weld deposits which are much smoother and flatter than those produced by USA 6012. This electrode was primarily designed to provide good wetting and shallow penetration for thin sheet metal applications (using smaller diameter electrodes), but with sufficient penetration for welding medium gauge steel. As a result, USA 6013 is an all- purpose electrode that provides a soft steady arc which is easily regenerated, easy slag control for vertical-down welding, low spatter and a beautiful bead appearance. USA 6013 electrodes may be used in any position with AC or DC (straight or reverse polarity).

TYPICAL APPLICATIONS

USA 6013 is commonly used for automobile bodies, truck frames and bodies, ornamental iron, metal furniture, farm implements, machinery guards, storage tanks, or wherever appearance is important or desirable.

TYPICAL WELD METAL CHEMISTRY (%)

C	0.070
Mn	0.450
Si	0.320
P	0.014
S	0.008

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)

Yield strength (psi).....	63,000
Tensile strength (psi).....	70,000
Elongation in 2" (%).....	29.7
Charpy V-notch at -32°F (ft. lbs.).....	58
Reduction in area(%).....	58

AVAILABLE SIZES AND RECOMMENDED CURRENTS (AC or DC+)

Dia. (in.)	1/16	5/64	3/32	1/8	5/32	3/16	1/4
Lgth. (in.)	10	12	14	14	14	14	14
Amps F	25-50	35-60	50-100	80-130	140-180	180-230	260-320
Amps V & O	25-50	35-60	50-90	60-110	110-160	120-160	

Mild Steel and Low Hydrogen/Low Alloy Electrodes

USA 6027 AWS A5.1 Class E6027	USA 7010-A1 AWS A5.5 Class E7010-A1	USA 7014 AWS A5.1 Class E7014																																																																																																																																						
<p>DESCRIPTION</p> <p>USA 6027 is a heavy iron powder, iron oxide coated electrode developed to provide maximum deposition efficiency and deep penetration at higher speeds. It is particularly suited for welding flat, deep groove joints as well as horizontal butt and fillet welds. USA 6027 weld deposits exhibit exceptional ductility, high impact strength and easy slag removability. This electrode provides easy operation and excellent restarting capability making it suitable for intermittent welding. USA 6027 may be used with AC or DC (straight or reverse polarity).</p> <p>TYPICAL APPLICATIONS</p> <p>USA 6027 electrodes are used for the welding of ship hulls, bridges, structural steels, railroad cars, earthmoving equipment and pressure vessels or pipes that have been poisoned for horizontal welding.</p> <p>TYPICAL WELD METAL CHEMISTRY (%)</p> <table><tr><td>C</td><td>0.060</td></tr><tr><td>Mn</td><td>0.850</td></tr><tr><td>Si</td><td>0.350</td></tr><tr><td>P</td><td>0.021</td></tr><tr><td>S</td><td>0.009</td></tr></table> <p>TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)</p> <table><tr><td>Yield strength (psi).....</td><td>63,000</td></tr><tr><td>Tensile strength (psi).....</td><td>70,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>31.5</td></tr><tr><td>Charpy V-notch at -20°F (ft. lbs.).....</td><td>51</td></tr><tr><td>Reduction in area(%).....</td><td>58</td></tr></table> <p>AVAILABLE SIZES AND RECOMMENDED CURRENTS (AC or DC+)</p> <table><tr><td>Dia. (in.)</td><td>1/8</td><td>5/32</td><td>3/16</td><td>7/32</td><td>1/4</td></tr><tr><td>Lgth. (in.)</td><td>14</td><td>18</td><td>18-28</td><td>18/28</td><td>18/28</td></tr><tr><td>Amps F</td><td>40-150</td><td>140-170</td><td>180-230</td><td>200-240</td><td>250-280</td></tr></table>	C	0.060	Mn	0.850	Si	0.350	P	0.021	S	0.009	Yield strength (psi).....	63,000	Tensile strength (psi).....	70,000	Elongation in 2" (%).....	31.5	Charpy V-notch at -20°F (ft. lbs.).....	51	Reduction in area(%).....	58	Dia. (in.)	1/8	5/32	3/16	7/32	1/4	Lgth. (in.)	14	18	18-28	18/28	18/28	Amps F	40-150	140-170	180-230	200-240	250-280	<p>DESCRIPTION</p> <p>USA 7010-A1 is a high cellulose electrode developed specifically for welding pipe lines. Although this electrode may be used in any position, it is best suited for vertical up or vertical down welding. USA 7010-A1 yields a forceful arc with deep penetration, producing a weld puddle that wets and spreads well, with rapid solidification. Weld deposits are of X-ray quality, with 70,000 psi tensile strengths and containing 1/2% Mo, USA 7010-A1 electrodes may be used with AC or DC (reverse polarity).</p> <p>PREHEATING</p> <p>When welding carbon-molybdenum steels, preheating at 300-575°F is recommended. Exact preheat temperature will depend upon the thickness and hardening characteristics of the work piece.</p> <p>TYPICAL APPLICATIONS</p> <p>USA 7010-A1 is most commonly used for welding carbon-moly piping used in high pressure, high temperature steam service and structural shapes, plates and castings, which have a 1/2% Mo content.</p> <p>TYPICAL WELD METAL CHEMISTRY (%)</p> <table><tr><td>C</td><td>0.090</td></tr><tr><td>Mn</td><td>0.430</td></tr><tr><td>Si</td><td>0.140</td></tr><tr><td>Mo</td><td>0.490</td></tr><tr><td>S</td><td>0.010</td></tr><tr><td>P</td><td>0.012</td></tr></table> <p>TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)</p> <table><tr><td>Yield strength (psi).....</td><td>65,000</td></tr><tr><td>Tensile strength (psi).....</td><td>80,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>29</td></tr><tr><td>Charpy V-notch at -32oF (ft. lbs.).....</td><td>65</td></tr></table> <p>AVAILABLE SIZES AND RECOMMENDED CURRENTS (AC or DC+)</p> <table><tr><td>Dia. (in.)</td><td>3/32</td><td>1/8</td><td>5/32</td><td>3/16</td></tr><tr><td>Lgth. (in.)</td><td>14</td><td>14</td><td>14</td><td>14</td></tr><tr><td>Amps F</td><td>60-90</td><td>90-120</td><td>120-160</td><td>160-200</td></tr><tr><td>Amps V & O</td><td>50-80</td><td>80-100</td><td>110-150</td><td>150-180</td></tr></table>	C	0.090	Mn	0.430	Si	0.140	Mo	0.490	S	0.010	P	0.012	Yield strength (psi).....	65,000	Tensile strength (psi).....	80,000	Elongation in 2" (%).....	29	Charpy V-notch at -32oF (ft. lbs.).....	65	Dia. (in.)	3/32	1/8	5/32	3/16	Lgth. (in.)	14	14	14	14	Amps F	60-90	90-120	120-160	160-200	Amps V & O	50-80	80-100	110-150	150-180	<p>DESCRIPTION</p> <p>USA 7014 is an iron powder, rutile type electrode designed to operate at higher speeds and with greater deposition efficiency than USA 6012 or USA 6013 electrodes. This electrode provides a stable arc, flat smooth bead appearance and easy slag removability. USA 7014 is used for all position, single-pass and multi-layer welding applications. AC or DC (straight or reverse polarity) may be used.</p> <p>TYPICAL APPLICATIONS</p> <p>USA 7014 is an all-purpose electrode used wherever the welding efficiency of USA 6012 or USA 6013 is not acceptable. Typical applications would include: ship structures, bridges, structural steels for buildings, sheet metal, ornamental iron, auto bodies and fenders, machine parts, storage tanks, etc.</p> <p>TYPICAL WELD METAL CHEMISTRY (%)</p> <table><tr><td>C</td><td>0.070</td></tr><tr><td>Mn</td><td>0.450</td></tr><tr><td>Si</td><td>0.320</td></tr><tr><td>P</td><td>0.014</td></tr><tr><td>S</td><td>0.008</td></tr></table> <p>TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)</p> <table><tr><td>Yield strength (psi).....</td><td>69,000</td></tr><tr><td>Tensile strength (psi).....</td><td>79,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>30</td></tr><tr><td>Charpy V-notch at -32°F (ft. lbs.).....</td><td>58</td></tr><tr><td>Reduction in area(%).....</td><td>44</td></tr></table> <p>AVAILABLE SIZES AND RECOMMENDED CURRENTS (AC or DC+)</p> <table><tr><td>Dia. (in.)</td><td>1/16</td><td>5/64</td><td>3/32</td><td>1/8</td><td>5/32</td><td>3/16</td><td>7/32</td><td>1/4</td></tr><tr><td>Lgth. (in.)</td><td>10</td><td>12</td><td>14</td><td>14</td><td>14</td><td>14</td><td>14</td><td>14</td></tr><tr><td>Amps F</td><td>35-60</td><td>45-70</td><td>50-100</td><td>90-140</td><td>150-210</td><td>200-240</td><td>210-270</td><td>250-320</td></tr><tr><td>Amps V&O</td><td>35-60</td><td>45-70</td><td>40-65</td><td>60-90</td><td>110-160</td><td>120-160</td><td>-</td><td>-</td></tr></table>	C	0.070	Mn	0.450	Si	0.320	P	0.014	S	0.008	Yield strength (psi).....	69,000	Tensile strength (psi).....	79,000	Elongation in 2" (%).....	30	Charpy V-notch at -32°F (ft. lbs.).....	58	Reduction in area(%).....	44	Dia. (in.)	1/16	5/64	3/32	1/8	5/32	3/16	7/32	1/4	Lgth. (in.)	10	12	14	14	14	14	14	14	Amps F	35-60	45-70	50-100	90-140	150-210	200-240	210-270	250-320	Amps V&O	35-60	45-70	40-65	60-90	110-160	120-160	-	-
C	0.060																																																																																																																																							
Mn	0.850																																																																																																																																							
Si	0.350																																																																																																																																							
P	0.021																																																																																																																																							
S	0.009																																																																																																																																							
Yield strength (psi).....	63,000																																																																																																																																							
Tensile strength (psi).....	70,000																																																																																																																																							
Elongation in 2" (%).....	31.5																																																																																																																																							
Charpy V-notch at -20°F (ft. lbs.).....	51																																																																																																																																							
Reduction in area(%).....	58																																																																																																																																							
Dia. (in.)	1/8	5/32	3/16	7/32	1/4																																																																																																																																			
Lgth. (in.)	14	18	18-28	18/28	18/28																																																																																																																																			
Amps F	40-150	140-170	180-230	200-240	250-280																																																																																																																																			
C	0.090																																																																																																																																							
Mn	0.430																																																																																																																																							
Si	0.140																																																																																																																																							
Mo	0.490																																																																																																																																							
S	0.010																																																																																																																																							
P	0.012																																																																																																																																							
Yield strength (psi).....	65,000																																																																																																																																							
Tensile strength (psi).....	80,000																																																																																																																																							
Elongation in 2" (%).....	29																																																																																																																																							
Charpy V-notch at -32oF (ft. lbs.).....	65																																																																																																																																							
Dia. (in.)	3/32	1/8	5/32	3/16																																																																																																																																				
Lgth. (in.)	14	14	14	14																																																																																																																																				
Amps F	60-90	90-120	120-160	160-200																																																																																																																																				
Amps V & O	50-80	80-100	110-150	150-180																																																																																																																																				
C	0.070																																																																																																																																							
Mn	0.450																																																																																																																																							
Si	0.320																																																																																																																																							
P	0.014																																																																																																																																							
S	0.008																																																																																																																																							
Yield strength (psi).....	69,000																																																																																																																																							
Tensile strength (psi).....	79,000																																																																																																																																							
Elongation in 2" (%).....	30																																																																																																																																							
Charpy V-notch at -32°F (ft. lbs.).....	58																																																																																																																																							
Reduction in area(%).....	44																																																																																																																																							
Dia. (in.)	1/16	5/64	3/32	1/8	5/32	3/16	7/32	1/4																																																																																																																																
Lgth. (in.)	10	12	14	14	14	14	14	14																																																																																																																																
Amps F	35-60	45-70	50-100	90-140	150-210	200-240	210-270	250-320																																																																																																																																
Amps V&O	35-60	45-70	40-65	60-90	110-160	120-160	-	-																																																																																																																																



Mild Steel and Low Hydrogen/Low Alloy Electrodes

USA 7016 AWS A5.1 Class E7016	USA 7016-A1 AWS A5.5 Class E7016-A1	USA 7016HT AWS A5.1 Class E7016																																																																								
DESCRIPTION USA 7016 is a low hydrogen, all position electrode used for welding heavy duty steel structures and plates. This electrode provides excellent arc stability and produces X-ray quality weld deposits with higher crack resistance, elongation and ductility than other mild steel electrodes. USA 7016 yields a beautiful bead appearance with easy slag removability.	DESCRIPTION USA 7016-A1 is a low hydrogen, 1/2% Mo electrode used for welding carbon-molybdenum steels which are subjected to temperatures as high as 940°F, such as those found in boilers. USA 7016-A1 electrodes may be used with AC or DC (reverse polarity).	DESCRIPTION USA 7016HT is the most popular low hydrogen electrode for welding 71,000 psi high tensile steel. This electrode may be used in any position, producing weld deposits with excellent crack resistance and slag removability. USA 7016HT also exhibits good arc regeneration. This electrode may be used with AC or DC (reverse polarity).																																																																								
TYPICAL APPLICATIONS Typical applications would include strength members of ship hulls, rolling stocks, machinery, bridges, free-cutting steels and medium carbon steels.	PREHEATING AND POSTHEATING Depending upon the thickness and hardening characteristics of the work piece, preheating at a temperature between 200-400°F and postheating at 1150-1250°F (for 1 hour), is required.	TYPICAL APPLICATIONS USA 7016HT is most commonly used for ships, machinery, rolling stocks, bridges and buildings.																																																																								
TYPICAL WELD METAL CHEMISTRY (%) <table><tr><td>C</td><td>0.080</td></tr><tr><td>Mn</td><td>0.980</td></tr><tr><td>Si</td><td>0.480</td></tr><tr><td>P</td><td>0.012</td></tr><tr><td>S</td><td>0.010</td></tr></table>	C	0.080	Mn	0.980	Si	0.480	P	0.012	S	0.010	TYPICAL WELD METAL CHEMISTRY (%) <table><tr><td>C</td><td>0.070</td></tr><tr><td>Mn</td><td>0.830</td></tr><tr><td>Si</td><td>0.540</td></tr><tr><td>Mo</td><td>0.520</td></tr><tr><td>S</td><td>0.010</td></tr><tr><td>P</td><td>0.008</td></tr></table>	C	0.070	Mn	0.830	Si	0.540	Mo	0.520	S	0.010	P	0.008	TYPICAL WELD METAL CHEMISTRY (%) <table><tr><td>C</td><td>0.080</td></tr><tr><td>Mn</td><td>1.020</td></tr><tr><td>Si</td><td>0.570</td></tr><tr><td>P</td><td>0.011</td></tr><tr><td>S</td><td>0.009</td></tr></table>	C	0.080	Mn	1.020	Si	0.570	P	0.011	S	0.009																																								
C	0.080																																																																									
Mn	0.980																																																																									
Si	0.480																																																																									
P	0.012																																																																									
S	0.010																																																																									
C	0.070																																																																									
Mn	0.830																																																																									
Si	0.540																																																																									
Mo	0.520																																																																									
S	0.010																																																																									
P	0.008																																																																									
C	0.080																																																																									
Mn	1.020																																																																									
Si	0.570																																																																									
P	0.011																																																																									
S	0.009																																																																									
TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded) Yield strength (psi)..... 69,000 Tensile strength (psi)..... 79,000 Elongation in 2" (%)..... 33.6 Charpy V-notch at -20°F (ft. lbs.)..... 109	TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (stress-relieved) Yield strength (psi)..... 80,000 Tensile strength (psi)..... 94,000 Elongation in 2" (%)..... 31	TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded) Yield strength (psi).....70,000 Tensile strength (psi).....82,000 Elongation in 2" (%).....32.6 Charpy V-notch at -32°F (ft. lbs.)..... 100																																																																								
AVAILABLE SIZES AND RECOMMENDED CURRENTS (AC or DC+) <table><tr><td>Dia. (in.)</td><td>3/32</td><td>1/8</td><td>5/32</td><td>3/16</td><td>1/4</td></tr><tr><td>Lgth. (in.)</td><td>14</td><td>14</td><td>14</td><td>14</td><td>18</td></tr><tr><td>Amps F</td><td>50-100</td><td>90-130</td><td>150-190</td><td>180-230</td><td>250-300</td></tr><tr><td>Amps. V&O</td><td>40-80</td><td>70-100</td><td>120-160</td><td>140-180</td><td>-</td></tr></table>	Dia. (in.)	3/32	1/8	5/32	3/16	1/4	Lgth. (in.)	14	14	14	14	18	Amps F	50-100	90-130	150-190	180-230	250-300	Amps. V&O	40-80	70-100	120-160	140-180	-	AVAILABLE SIZES AND RECOMMENDED CURRENTS (AC or DC+) <table><tr><td>Dia. (in.)</td><td>3/32</td><td>1/8</td><td>5/32</td><td>3/16</td><td>1/4</td></tr><tr><td>Lgth. (in.)</td><td>14</td><td>14</td><td>14</td><td>14</td><td>18</td></tr><tr><td>Amps. F</td><td>55-85</td><td>90-130</td><td>140-190</td><td>190-240</td><td>250-310</td></tr><tr><td>Amps. V&O</td><td>50-80</td><td>80-120</td><td>110-170</td><td>-</td><td>-</td></tr></table>	Dia. (in.)	3/32	1/8	5/32	3/16	1/4	Lgth. (in.)	14	14	14	14	18	Amps. F	55-85	90-130	140-190	190-240	250-310	Amps. V&O	50-80	80-120	110-170	-	-	AVAILABLE SIZES AND RECOMMENDED CURRENTS (AC or DC+) <table><tr><td>Dia. (in.)</td><td>3/32</td><td>1/8</td><td>5/32</td><td>3/16</td><td>1/4</td></tr><tr><td>Lgth. (in.)</td><td>14</td><td>14</td><td>14</td><td>14</td><td>18</td></tr><tr><td>Amps F</td><td>40-80</td><td>70-130</td><td>150-190</td><td>210-250</td><td>250-300</td></tr><tr><td>Amps V&O</td><td>30-70</td><td>70-100</td><td>120-160</td><td>130-180</td><td>-</td></tr></table>	Dia. (in.)	3/32	1/8	5/32	3/16	1/4	Lgth. (in.)	14	14	14	14	18	Amps F	40-80	70-130	150-190	210-250	250-300	Amps V&O	30-70	70-100	120-160	130-180	-
Dia. (in.)	3/32	1/8	5/32	3/16	1/4																																																																					
Lgth. (in.)	14	14	14	14	18																																																																					
Amps F	50-100	90-130	150-190	180-230	250-300																																																																					
Amps. V&O	40-80	70-100	120-160	140-180	-																																																																					
Dia. (in.)	3/32	1/8	5/32	3/16	1/4																																																																					
Lgth. (in.)	14	14	14	14	18																																																																					
Amps. F	55-85	90-130	140-190	190-240	250-310																																																																					
Amps. V&O	50-80	80-120	110-170	-	-																																																																					
Dia. (in.)	3/32	1/8	5/32	3/16	1/4																																																																					
Lgth. (in.)	14	14	14	14	18																																																																					
Amps F	40-80	70-130	150-190	210-250	250-300																																																																					
Amps V&O	30-70	70-100	120-160	130-180	-																																																																					

Mild Steel and Low Hydrogen/Low Alloy Electrodes

USA 7016V AWS A5.1 Class E7016	USA 7016W AWS A5.1 Class E7016	USA 7018* AWS A5.1 Class E7018																																																																				
DESCRIPTION USA 7016V low hydrogen electrodes were specifically designed for vertical downward butt and fillet welds on mild steel. This electrode yields high deposition efficiency, producing weld deposits with excellent mechanical properties and high resistance to cracking. USA 701V welds have a very fine bead appearance, easy slag removability, and are free from undercuts. This electrode may be used with AC or DC (reverse polarity).	DESCRIPTION USA 7016W low hydrogen electrodes were developed for one-side welding of pipes, as well as butt joints in general. This electrode is excellent for root-pass welding where sound bead appearance on the reverse side is assured, thereby eliminating back-chipping and saving precious man-hours. USA 7016W is suitable for vertical and overhead welding.	DESCRIPTION USA 7018 is the most efficient general purpose, iron powder — low hydrogen electrode used for welding carbon steels, free-machining steels and low alloy steels with a minimum yield strength of 50,000 psi. USA 7018 has a very good deposition rate, providing a quiet steady arc with low spatter and medium penetration. Weld deposits are of X-ray quality with easy slag removal, exceptional mechanical properties and a smooth uniform bead appearance. USA 7018 has excellent operator appeal and may be used in any position with AC or DC (reverse polarity).																																																																				
TYPICAL APPLICATIONS USA 7016V is used mainly for ships, buildings, bridges, construction machinery, pressure vessels and rolling stocks.	TYPICAL APPLICATIONS Typical applications would include strength members in ship hulls, pressure vessels, rolling stocks, bridges and the one-side welding of pipes.	TYPICAL APPLICATIONS USA 7018 electrodes are used for many ASTM specifications. More specific applications would include process piping, cold rolled steels such as found in heavy machinery fabrications, fired and unfired pressure vessels, shop and field welding of bridges and structural steels, cast steels, shipbuilding, just about any medium carbon, low alloy steel where the welds are subject to X-ray inspection.																																																																				
TYPICAL WELD METAL CHEMISTRY (%) <table><tr><td>C</td><td>0.080</td></tr><tr><td>Mn</td><td>0.850</td></tr><tr><td>Si</td><td>0.450</td></tr><tr><td>P</td><td>0.014</td></tr><tr><td>S</td><td>0.011</td></tr></table>	C	0.080	Mn	0.850	Si	0.450	P	0.014	S	0.011	TYPICAL WELD METAL CHEMISTRY (%) <table><tr><td>C</td><td>0.070</td></tr><tr><td>Mn</td><td>0.900</td></tr><tr><td>Si</td><td>0.580</td></tr><tr><td>P</td><td>0.013</td></tr><tr><td>S</td><td>0.010</td></tr></table>	C	0.070	Mn	0.900	Si	0.580	P	0.013	S	0.010	TYPICAL WELD METAL CHEMISTRY (%) <table><tr><td>C</td><td>0.070</td></tr><tr><td>Mn</td><td>0.970</td></tr><tr><td>Si</td><td>0.570</td></tr><tr><td>P</td><td>0.012</td></tr><tr><td>S</td><td>0.011</td></tr></table>	C	0.070	Mn	0.970	Si	0.570	P	0.012	S	0.011																																						
C	0.080																																																																					
Mn	0.850																																																																					
Si	0.450																																																																					
P	0.014																																																																					
S	0.011																																																																					
C	0.070																																																																					
Mn	0.900																																																																					
Si	0.580																																																																					
P	0.013																																																																					
S	0.010																																																																					
C	0.070																																																																					
Mn	0.970																																																																					
Si	0.570																																																																					
P	0.012																																																																					
S	0.011																																																																					
TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded) <table><tr><td>Yield strength (psi).....</td><td>65,000</td></tr><tr><td>Tensile strength (psi).....</td><td>79,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>32.9</td></tr><tr><td>Charpy V-notch at -20°F (ft. lbs.).....</td><td>78</td></tr></table>	Yield strength (psi).....	65,000	Tensile strength (psi).....	79,000	Elongation in 2" (%).....	32.9	Charpy V-notch at -20°F (ft. lbs.).....	78	TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded) <table><tr><td>Yield strength (psi).....</td><td>67,000</td></tr><tr><td>Tensile strength (psi).....</td><td>81,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>32.2</td></tr><tr><td>Charpy V-notch at -20°F (ft. lbs.).....</td><td>58</td></tr></table>	Yield strength (psi).....	67,000	Tensile strength (psi).....	81,000	Elongation in 2" (%).....	32.2	Charpy V-notch at -20°F (ft. lbs.).....	58	TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded) <table><tr><td>Yield strength (psi).....</td><td>72,000</td></tr><tr><td>Tensile strength (psi).....</td><td>86,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>31</td></tr><tr><td>Charpy V-notch at -20°F (ft. lbs.).....</td><td>65</td></tr></table>	Yield strength (psi).....	72,000	Tensile strength (psi).....	86,000	Elongation in 2" (%).....	31	Charpy V-notch at -20°F (ft. lbs.).....	65																																												
Yield strength (psi).....	65,000																																																																					
Tensile strength (psi).....	79,000																																																																					
Elongation in 2" (%).....	32.9																																																																					
Charpy V-notch at -20°F (ft. lbs.).....	78																																																																					
Yield strength (psi).....	67,000																																																																					
Tensile strength (psi).....	81,000																																																																					
Elongation in 2" (%).....	32.2																																																																					
Charpy V-notch at -20°F (ft. lbs.).....	58																																																																					
Yield strength (psi).....	72,000																																																																					
Tensile strength (psi).....	86,000																																																																					
Elongation in 2" (%).....	31																																																																					
Charpy V-notch at -20°F (ft. lbs.).....	65																																																																					
AVAILABLE SIZES AND RECOMMENDED CURRENTS (AC or DC+) <table><tr><td>Dia. (in.)</td><td>1/8</td><td>5/32</td><td>3/16</td><td>7/32</td></tr><tr><td>Lgth. (in.)</td><td>14</td><td>18</td><td>18</td><td>18</td></tr><tr><td>Amps V</td><td>100-150</td><td>160-210</td><td>220-280</td><td>260-330</td></tr></table>	Dia. (in.)	1/8	5/32	3/16	7/32	Lgth. (in.)	14	18	18	18	Amps V	100-150	160-210	220-280	260-330	AVAILABLE SIZES AND RECOMMENDED CURRENTS (AC or DC+) <table><tr><td>Dia. (in.)</td><td>3/32</td><td>1/8</td><td>5/32</td><td>3/16</td></tr><tr><td>Lgth. (in.)</td><td>14</td><td>14</td><td>14</td><td>14</td></tr><tr><td>Amps F</td><td>50-100</td><td>90-140</td><td>120-180</td><td>150-240</td></tr><tr><td>Amps V&O</td><td>40-80</td><td>80-120</td><td>100-150</td><td>140-200</td></tr><tr><td>One side welding</td><td>30-65</td><td>60-110</td><td>90-140</td><td>130-180</td></tr></table>	Dia. (in.)	3/32	1/8	5/32	3/16	Lgth. (in.)	14	14	14	14	Amps F	50-100	90-140	120-180	150-240	Amps V&O	40-80	80-120	100-150	140-200	One side welding	30-65	60-110	90-140	130-180	AVAILABLE SIZES AND RECOMMENDED CURRENTS (AC or DC+) <table><tr><td>Dia. (in.)</td><td>3/32</td><td>1/8</td><td>5/32</td><td>3/16</td><td>7/32</td><td>1/4</td></tr><tr><td>Lgth. (in.)</td><td>14</td><td>14</td><td>14</td><td>14</td><td>18</td><td>18</td></tr><tr><td>Amps. F</td><td>55-85</td><td>90-140</td><td>130-185</td><td>190-250</td><td>230-285</td><td>250-320</td></tr><tr><td>Amps. V&O</td><td>50-80</td><td>80-120</td><td>110-180</td><td>160-210</td><td>-</td><td>-</td></tr></table> <p>* USA 7018-1 AWS A5.1 Class E7018-1 available upon request.</p>	Dia. (in.)	3/32	1/8	5/32	3/16	7/32	1/4	Lgth. (in.)	14	14	14	14	18	18	Amps. F	55-85	90-140	130-185	190-250	230-285	250-320	Amps. V&O	50-80	80-120	110-180	160-210	-	-
Dia. (in.)	1/8	5/32	3/16	7/32																																																																		
Lgth. (in.)	14	18	18	18																																																																		
Amps V	100-150	160-210	220-280	260-330																																																																		
Dia. (in.)	3/32	1/8	5/32	3/16																																																																		
Lgth. (in.)	14	14	14	14																																																																		
Amps F	50-100	90-140	120-180	150-240																																																																		
Amps V&O	40-80	80-120	100-150	140-200																																																																		
One side welding	30-65	60-110	90-140	130-180																																																																		
Dia. (in.)	3/32	1/8	5/32	3/16	7/32	1/4																																																																
Lgth. (in.)	14	14	14	14	18	18																																																																
Amps. F	55-85	90-140	130-185	190-250	230-285	250-320																																																																
Amps. V&O	50-80	80-120	110-180	160-210	-	-																																																																

* USA 7018-1 AWS A5.1 Class E7018-1 available upon request.



Mild Steel and Low Hydrogen/Low Alloy Electrodes

USA 7018-A1

AWS A5.5 Class E7018-A1 (Weld deposit also meets the requirements of AWS A5.5 Class E7015-A1 and E7016-A1)

DESCRIPTION

USA 7018-A1 is an iron powder, low hydro-gen electrode designed for welding low alloy, high tensile steel of 65,000 psi minimum yield strength and containing 1/2% Mo. This electrode offers the welder high deposition efficiency and produces a weld deposit with fine bead appearance, easily removable slag, low spatter and medium penetration. USA 7018-A1 weld metal solidifies rather rapidly, making this electrode suitable for out of position welding.

TYPICAL APPLICATIONS

USA 7018-A1 is typically used for the fabrication of carbon-molybdenum pipes, pressure vessels, boilers and tubing containing 1/2% Mo.

TYPICAL WELD METAL CHEMISTRY (%)

C	0.060
Mn	0.720
Mo	0.530
Si	0.490
P	0.012
S	0.010

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)

Yield strength (psi).....	86,000
Tensile strength (psi).....	98,000
Elongation in 2" (%).....	28
Charpy V-notch at -20°F (ft. lbs.).....	87

AVAILABLE SIZES AND RECOMMENDED CURRENTS (AC or DC+)

Dia. (in.)	3/32	1/8	5/32	3/16	1/4
Lgth. (in.)	14	14	14	14	18
Amps. F	70-120	100-150	120-200	200-275	275-350
Amps. V&O	55-80	80-120	100-160	180-240	-

USA 7018-B2L

AWS A5.5 Class E7018-B2L
Formerly AWS A5.5 Class E8018-B2L

DESCRIPTION

USA 7018-B2L is a low hydrogen, low alloy, chrome-moly electrode containing extra low carbon and designed for welding 1/2% chromium- 1/2% molybdenum, 1% chromium- 1/2% molybdenum and 1-1/4% chromium - 1/2% molybdenum steel. The extra low carbon content improves microstructure stability during high temperature service such as found in pressure piping or boiler work. USA 7018-B2L can be used in all positions with AC or DC (reverse polarity) and offers good arc stability, easy slag removal and high deposition efficiency. Excellent mechanical properties.

PREHEATING AND POSTHEATING

Depending upon the thickness and hardening characteristics of the work piece, preheating at a temperature between 300-550°F and postheating at 1250-1350°F (for 1 hour) is required. Note: In many cases the lower carbon content of USA 7018B2L will permit a lower preheat temperature.

TYPICAL APPLICATIONS

USA 7018-B2L is similar in usage and applications to USA 7018-B2. More common applications would include pressure piping such as found in steam power generating equipment, petrochemical pressure vessels, chemical processing equipment and in the shipbuilding industries.

C	0.035
Mn	0.700
Si	0.610
Cr	1.320
Mo	0.550
P	0.011
S	0.010

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (stress-relieved*)

Yield point (psi).....	57,000
Tensile strength (psi).....	75,000
Elongation in 2" (%).....	24
Charpy V-notch at 72°F (ft. lbs.).....	48
Reduction of area (%).....	71

* 1 hour at 1275°F.

AVAILABLE SIZES AND RECOMMENDED CURRENTS (AC or DC+)

Dia. (in.)	3/32	1/8	5/32	3/16	7/32	1/4
Lgth. (in.)	14	14	14	14	18	18
Amps. F	60-100	90-130	130-190	190-250	230-270	250-300
Amps. V&O	60-90	80-120	110-170	—	—	—

USA 7024

AWS A5.1 Class E7024

DESCRIPTION

USA 7024 is an iron powder, rutile coated electrode designed for high speed, single pass horizontal and flat fillet welding of mild steel. This electrode provides greater deposition efficiency and better physical properties than USA 7014 electrodes. USA 7024 offers a quiet stable arc and produces weld deposits with low spatter, free of undercuts and a "self-removing" slag. Bead appearance is superb. This electrode may be used with AC or DC (straight or reverse polarity).

TYPICAL APPLICATIONS

Ship structures, bridges, structural steels, machine bases, truck fabrication, storage tanks and rolling stocks.

TYPICAL WELD METAL CHEMISTRY (%)

C	0.090
Mn	0.780
Si	0.350
P	0.019
S	0.014

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)

Yield Point (psi).....	70,000
Tensile strength (psi).....	83,000
Elongation in 2" (%).....	28
Charpy V-notch at 32°F (ft. lbs.).....	51
Reduction in area (%).....	40

AVAILABLE SIZES AND RECOMMENDED CURRENTS (AC or DC+)

Dia. (in.)	3/32	1/8	5/32	3/16	7/32	1/4
Lgth. (in.)	14	14-18	14-18	18-28	18-28	18-28
Amps F	60-100	120-170	140-190	200-250	230-270	280-380

Mild Steel and Low Hydrogen/Low Alloy Electrodes

USA 7028 AWS A5.1 Class E7028

DESCRIPTION

USA 7028 is an iron powder, low hydrogen electrode developed for high deposition efficiency welding of flat and horizontal fillets, as well as deep groove joints in 71,000 psi, high tensile strength steel. This electrode produces X-ray quality weld deposits which exhibit high cracking resistance and excellent mechanical properties. In addition to its high deposition rate, USA 7028 provides easy slag removability and a nice bead appearance, free from undercuts. Welding efficiency can be further improved by using a gravity welder. This electrode can be used with AC or DC (reverse polarity).

TYPICAL APPLICATIONS

USA 7028 is used for welding strength members of ship hulls, bridges, heavy machinery parts and fired or unfired pressure vessels.

TYPICAL WELD METAL CHEMISTRY (%)

C	0.070
Mn	0.980
Si	0.520
P	0.012
S	0.010

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)

Yield point (psi).....	69,000
Tensile strength (psi).....	80,000
Elongation in 2" (%).....	31.2
Charpy V-notch at 0°F (ft. lbs.).....	94
Reduction in area (5).....	60

AVAILABLE SIZES AND RECOMMENDED CURRENTS (AC or DC+)

Dia. (in.)	1/8	5/32	3/16	7/32	1/4
Lgth. (in.)	14	18-28	18-28	18-28	18-28
Amps F	90-150	160-220	200-250	220-270	290-340

USA 7048 AWS A5.1 Class E7048

DESCRIPTION

USA 7048 is an iron-powder-potassium low-hydrogen flux coated electrode developed to provide exceptional welding properties for vertical down welding application. USA 7048 electrodes are designed to weld mild, low carbon, low alloy, and free-machining steels. USA 7048 has a very good deposition rate, providing a stable arc with extremely low spatter loss with good penetration. USA 7048 is known for x-ray quality weld deposits with smooth, uniform bead appearance and ease of slag removal. USA 7048 is designed to operate on AC or DC reverse polarity (DCEP) welding current.

TYPICAL APPLICATIONS

USA 7048 is extensively used for fabrication and repair of fired and non-fired pressure vessels using ASTM A-516 or A-537 plate, process piping using ASTM A-33 or A-523 pipe, shop and field welding or bridges using ASTM A-709 plate, shipbuilding using ASTM A-131 plate, structural steels, cast steels, and cold rolled steels used in heavy machinery fabrication. USA 7048 is used anywhere welds are deemed critical and subject to x-ray inspection.

TYPICAL WELD METAL CHEMISTRY (%) (Welded with DCSP, 100% Argon Shield Gas)

C	0.070
Mn	0.970
Si	0.570
P	0.012
S	0.011

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (stress-relieved)

Yield point (psi).....	72,000
Tensile strength (psi).....	86,000
Elongation in 2" (%).....	31
Charpy V-notch at -20°F (ft. lbs.).....	58

AVAILABLE SIZES AND RECOMMENDED CURRENTS (AC or DC+)

Dia. (in.)	3/32	1/8	5/32	3/16	7/32	1/4
Amps F	55-85	90-140	130-185	190-250	230-285	250-320
Amps V&O	50-80	80-120	110-180	160-210	-	-

USA 8016-B1 AWS A5.5 Class E8016-B1

DESCRIPTION

USA 8016-B1 is a low hydrogen electrode used for welding ½% Cr – ½% Mo steel which is subjected to high pressures and temperatures up to 1000°F. This electrode produces a weld deposit with minimal hydrogen content and excellent crack resistance. USA 8016-B1 may be used with AC or DC (reverse polarity).

PREHEATING AND POSTHEATING

Depending upon the thickness and hardening characteristics of the work piece, preheating at a temperature between 300-475°F and postheating at 1150-1250°F (for 1 hour) is required.

TYPICAL APPLICATIONS

More common uses would include boilers, chemical equipment, oil refineries, heat exchangers steel tubes (A213-T2), rolled steels and cast iron.

TYPICAL WELD METAL CHEMISTRY (%)

C	0.070
Mn	0.810
Si	0.510
Cr	0.510
Mo	0.490
S	0.012
P	0.012

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (stress-relieved)

Yield strength (psi).....	86,000
Tensile strength (psi).....	97,000
Elongation in 2" (%).....	26
Charpy V-notch at -20°F (ft. lbs.).....	79

AVAILABLE SIZES AND RECOMMENDED CURRENTS (AC or DC+)

Dia. (in.)	3/32	1/8	5/32	3/16	1/4
Lgth. (in.)	14	14	14	14	18
Amps. F	55-85	90-130	130-180	190-240	250-320
Amps. V&O	40-80	80-120	110-160	-	-



Mild Steel and Low Hydrogen/Low Alloy Electrodes

USA 8016-B2 AWS A5.5 Class 8016-B2	USA 8016G AWS A5.5 Class E8016-G	USA 8018-B2 AWS A5.5 Class E8018-B2																																																																		
DESCRIPTION USA 8016-B2 is an all-position, low hydrogen electrode used for welding 1-1/4% Cr, 1/2% Mo, steel which is subjected to temperatures as high as 1000°F. USA 8016-B2 electrodes yield a forceful arc with medium penetration, producing weld deposits with low spatter, rapid solidification of weld metal and easy slag removability. USA 8016-B2 electrodes may be used with AC or DC (reverse polarity).	DESCRIPTION USA 8016G is an extra-low hydrogen type electrode used for welding 86,000 psi high tensile steel. This electrode produces X-ray quality welds with good crack resistance, notch toughness and a fine bead appearance. USA 8016G may be used in any position with either AC or DC (reverse polarity).	DESCRIPTION USA 8018-B2 iron powder, low hydrogen electrodes are designed for welding 1/2-1-1/4% chromium and 1/2% molybdenum alloy steels which are exposed to high pressures and temperatures. This electrode has high deposition efficiency, producing X-ray quality weld deposits that meet or exceed AWS/ASTM charpy V-notch impact requirements, USA 8018-B2 electrodes yield a smooth arc, with low spatter, a fine bead appearance and exceptional mechanical properties. USA 8018-B2 may be used with AC or DC (reverse polarity)																																																																		
PREHEATING AND POSTHEATING Depending upon the thickness and hardening characteristics of the work piece, preheating at temperature between 300-550°F and postheating at 1250-1350°F (for 1 hour) is required.	TYPICAL APPLICATIONS USA 8016G is commonly used for welding high tensile steels such as pressure vessels, bridges, penstocks and rails.	PREHEATING AND POSTHEATING Depending upon the thickness and hardening characteristics of the work piece, preheating at a temperature between 300-550°F and postheating at 1250-1350°F (for 1 hour) is required.																																																																		
TYPICAL APPLICATIONS USA 8016-B2 is commonly used for welding piping steels (A335-P2, P11, P12) boiler and heat exchanger steel tubes (A119-T11, A200-T11, T12), rolled steel (A301-B, A387-B, C), cast steel (A217-WC6) and forged steel (A182-F11, F12, A336-F12).	TYPICAL WELD METAL CHEMISTRY (%) <table><tr><td>C</td><td>0.080</td></tr><tr><td>Mn</td><td>1.200</td></tr><tr><td>Si</td><td>0.800</td></tr><tr><td>P</td><td>0.014</td></tr><tr><td>S</td><td>0.070</td></tr></table>	C	0.080	Mn	1.200	Si	0.800	P	0.014	S	0.070	TYPICAL APPLICATIONS USA 8018-B2 can be used for many ASTM specifications. More common applications would include steam pipes of boilers for electric power plants, equipment found in the oil refining industry, synthetic chemical plants and ships. (A335-P2, P11, P12, A119-T11, A301-B, A217-WC6, A182-F11).																																																								
C	0.080																																																																			
Mn	1.200																																																																			
Si	0.800																																																																			
P	0.014																																																																			
S	0.070																																																																			
TYPICAL WELD METAL CHEMISTRY (%) <table><tr><td>C</td><td>0.060</td></tr><tr><td>Mn</td><td>0.650</td></tr><tr><td>Si</td><td>0.470</td></tr><tr><td>Cr</td><td>1.310</td></tr><tr><td>Mo</td><td>0.520</td></tr><tr><td>P</td><td>0.011</td></tr><tr><td>S</td><td>0.009</td></tr></table>	C	0.060	Mn	0.650	Si	0.470	Cr	1.310	Mo	0.520	P	0.011	S	0.009	TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded) <table><tr><td>Yield Point (psi).....</td><td>79,000</td></tr><tr><td>Tensile strength (psi).....</td><td>87,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>28</td></tr><tr><td>Charpy V-notch at -20°F (ft. lbs.).....</td><td>94</td></tr></table> AVAILABLE SIZES AND RECOMMENDED CURRENTS (AC or DC+) <table><tr><td>Dia. (in.)</td><td>3/32</td><td>1/8</td><td>5/32</td><td>3/16</td><td>1/4</td></tr><tr><td>Lgth. (in.)</td><td>14</td><td>14</td><td>14</td><td>14</td><td>14</td></tr><tr><td>Amps. F</td><td>45-75</td><td>70-130</td><td>150-200</td><td>190-230</td><td>260-300</td></tr><tr><td>Amps. V&O</td><td>45-75</td><td>80-130</td><td>120-160</td><td>140-170</td><td>-</td></tr></table>	Yield Point (psi).....	79,000	Tensile strength (psi).....	87,000	Elongation in 2" (%).....	28	Charpy V-notch at -20°F (ft. lbs.).....	94	Dia. (in.)	3/32	1/8	5/32	3/16	1/4	Lgth. (in.)	14	14	14	14	14	Amps. F	45-75	70-130	150-200	190-230	260-300	Amps. V&O	45-75	80-130	120-160	140-170	-	TYPICAL WELD METAL CHEMISTRY (%) <table><tr><td>C</td><td>0.060</td></tr><tr><td>Mn</td><td>0.700</td></tr><tr><td>Si</td><td>0.610</td></tr><tr><td>Cr</td><td>1.320</td></tr><tr><td>Mo</td><td>0.550</td></tr><tr><td>P</td><td>0.011</td></tr><tr><td>S</td><td>0.010</td></tr></table>	C	0.060	Mn	0.700	Si	0.610	Cr	1.320	Mo	0.550	P	0.011	S	0.010						
C	0.060																																																																			
Mn	0.650																																																																			
Si	0.470																																																																			
Cr	1.310																																																																			
Mo	0.520																																																																			
P	0.011																																																																			
S	0.009																																																																			
Yield Point (psi).....	79,000																																																																			
Tensile strength (psi).....	87,000																																																																			
Elongation in 2" (%).....	28																																																																			
Charpy V-notch at -20°F (ft. lbs.).....	94																																																																			
Dia. (in.)	3/32	1/8	5/32	3/16	1/4																																																															
Lgth. (in.)	14	14	14	14	14																																																															
Amps. F	45-75	70-130	150-200	190-230	260-300																																																															
Amps. V&O	45-75	80-130	120-160	140-170	-																																																															
C	0.060																																																																			
Mn	0.700																																																																			
Si	0.610																																																																			
Cr	1.320																																																																			
Mo	0.550																																																																			
P	0.011																																																																			
S	0.010																																																																			
TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (stresses-relieved) <table><tr><td>Yield Point (psi).....</td><td>83,000</td></tr><tr><td>Tensile strength (psi).....</td><td>94,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>26</td></tr><tr><td>Charpy V-notch at -20°F (ft. lbs.).....</td><td>76</td></tr></table> AVAILABLE SIZES AND RECOMMENDED CURRENTS (AC or DC+) <table><tr><td>Dia. (in.)</td><td>3/32</td><td>1/8</td><td>5/32</td><td>3/16</td><td>1/4</td></tr><tr><td>Lgth. (in.)</td><td>14</td><td>14</td><td>14</td><td>14</td><td>18</td></tr><tr><td>Amps. F</td><td>60-90</td><td>80-120</td><td>125-175</td><td>185-235</td><td>240-300</td></tr><tr><td>Amps. V&O</td><td>50-80</td><td>75-100</td><td>100-160</td><td>—</td><td>—</td></tr></table>	Yield Point (psi).....	83,000	Tensile strength (psi).....	94,000	Elongation in 2" (%).....	26	Charpy V-notch at -20°F (ft. lbs.).....	76	Dia. (in.)	3/32	1/8	5/32	3/16	1/4	Lgth. (in.)	14	14	14	14	18	Amps. F	60-90	80-120	125-175	185-235	240-300	Amps. V&O	50-80	75-100	100-160	—	—		TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (stress-relived) <table><tr><td>Yield Point (psi).....</td><td>86,000</td></tr><tr><td>Tensile strength (psi).....</td><td>97,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>25</td></tr><tr><td>Charpy V-notch at 72°F (ft. lbs.).....</td><td>44</td></tr><tr><td>Reduction of area (%).....</td><td>62</td></tr></table> AVAILABLE SIZES AND RECOMMENDED CURRENTS (AC or DC+) <table><tr><td>Dia. (in.)</td><td>3-32</td><td>1/8</td><td>5/32</td><td>3/16</td><td>1/4</td></tr><tr><td>Lgth. (in.)</td><td>14</td><td>14</td><td>14</td><td>14</td><td>18</td></tr><tr><td>Amps. F</td><td>60-100</td><td>90-130</td><td>130-190</td><td>190-250</td><td>250-300</td></tr><tr><td>Amps. V&O</td><td>60-90</td><td>80-120</td><td>110-170</td><td>-</td><td>-</td></tr></table>	Yield Point (psi).....	86,000	Tensile strength (psi).....	97,000	Elongation in 2" (%).....	25	Charpy V-notch at 72°F (ft. lbs.).....	44	Reduction of area (%).....	62	Dia. (in.)	3-32	1/8	5/32	3/16	1/4	Lgth. (in.)	14	14	14	14	18	Amps. F	60-100	90-130	130-190	190-250	250-300	Amps. V&O	60-90	80-120	110-170	-	-
Yield Point (psi).....	83,000																																																																			
Tensile strength (psi).....	94,000																																																																			
Elongation in 2" (%).....	26																																																																			
Charpy V-notch at -20°F (ft. lbs.).....	76																																																																			
Dia. (in.)	3/32	1/8	5/32	3/16	1/4																																																															
Lgth. (in.)	14	14	14	14	18																																																															
Amps. F	60-90	80-120	125-175	185-235	240-300																																																															
Amps. V&O	50-80	75-100	100-160	—	—																																																															
Yield Point (psi).....	86,000																																																																			
Tensile strength (psi).....	97,000																																																																			
Elongation in 2" (%).....	25																																																																			
Charpy V-notch at 72°F (ft. lbs.).....	44																																																																			
Reduction of area (%).....	62																																																																			
Dia. (in.)	3-32	1/8	5/32	3/16	1/4																																																															
Lgth. (in.)	14	14	14	14	18																																																															
Amps. F	60-100	90-130	130-190	190-250	250-300																																																															
Amps. V&O	60-90	80-120	110-170	-	-																																																															

Mild Steel and Low Hydrogen/Low Alloy Electrodes

USA 8018-B3L AWS A5.5 Class E8018-B3L Formerly AWS A5.5 Class E9018-B3L

DESCRIPTION

USA 8018-B3L is a low hydrogen, low alloy, chrome-moly electrode containing extra low carbon and designed for welding 2-1/4% chromium -1% molybdenum steel. The extra low carbon content of USA 8018-B3L improves micro structure stability during high temperature service applications such as found in pressure piping or boiler work. USA 8018-B3L can be used in any position with AC or DC (reverse polarity) and offers good arc stability, low spatter and high deposition efficiency. Excellent mechanical properties and X-ray quality weld deposits.

PREHEATING AND POSTHEATING

Depending upon the thickness and hardening characteristics of the work piece, preheating at a temperature between 400-650°F and postheating at 1250-1350°F (for 1 hour) is required. Note: In many cases the lower carbon content of USA 8018-B3L will permit a lower preheat temperature.

TYPICAL APPLICATIONS

USA 8018-B3L is similar in usage and applications to USA 8018-B3. USA 8018-B3L is most commonly used for castings, forgings and plates of 2-1/4 chromium -1% molybdenum steel, pressure piping such as found in steam power generating equipment, boiler and heat exchanger steel tubes, marine equipment, chemical processing equipment and oil refinery equipment.

TYPICAL WELD METAL CHEMISTRY (%)

C	0.035
Mn	0.770
Si	0.500
Cr	2.250
Mo	1.020
P	0.014
S	0.010

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (stress-relieved*)

Yield strength (psi).....	67,000
Tensile strength (psi).....	80,000
Elongation in 2" (%).....	21
Charpy V-notch at -72°F (ft. lbs.).....	42
Reduction in area (%).....	67

AVAILABLE SIZES AND RECOMMENDED CURRENTS (AC or DC+)

Dia. (in.)	3/32	1/8	5/32	3/16	7/32	1/4
Lgth. (in.)	14	14	14	14	18	18
Amps. F	60-100	90-130	130-190	190-250	230-270	250-300
Amps. V&O	60-90	80-120	110-170	—	—	—

USA 8018-C1 AWS A5.5 Class E8018-C1 (Weld deposit also meets the requirements of AWS A5.5 Class E8016-C1)

DESCRIPTION

USA 8018-C1 is a low alloy, low hydrogen, iron powder electrode designed to weld 2% nickel steels in the 70-80,000 psi range and where low temperature impact properties must be good. This electrode provides a stable arc in flat and horizontal fillet welding positions, producing weld deposits with fine bead appearance, free from undercuts and with excellent mechanical properties. USA 8018-C1 may be used with AC or DC (reverse polarity).

TYPICAL APPLICATIONS

USA 8018-C1 is commonly used for welding alloys subjected to low temperatures such as found in Industries involved with liquid ammonia, propane and other gases. More specific uses would include cast and wrought air-hardenable steels.

TYPICAL WELD METAL CHEMISTRY (%)

C	0.060
Mn	0.980
Si	0.600
Ni	2.410
P	0.013
S	0.007

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)

Yield strength (psi).....	73,000
Tensile strength (psi).....	87,000
Elongation in 2" (%).....	32
Charpy V-notch at -75°F (ft. lbs.).....	94
Reduction of area (%).....	60

AVAILABLE SIZES AND RECOMMENDED CURRENTS (AC or DC+)

Dia. (in.)	3/32	1/8	5/32	3/16	1/4
Lgth. (in.)	14	14	14	14	14
Amps. F	45-75	110-150	150-190	200-240	230-270
Amps. V&O	45-75	100-140	120-170	—	—

USA 8018-C2 AWS A5.5 Class E8018-C2 (Weld deposit also meets the requirements of AWS A5.5 Class E8016-C2)

DESCRIPTION

USA 8018-C2 is a low alloy, low hydrogen, iron powder electrode designed for welding 3% nickel steel and aluminum-killed steel where low temperature impact properties must be good. This electrode offers fast and efficient deposition in all positions.

TYPICAL APPLICATIONS

USA 8018-C2 is primarily used for welding 3% nickel steels intended for low temperature service, such as found in the production or storage of propane and liquid ammonia. USA 8018-C2 is commonly used to weld ASTM A8, A203, A333 Gr.3, A334 Gr.4, A352 Gr.LC2, LC3, A350 Gr.LF3 and others. Preheating is recommended for highly hardenable steels and is used to prevent cracking during cooling.

TYPICAL WELD METAL CHEMISTRY (%)

C	0.07
Si	0.32
Mn	1.12
Ni	3.45

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)

Yield Point (psi).....	83,000
Tensile strength (psi).....	94,000
Elongation in 2" (%).....	22
Charpy V-notch at -100°F (ft. lbs.).....	44

AVAILABLE SIZES AND RECOMMENDED CURRENTS (AC or DC+)

Dia. (in.)	3/32	1/8	5/32	3/16	1/4
Lgth. (in.)	14	14	14	14	14
Amps. F	60-90	110-150	150-190	200-240	250-310
Amps. V&O	50-80	100-140	120-170	-	-

Other Low Alloy Electrodes available

USA 8018-B6 AWS A5.5 E 8018-B6 see page 33
USA 8018-B8 AWS A5.5 E 8018-B8 see page 33



Mild Steel and Low Hydrogen/Low Alloy Electrodes

USA 8018-C3

AWS A5.5 Class E8018-C3 (Weld deposit also meets the requirements of AWS A5.5 Class E8016-C3)

DESCRIPTION

USA 8018-C3 is a 1 % nickel, low hydrogen, iron powder electrode used for welding high strength steels in the 70-80,000 psi tensile strength range. This electrode offers high deposition efficiency, producing excellent quality weld deposits with good impact properties even at temperatures as low as -60°F. USA 8018-C3 is also used for fillet welds on high strength quenched and tempered steels such as ASTM A514 and A517. USA 8018-C3 may be used in any position with AC or DC (reverse polarity).

TYPICAL APPLICATIONS

Cor-ten, Mayari R, LT75, N-A-Z High Tensile, V-55, Yolo HS. military and commercial applications.

TYPICAL WELD METAL CHEMISTRY (%)

C	0.070
Mn	0.910
Si	0.450
Ni	1.030
Mo	0.220
P	0.013
S	0.014

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)

Yield point (psi).....	77,000
Tensile strength (psi).....	87,000
Elongation in 2" (%).....	31
Charpy V-notch at -40°F (ft. lbs.).....	44

AVAILABLE SIZES AND RECOMMENDED CURRENTS (AC or DC+)

Dia. (in.)	3/32	1/8	5/32	3/16	1/4
Lgth. (in.)	14	14	14	14	18
Amps. F	60-95	90-130	135-180	190-240	250-300
Amps. V&O	60-90	80-120	110-170	—	—

USA 8018G

AWS A5.5 Class E8018-G

DESCRIPTION

USA B01BG is an iron powder - low hydrogen electrode designed for welding 86,000 psi high tensile strength steels. This electrode offers highly efficient operational characteristics for welding in all positions. USA 8018G electrodes yield a stable arc with low spatter and produce weld deposits with good crack resistance and easy slag removability. This electrode is used with AC or DC (reverse polarity).

TYPICAL APPLICATIONS

USA 8018G is most commonly used for welding ships, bridges, tanks and buildings.

TYPICAL WELD METAL CHEMISTRY (%)

C	0.070
Mn	1.240
Si	0.450
P	0.012
S	0.011

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)

Yield point (psi).....	80,000
Tensile strength (psi).....	90,000
Elongation in 2" (%).....	30
Charpy V-notch at -20°F (ft. lbs.).....	72

AVAILABLE SIZES AND RECOMMENDED CURRENTS (AC or DC+)

Dia. (in.)	3/32	1/8	5/32	3/16	1/4
Lgth. (in.)	14	14	14	14	18
Amps. F	55-85	90-130	120-180	180-240	240-310
Amps. V&O	55-85	80-110	110-170	150-200	—

USA 9016-B3

AWS A5.5 Class E9016-B3

DESCRIPTION

USA 9016-B3 is an all-position, low hydrogen electrode designed for welding 2-1/4% Cr, 1% Mo steel. This electrode yields a forceful arc with medium penetration, producing weld deposits with low spatter; easily removable slag and a fine bead appearance. USA 9016-B3 may be used with AC or DC (reverse polarity).

PREHEATING AND POSTHEATING

Depending upon the thickness and hardening characteristics of the work piece, preheating at a temperature between 400-650°F and postheating at 1250-1350°F (for 1 hour) is required.

TYPICAL APPLICATIONS

USA 9016B-3 is most commonly used for the welding of piping steels (A335-P22), boiler and heat exchanger steel tubes (A 199-T22, A200-T22, A213-T22), rolled steels (A387-D), cast steels (A217WC), and forged steels (A182-F22, A336-F22).

TYPICAL WELD METAL CHEMISTRY (%)

C	0.080
Mn	0.780
Si	0.450
Cr	2.370
Mo	1.030
P	0.011
S	0.010

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (stress-relieved)

Yield point (psi).....	90,000
Tensile strength (psi).....	103,000
Elongation in 2" (%).....	24

AVAILABLE SIZES AND RECOMMENDED CURRENTS (AC or DC+)

Dia. (in.)	3-32	1/8	5/32	3/16	1/4
Lgth. (in.)	14	14	14	14	18
Amps F	55-85	90-130	140-190	190-240	240-300
Amps. V&O	50-80	75-115	75-115	100-160	-

Mild Steel and Low Hydrogen/Low Alloy Electrodes

USA 9016-G AWS A5.5 Class E9016G

DESCRIPTION

USA 9016G is a low hydrogen electrode developed for welding 86,000 psi high tensile steel. This electrode produces X-ray quality, Mn-Ni-Mo weld deposits which have minimal hydrogen content and good crack resistance. USA 9016G electrodes may be used with AC or DC (reverse polarity).

PREHEATING

It is recommended that the work piece be preheated at 140-180°F.

TYPICAL APPLICATIONS

USA 9016G is used for high tensile steels such as those found in pressure vessels, penstocks, bridges, vehicles and machinery.

TYPICAL WELD METAL CHEMISTRY (%)

C	0.080
Mn	1.040
Si	0.580
P	0.012
S	0.008
Ni	0.630
Mo	0.260

TYPICAL MECHANICAL PROPERTIES OF WELD METAL (stress-relieved)

Yield strength (psi).....	88,000
Tensile strength (psi).....	96,000
Elongation in 2" (%).....	30.5
Charpy V-notch at -20°F (ft. lbs.).....	101

AVAILABLE SIZES AND RECOMMENDED CURRENTS (AC or DC+)

Dia. (in.)	3/32	1/8	5/32	3/16	1/4
Lgth. (in.)	14	14	14	14	18
Amps F	70-100	100-130	150-190	190-240	250-300
Amps. V & O	60-90	80-120	120-160	140-180	-

USA 9018-B3 AWS A5.5 Class E908-B3 (Weld de- posit also meets the requirements of E9015-B3 and E9016-B3)

DESCRIPTION

USA 9018-B3 is an all position, iron powder-low hydrogen electrode developed for welding 2-1/4% Cr-1% Mo steel which is subjected to elevated temperatures such as those found in the power piping and boiler industries. This electrode has extremely high deposition efficiency, producing X-ray quality weld deposits with mechanical properties that meet or exceed AWS-ASTM requirements. USA 9018-B3 electrodes yield a stable arc with low spatter. AC or DC (reverse polarity) may be used.

PREHEATING AND POSTHEATING

Depending upon the thickness and hardening characteristics of the work; piece, preheating at a temperature between 400-650°F and postheating at 1250-1350°F (for 1 hour) is required.

TYPICAL APPLICATIONS

USA 9018-B3 is used in piping steels (A335-P22), boiler and heat exchanger steel tubes (A199-T22, A200-T22, A213-T22), rolled steels (A387-D), cast steels (A217-WC) and forged steels (A182-F22, 336-F22).

TYPICAL WELD METAL CHEMISTRY (%)

C	0.080
Mn	0.770
Si	0.500
Cr	2.250
Mo	1.020
P	0.014
S	0.010

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (stress-relieved)

Yield point (psi).....	99,000
Tensile strength (psi).....	110,000
Elongation in 2" (%).....	21
Charpy V-notch at -75°F (ft. lbs.).....	85

AVAILABLE SIZES AND RECOMMENDED CURRENTS (AC or DC+)

Dia. (in.)	3/32	1/8	5/32	3/16	1/4
Lgth. (in.)	14	14	14	14	18
Amps. F	55-85	90-130	135-185	190-250	250-320
Amps. V&O	50-80	80-120	110-170	-	-

USA 9018-B9* AWS A5.5 Class E9018-B9

DESCRIPTION

USA 9018-B9 is a 9% Cr-1% Mo low hydrogen electrode modified with niobium (columbium) and vanadium designed to provide improved creep-rupture strength, toughness, fatigue life, oxidation and corrosion resistance at elevated operating temperatures. Fabrications of 9% Cr (P91) 12% Cr (P22) grade base metals can be made with USA E9018-B9 to allow higher operating steam temperatures and to provide higher creep-rupture properties. The weld deposits of USA E9018-B9, unlike 12% Cr steel filler metals, can be cooled to room temperature without the risk of cold cracks.

TYPICAL APPLICATIONS

The major usage of this electrode is for welding martensitic grade P91 steels used in header systems, re-heat piping and high temperature (1040-1112°F), high pressure (up to 4,000 psi) steam piping in electric power generating stations.

TYPICAL WELD METAL CHEMISTRY (%)

C	0.080
Mn	1.250
Si	0.500
P	0.010
S	0.010
Cr	9.500
Mo	0.850-1.200
V	0.150
Al	0.250
Nb	0.020-0.100
N	0.020-0.070
Ni	1.000

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (stress-relieved)

(PWHT at 1400°F for two hours (weld should be cooled to 200°F prior to PWHT)

Yield Point (psi).....	83,000
Tensile strength (psi).....	123,000
Elongation in 2" (%).....	35
Charpy V-notch at 72°F (ft. lbs.).....	45

following PWHT

AVAILABLE SIZES AND RECOMMENDED CURRENTS

Dia. (in.)	3/32	1/8	5/32	3/16	7/32	1/4
Amps. F	55-85	90-140	130-185	190-250	230-285	250-320
Amps. V&O	50-80	80-120	110-180	160-210	—	—

*E9015-B9 is also available upon request



Mild Steel and Low Hydrogen/Low Alloy Electrodes

USA 9018M AWS A5.5 Class E9018M	USA 10016G AWS A5.5 Class E10016-G	USA 11016G AWS A5.5 Class E11016-G																																																																
DESCRIPTION USA 9018M is an all-position, low-hydrogen, iron-powder electrode containing manganese, molybdenum and nickel. USA 9018M is designed for welding low alloy, high tensile, quenched and tempered steels such as T1, HY80 and HY90. Weld deposits have excellent impact properties and are X-ray quality.	DESCRIPTION USA 10016G is a low alloy, low hydrogen electrode used for all position welding of 100,000 psi high tensile strength steels. This electrode produces weld deposits of good notch toughness, extremely low hydrogen content and good crack resistance. USA 10016G electrodes may be used with AC or DC (reverse polarity),	DESCRIPTION USA 11016G low hydrogen electrodes are used for welding 115,000 psi high tensile steel with a yield point of 100,000 psi and over. This electrode produces X-ray quality, Mn-Ni-Mo weld deposits which have minimal hydrogen content, good notch toughness and good crack resistance. USA 11016G electrodes may be used with AC or DC (reverse polarity).																																																																
PREHEATING AND POSTHEATING Depending upon the thickness and hardening characteristics of the work piece, preheating at a temperature between 140-220°F is recommended.	PREHEATING Depending upon the thickness and hardening characteristics of the work piece, it is recommended that it be preheated at 200-300°F.	PREHEATING Depending upon the thickness and hardening characteristics of the work piece, it is recommended that it is preheated at 250-350°F.																																																																
TYPICAL APPLICATIONS USA 9018M is commonly used to make attachment welds on steels in the 90,000 psi tensile strength range. Typical applications would involve pressure vessels, bridges, machinery and penstocks. Base metals would include ASTM A225 Gr. B, A235 Gr. G, A288 class 2, A291 class 1, 2 and many others.	TYPICAL APPLICATIONS USA 10016G is used for stress-relieved weldments in T-1, N-Xtra 100, SSS100, Jaijoy-S-100, HY80 as well as wrought or cast armour plates.	TYPICAL APPLICATIONS USA 11016G electrodes are commonly used for pressure vessels, penstocks and bridges.																																																																
TYPICAL WELD METAL CHEMISTRY (%) <table><tr><td>C</td><td>0.07</td></tr><tr><td>Si</td><td>0.51</td></tr><tr><td>Mn</td><td>1.10</td></tr><tr><td>Ni</td><td>1.58</td></tr><tr><td>Mo</td><td>0.20</td></tr></table>	C	0.07	Si	0.51	Mn	1.10	Ni	1.58	Mo	0.20	TYPICAL WELD METAL CHEMISTRY (%) <table><tr><td>C</td><td>0.080</td></tr><tr><td>Mn</td><td>1.050</td></tr><tr><td>Si</td><td>0.370</td></tr><tr><td>P</td><td>0.010</td></tr><tr><td>S</td><td>0.009</td></tr><tr><td>Ni</td><td>1.870</td></tr><tr><td>Mo</td><td>0.400</td></tr></table>	C	0.080	Mn	1.050	Si	0.370	P	0.010	S	0.009	Ni	1.870	Mo	0.400	TYPICAL WELD METAL CHEMISTRY (%) <table><tr><td>C</td><td>0.08</td></tr><tr><td>Mn</td><td>1.28</td></tr><tr><td>Si</td><td>0.60</td></tr><tr><td>Ni</td><td>1.84</td></tr><tr><td>Cr</td><td>0.43</td></tr><tr><td>Mo</td><td>0.43</td></tr></table>	C	0.08	Mn	1.28	Si	0.60	Ni	1.84	Cr	0.43	Mo	0.43																												
C	0.07																																																																	
Si	0.51																																																																	
Mn	1.10																																																																	
Ni	1.58																																																																	
Mo	0.20																																																																	
C	0.080																																																																	
Mn	1.050																																																																	
Si	0.370																																																																	
P	0.010																																																																	
S	0.009																																																																	
Ni	1.870																																																																	
Mo	0.400																																																																	
C	0.08																																																																	
Mn	1.28																																																																	
Si	0.60																																																																	
Ni	1.84																																																																	
Cr	0.43																																																																	
Mo	0.43																																																																	
TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded) <table><tr><td>Yield strength (psi).....</td><td>83,000</td></tr><tr><td>Tensile strength (psi).....</td><td>97,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>30</td></tr><tr><td>Charpy V-notch at -60°F (ft. lbs.).....</td><td>65</td></tr></table>	Yield strength (psi).....	83,000	Tensile strength (psi).....	97,000	Elongation in 2" (%).....	30	Charpy V-notch at -60°F (ft. lbs.).....	65	TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (stress-relieved) <table><tr><td>Yield strength (psi).....</td><td>93,000</td></tr><tr><td>Tensile strength (psi).....</td><td>107,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>26.2</td></tr><tr><td>Charpy V-notch at -20°F (ft. lbs.).....</td><td>86</td></tr></table>	Yield strength (psi).....	93,000	Tensile strength (psi).....	107,000	Elongation in 2" (%).....	26.2	Charpy V-notch at -20°F (ft. lbs.).....	86	TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (stress-relieved) <table><tr><td>Yield strength (psi).....</td><td>106,000</td></tr><tr><td>Tensile strength (psi).....</td><td>121,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>22</td></tr><tr><td>Charpy V-notch at -20°F (ft. lbs.).....</td><td>86</td></tr></table>	Yield strength (psi).....	106,000	Tensile strength (psi).....	121,000	Elongation in 2" (%).....	22	Charpy V-notch at -20°F (ft. lbs.).....	86																																								
Yield strength (psi).....	83,000																																																																	
Tensile strength (psi).....	97,000																																																																	
Elongation in 2" (%).....	30																																																																	
Charpy V-notch at -60°F (ft. lbs.).....	65																																																																	
Yield strength (psi).....	93,000																																																																	
Tensile strength (psi).....	107,000																																																																	
Elongation in 2" (%).....	26.2																																																																	
Charpy V-notch at -20°F (ft. lbs.).....	86																																																																	
Yield strength (psi).....	106,000																																																																	
Tensile strength (psi).....	121,000																																																																	
Elongation in 2" (%).....	22																																																																	
Charpy V-notch at -20°F (ft. lbs.).....	86																																																																	
AVAILABLE SIZES AND RECOMMENDED CURRENTS (AC or DC+) <table><tr><td>Dia. (in.)</td><td>3/32</td><td>1/8</td><td>5/32</td><td>3/16</td><td>1/4</td></tr><tr><td>Lgth. (in.)</td><td>14</td><td>14</td><td>14</td><td>14</td><td>14</td></tr><tr><td>Amps. F</td><td>50-100</td><td>90-130</td><td>140-190</td><td>190-240</td><td>250-310</td></tr><tr><td>Amps. V&O</td><td>40-80</td><td>80-115</td><td>110-160</td><td>140-170</td><td>—</td></tr></table>	Dia. (in.)	3/32	1/8	5/32	3/16	1/4	Lgth. (in.)	14	14	14	14	14	Amps. F	50-100	90-130	140-190	190-240	250-310	Amps. V&O	40-80	80-115	110-160	140-170	—	AVAILABLE SIZES AND RECOMMENDED CURRENTS (AC or DC+) <table><tr><td>Dia. (in.)</td><td>1/8</td><td>5/32</td><td>3/16</td><td>1/4</td></tr><tr><td>Lgth. (in.)</td><td>14</td><td>14</td><td>14</td><td>18</td></tr><tr><td>Amps. F</td><td>90-130</td><td>140-190</td><td>180-230</td><td>250-300</td></tr><tr><td>Amps. V&O</td><td>80-120</td><td>110-160</td><td>130-190</td><td>—</td></tr></table>	Dia. (in.)	1/8	5/32	3/16	1/4	Lgth. (in.)	14	14	14	18	Amps. F	90-130	140-190	180-230	250-300	Amps. V&O	80-120	110-160	130-190	—	AVAILABLE SIZES AND RECOMMEND-ED CURRENTS (AC or DC+) <table><tr><td>Dia. (in.)</td><td>1/8</td><td>5/32</td><td>3/16</td><td>1/4</td></tr><tr><td>Lgth. (in.)</td><td>14</td><td>14</td><td>14</td><td>14</td></tr><tr><td>Amps. F</td><td>90-130</td><td>140-190</td><td>180-230</td><td>250-300</td></tr><tr><td>Amps. V&O</td><td>80-120</td><td>110-150</td><td>130-190</td><td>—</td></tr></table>	Dia. (in.)	1/8	5/32	3/16	1/4	Lgth. (in.)	14	14	14	14	Amps. F	90-130	140-190	180-230	250-300	Amps. V&O	80-120	110-150	130-190	—
Dia. (in.)	3/32	1/8	5/32	3/16	1/4																																																													
Lgth. (in.)	14	14	14	14	14																																																													
Amps. F	50-100	90-130	140-190	190-240	250-310																																																													
Amps. V&O	40-80	80-115	110-160	140-170	—																																																													
Dia. (in.)	1/8	5/32	3/16	1/4																																																														
Lgth. (in.)	14	14	14	18																																																														
Amps. F	90-130	140-190	180-230	250-300																																																														
Amps. V&O	80-120	110-160	130-190	—																																																														
Dia. (in.)	1/8	5/32	3/16	1/4																																																														
Lgth. (in.)	14	14	14	14																																																														
Amps. F	90-130	140-190	180-230	250-300																																																														
Amps. V&O	80-120	110-150	130-190	—																																																														

Mild Steel and Low Hydrogen/Low Alloy Electrodes

USA 11018M AWS A5.5 Class E11018M

DESCRIPTION

USA 11018M low hydrogen, iron powder electrodes are used for fast, efficient deposition of weld metal with mechanical properties equal to or exceeding that of the base metal. This electrode produces X-ray quality weld deposits with medium penetration and easy slag removability. Although USA 11018M electrodes may be used in any position, they are particularly suited for horizontal and downhand welding with either AC or DC (reverse polarity)

TYPICAL APPLICATIONS

USA 11018M electrodes were designed for welding quenched and tempered steels with tensile strengths of up to 110,000 psi such as ASTM A514 and A517, HY80, T-1, SSS-100, etc.

TYPICAL WELD METAL CHEMISTRY (%)

C	0.08
Mn	1.49
Si	0.41
Cr	0.32
Mo	0.32
Ni	1.86

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)

Yield Point (psi).....	104,000
Tensile strength (psi).....	120,000
Elongation in 2" (%).....	23
Charpy V-notch at -60°F (ft. lbs.).....	44

AVAILABLE SIZES AND RECOMMENDED CURRENTS (AC or DC+)

Dia. (in.)	3/32	1/8	5/32	3/16	1/4
Lgth. (in.)	14	14	14	14	18
Amps F	55-85	90-130	140-190	180-230	250-300
Amps. V&O	50-80	80-120	110-150	130-190	-

USA 12018M AWS A5.5 Class E12018M

DESCRIPTION

USA 12018M is an all-position, low-hydrogen iron powder electrode containing manganese, chromium, nickel and molybdenum. USA 12018M was developed for welding high strength steels requiring a weld deposit tensile strength of 120,000 psi minimum. The weld deposits of USA 12018M have excellent impact properties and are X-ray quality.

PREHEATING AND POSTHEATING

Depending upon the thickness and hardening characteristics of the work piece, preheating at a temperature between 140-220°F is recommended. Do not exceed the recommended preheat temperatures as excessive heat input can cause a deterioration of impact values and the yield strength of the weld deposit.

TYPICAL APPLICATIONS

USA 12018M is designed for welding high tensile strength steels such as ASTM A148 Gr. 120-95, A238 Gr. F, A291 class 4, A514 and many other specifications all requiring a weld deposit tensile strength of 120,000 psi minimum.

TYPICAL WELD METAL CHEMISTRY (%)

C	0.08
Si	0.30
Mn	1.46
Cr	0.98
Ni	1.86
Mo	0.41

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)

Yield Point (psi).....	117,000
Tensile strength (psi).....	138,000
Elongation in 2" (%).....	20
Charpy V-notch at -20°F (ft. lbs.).....	36

AVAILABLE SIZES AND RECOMMENDED CURRENTS (AC or DC+)

Dia. (in.)	3/32	1/8	5/32	3/16	7/32	1/4
Lgth. (in.)	14	14	14	14	14	18
Amps F	50-95	90-130	130-190	190-250	220-280	250-320
Amps. V & O	40-95	80-120	100-160	120-160	150-210	-

Chemical Requirements of Low-Alloy Weld Metal

AWS Classification ^a	Chemical Composition, Percent ^b								
	C	Mn	P	S	Si	Ni	Cr	Mo	V
Carbon-Molybdenum Steel Electrodes									
E7010-A1 E7011-A1 E7015-A1 E7016-A1 E7018-A1 E7020-A1 E7027-A1	0.12	0.60 0.60 0.90 0.90 0.90 0.60 1.00	0.03	0.04	0.40 0.40 0.60 0.60 0.80 0.40 0.40	—	—	0.40 to 0.65	—
Chromium-Molybdenum Steel Electrodes									
E8016-B1 E8018-B1	0.05 to 0.12	0.90	0.03	0.04	0.60 0.80	—	0.40 to 0.65	0.40 to 0.65	—
E8015-B2L	0.05	0.90	0.03	0.04	1.00	—	1.00 to 1.50	0.40 to 0.65	—
E8016-B2 E8018-B2	0.05 to 0.12	0.90	0.03	0.04	0.60 0.80	—	1.00 to 1.50	0.40 to 0.65	—
E7018-B2L	0.05	0.90	0.03	0.04	0.80	—	1.00 to 1.50	0.40 to 0.65	—
E9015-B3L	0.05	0.90	0.03	0.04	1.00	—	2.00 to 2.50	0.90 to 1.20	—
E9015-B3 E9016-B3 E9018-B3	0.05 to 0.12	0.90	0.03	0.04	0.60 0.60 0.80	—	2.00 to 2.50	0.90 to 1.20	—
E8018-B3L	0.05	0.90	0.03	0.04	0.80	—	2.00 to 2.50	0.90 to 1.20	—
E8015-B4L	0.05	0.90	0.03	0.04	1.00	—	1.75 to 2.25	0.40 to 0.65	—
E8016-B5	0.07 to 0.15	0.40 to 0.70	0.03	0.04	0.30 to 0.60	—	0.40 to 0.60	1.00 to 1.25	0.05
Nickel Steel Electrodes									
E8018-NM ^c	0.10	0.80 to 1.25	0.02	0.03	0.60	0.80 to 1.10	0.05	0.40 to 0.65	0.02
Manganese-Molybdenum Steel Electrodes									
E9015-D1 E9018-D1	0.12	1.25 to 1.75	0.03	0.04	0.60 0.80	—	—	0.25 to 0.45	—
E8016-D3 E8018-D3	0.12	1.00 to 1.75	0.03	0.04	0.60 0.80	—	—	0.40 to 0.65	—
E10015-D2 E10016-D2 E10018-D2	0.15	1.65 to 2.00	0.03	0.04	0.60 0.60 0.80	—	—	0.25 to 0.45	—
All other Low-Alloy Steel Electrodes ^e									
EXX10-G ^e EXX11-G EXX13-G EXX15-G EXX16-G EXX18-G E7020-G	—	1.00 min. ^f	—	—	0.80 min. ^f	0.50 min. ^f	0.30 min. ^f	0.20 min. ^f	0.10 min. ^f
E9018-M ^c E10018-M ^c E11018-M ^c E12018-M ^c E12018-M ^c E7018-W ^g E8018-W ^h	0.10 0.10 0.10 0.10 0.10 0.12 0.12	0.60 to 1.25 0.75 to 1.70 1.30 to 1.80 1.30 to 2.25 0.80 to 1.60 0.40 to 0.70 0.50 to 1.30	0.030 0.030 0.030 0.030 0.015 0.025 0.030	0.030 0.030 0.030 0.030 0.012 0.025 0.040	0.80 0.60 0.60 0.60 0.65 0.40 to 0.70 0.35 to 0.80	1.40 to 1.80 1.40 to 2.10 1.25 to 2.50 1.75 to 2.50 3.00 to 3.80 0.20 to 0.40 0.40 to 0.80	0.15 0.35 0.40 0.30 to 1.50 0.65 0.15 to 0.30 0.415 to 0.70	0.35 0.25 to 0.50 0.25 to 0.50 0.30 to 0.55 0.20 to 0.30 — —	0.05 0.05 0.05 0.05 0.05 0.08 —

Note: Single values shown are maximum percentages, except where otherwise specified.

a. The suffixes A1, B3, C2, etc. designate the chemical composition of the electrode classification.

b. For determining the chemical composition, DCEN (electrode negative) may be used where DC, both polarities, is specified.

c. These Classifications are intended to conform to classifications covered by the military specifications for similar compositions.

d. Copper shall be 0.10% max and aluminum shall be 0.05% max for E8018-NM electrodes.

e. The letters "XX" used in the classification designations in this table stand for the various strength levels (70, 80, 90, 100, 110 and 120) of electrodes.

f. In order to meet the alloy requirements of the G group, the weld deposit need minimum, as specified in the table, of only one of the elements listed. Additional chemical requirement may be as agreed between supplier and purchaser.

g. Copper shall be 0.30 to 0.60% for E7018-W electrodes.

h. Copper shall be 0.30 to 0.75% for E8018-W electrodes.

Courtesy: American Welding Society AWS A5.5

THE WELDING OF PLAIN CARBON STEEL & LOW ALLOY/HIGH STRENGTH STEEL

Washington Alloy supplies approximately 9 different specifications of steel MIG wire. In order to choose the correct wire for your welding needs, there are several factors to consider.

MECHANICAL PROPERTIES

It is important to know the ultimate tensile strength and impact strength (charpy V-notch) that is required of the weld deposit. USA 70S-2 through USA 70S-6 wires can be used for most carbon steel welding applications; while USA 80S-D2, 100S-1, 110S-1 and 120S-1 are used for greater tensile and impact strength. The mechanical properties are also influenced by the shielding gas used. Basically, the higher the argon level – the greater the impact strength

WELD METAL SOUNDNESS

The soundness of welds will be determined by the oxygen content, therefore you want to have the least amount of oxygen present to obtain the greatest weld metal soundness. The oxygen level can be reduced by using wires with deoxidizers. These deoxidizers would include: (Mn) manganese, (Si) silicon, (Ti) titanium, (Al) aluminum and (Zr) zirconium. The greater the deoxidizing power of the wire – the lower the oxygen content of the weld deposit. Washington Alloy MIG wires are listed in order of least deoxidizing power to greatest deoxidizing power: USA 70S- 3, 70S-4, 70S-6, 70S-2, 80S-D2.

To determine which wire you should use depends upon several factors:

(1) The condition of the base metal will determine the deoxidizing power required. If the base metal is killed (fully deoxidized), then you could use USA 70S-3 wire and produce very sound weld deposits. However if the base metal has rust, mill scale, oil or other impurities on it, then you would want to use a wire with greater deoxidizing power such as USA70S-6.

(2)The lower the argon content of the shielding gas (i.e., 100% CO₂) -the greater the deoxidizing power of the wire.

(3) The greater the size of the weld puddle - the greater the deoxidizing power of the wire.

WELDING PERFORMANCE

The performance of Washington Alloy MIG wire will depend upon the shielding gas used and the manganese-silicon content of the wire.

(1) The greater the argon content of the shielding gas - the smoother the bead appearance, with minimum spatter loss.

(2) The greater the manganese and silicon content of the wire-the greater the fluidity and wettability of the weld puddle. This characteristic makes the wire more suitable for out-of-position welding and yields a nicer bead appearance.

USA 70S-2 AWS A5.18 Class ER70S-2

DESCRIPTION

USA 70S-2 is a multiple deoxidized wire containing small amounts of zirconium, titanium and aluminum in addition to the manganese and silicon deoxidizers characteristic of the steel wire group. This wire may be used for MIG or TIG welding on all grades of mild and carbon steels, producing superior quality welds with minimal porosity even over rust and mill scale. USA 70S-2 is popular for out of position welding with small diameter wires utilizing the short-circuiting arc type transfer. MIG welding may be accomplished using CO₂, Argon-Oxygen mixtures or mixtures of the two.

TYPICAL APPLICATIONS

Pipes, offshore drilling rigs, structural steel work, etc.

TYPICAL WELD METAL CHEMISTRY (%)

	USA 70S-2	AWS SPEC
C	0.050	0.07 max.
Mn	1.250	0.90-1.40
Si	0.500	0.40-0.70
P	0.012	0.025 max.
S	0.012	0.035 max.
Al	0.100	0.05-0.15
Zr	0.090	0.02-0.12
Ti	0.100	0.05-0.15

TYPICAL MECHANICAL PROPERTIES OF WELD METAL (CO₂ shielding gas)

	AWS Spec.	USA 70S-2
Yield strength (psi).....	60,000 min.	71,000
Ultimate tensile strength(ksi).....	72,000 min.	83,000
Elongation in 2" (%).....	22 min.	27.5
Charpy V-notch at-20°F (ft. lbs.).....	20 min.	30
Reduction of area	—	58
Average Brinell Hardness	—	140

USA 70S-3 AWS A5.18 Class ER70S-3

DESCRIPTION

USA 70S-3 is a silicon and manganese deoxidized wire used for mild and low alloy steel general purpose fabrication. A well balanced silicon and manganese content permits its use with CO₂, Argon-Oxygen mixtures, or mixtures of the two. This wire may be used for short-circuiting arc (dip-transfer), buried arc, as well as spray transfer arc processes. USA 70S-3 produces quality welds with rimmed steels, better welds on semi-killed steels and excellent welds on killed steels. It yields an almost slag-free deposit which does not require cleaning for many applications thereby providing low plate preparation costs, good bead appearance and welder satisfaction.

TYPICAL APPLICATIONS

Automobile frames, earthmoving and farm equipment, sheet metal, ships and barges, railcars, trailers, ornamental iron, metal furniture, storage bins and general fabrications.

TYPICAL WELD METAL CHEMISTRY (%)

	USA 70S-2	AWS SPEC
C	0.100	0.06-0.15
Mn	1.000	0.90-1.40
Si	0.550	0.45-0.75
P	0.012	0.025 max.
S	0.012	0.035 max.

TYPICAL MECHANICAL PROPERTIES OF WELD METAL(CO₂ shielding gas)

	AWS Spec.	USA 70S-2
Yield strength (psi).....	60,000 min.	62,400
Ultimate tensile strength(ksi).....	72,000 min.	75,500
Elongation in 2" (%).....	22 min.	30.7
Charpy V-notch at-0°F (ft. lbs.).....	20 min.	66
Reduction of area	—	59
Average Brinell Hardness	—	130

Plain Carbon Steel and Low Alloy/ High strength Steel Wires

USA 70S-4 AWS A5.18 Class ER70S-4	USA 70S-6 AWS A5.18 Class ER70S-6	USA 80S-D2 AWS A5.28 Class ER80S-D2																																																															
DESCRIPTION USA 70S-4 has a higher content of manganese and silicon than USA 70S-3. This gives it greater weld metal strength and good quality weld deposits in semi-killed or rimmed steels. This wire may be used with CO ₂ , Argon-Oxygen mixtures, or mixtures of the two. USA 70S-4 has excellent fluidity and wettability resulting in a very smooth bead contour on butt and fillet welds. This wire can be used on all CO ₂ , semi-automatic and automatic equipment.	DESCRIPTION USA 70S-6 contains high levels of manganese and silicon for stronger deoxidizing power where stringent cleaning procedures are not possible. This wire has been designed to provide X-ray quality porosity-free welds and the highest tensile strength (as welded) of the plain carbon steel wires. The high silicon content increases the fluidity of the weld pool, creating a smoother bead appearance and resulting in minimal post-weld grinding. USA 70S-6 is excellent where poor fit-ups or rusty and oily plates may be used.	DESCRIPTION USA 80S-D2 is designed to give high strength welds on high sulfur bearing (free- machining) steels or medium carbon steels. This wire contains additional amounts of manganese and silicon which, when alloyed with 0.50% molybdenum, produces weld deposits which have high ductility, excellent impact values and tensile strengths of approximately 100,000 psi. USA 80S-D2 is commonly used on low carbon and low alloy steels such as AISI 4130 where the tensile strengths provided by plain carbon steel wires are inadequate. A well balanced silicon content gives this wire superior arc stability, a low spatter level and a flat bead with excellent appearance. USA 80S-D2 produces X-ray quality, porosity free welds even over dirt, rust or mill scale.																																																															
TYPICAL APPLICATIONS Joining structural steels, piping, ship steels, machinery, bridges, electric products, boiler and pressure vessel A515 in stress relieved conditions,	TYPICAL APPLICATIONS Construction work, tanks, truck bodies, farm implements, pipes, steel castings or forgings, shaft build-ups and general shop fabrications.	TYPICAL APPLICATIONS Farm implements, automotive parts, pipes, light-gauge steels, low alloy steels such as AISI 4130 and high yield steels such as T-1.																																																															
TYPICAL WIRE CHEMISTRY (%) <table> <tr> <th></th><th>USA 70S-4</th><th>AWS SPEC</th></tr> <tr> <td>C</td><td>0.100</td><td>0.07-0.15</td></tr> <tr> <td>Mn</td><td>1.250</td><td>1.00-1.50</td></tr> <tr> <td>Si</td><td>0.750</td><td>0.65-0.85</td></tr> <tr> <td>P</td><td>0.014</td><td>0.025 max.</td></tr> <tr> <td>S</td><td>0.022</td><td>0.0.5 max.</td></tr> </table>		USA 70S-4	AWS SPEC	C	0.100	0.07-0.15	Mn	1.250	1.00-1.50	Si	0.750	0.65-0.85	P	0.014	0.025 max.	S	0.022	0.0.5 max.	TYPICAL WIRE CHEMISTRY (%) <table> <tr> <th></th><th>USA 70S-6</th><th>AWS SPEC</th></tr> <tr> <td>C</td><td>0.100</td><td>0.06-0.15</td></tr> <tr> <td>Mn</td><td>1.700</td><td>1.40-1.85</td></tr> <tr> <td>Si</td><td>1.000</td><td>0.80-1.15</td></tr> <tr> <td>P</td><td>0.010</td><td>0.025 max.</td></tr> <tr> <td>S</td><td>0.015</td><td>0.035 max.</td></tr> </table>		USA 70S-6	AWS SPEC	C	0.100	0.06-0.15	Mn	1.700	1.40-1.85	Si	1.000	0.80-1.15	P	0.010	0.025 max.	S	0.015	0.035 max.	TYPICAL WELD METAL CHEMISTRY (%) <table> <tr> <th></th><th>USA 80S-D2</th><th>AWS SPEC</th></tr> <tr> <td>C</td><td>0.080</td><td>0.07-0.12</td></tr> <tr> <td>Mn</td><td>1.950</td><td>1.60-2.10</td></tr> <tr> <td>P</td><td>0.012</td><td>0.025 max.</td></tr> <tr> <td>Si</td><td>0.600</td><td>0.50-0.80</td></tr> <tr> <td>Mo</td><td>0.500</td><td>0.40-0.60</td></tr> <tr> <td>Ni</td><td>0.020</td><td>0.15 max</td></tr> </table>		USA 80S-D2	AWS SPEC	C	0.080	0.07-0.12	Mn	1.950	1.60-2.10	P	0.012	0.025 max.	Si	0.600	0.50-0.80	Mo	0.500	0.40-0.60	Ni	0.020	0.15 max						
	USA 70S-4	AWS SPEC																																																															
C	0.100	0.07-0.15																																																															
Mn	1.250	1.00-1.50																																																															
Si	0.750	0.65-0.85																																																															
P	0.014	0.025 max.																																																															
S	0.022	0.0.5 max.																																																															
	USA 70S-6	AWS SPEC																																																															
C	0.100	0.06-0.15																																																															
Mn	1.700	1.40-1.85																																																															
Si	1.000	0.80-1.15																																																															
P	0.010	0.025 max.																																																															
S	0.015	0.035 max.																																																															
	USA 80S-D2	AWS SPEC																																																															
C	0.080	0.07-0.12																																																															
Mn	1.950	1.60-2.10																																																															
P	0.012	0.025 max.																																																															
Si	0.600	0.50-0.80																																																															
Mo	0.500	0.40-0.60																																																															
Ni	0.020	0.15 max																																																															
TYPICAL MECHANICAL PROPERTIES OF WELD METAL (CO₂ shielding gas) <table> <tr> <th></th><th>AWS Spec.</th><th>USA 70S-4</th></tr> <tr> <td>Yield strength (psi).....</td><td>60,000 min.</td><td>65,000</td></tr> <tr> <td>Ultimate tensile strength(ksi).....</td><td>72,000 min.</td><td>80,000</td></tr> <tr> <td>Elongation in 2" (%).....</td><td>22 min.</td><td>30</td></tr> <tr> <td>Charpy V-notch at -32°F (ft. lbs.) -</td><td>-</td><td>98</td></tr> <tr> <td>Reduction of area</td><td>-</td><td>59</td></tr> <tr> <td>Average Brinell Hardness</td><td>-</td><td>130</td></tr> </table>		AWS Spec.	USA 70S-4	Yield strength (psi).....	60,000 min.	65,000	Ultimate tensile strength(ksi).....	72,000 min.	80,000	Elongation in 2" (%).....	22 min.	30	Charpy V-notch at -32°F (ft. lbs.) -	-	98	Reduction of area	-	59	Average Brinell Hardness	-	130	TYPICAL MECHANICAL PROPERTIES OF WELD METAL (CO₂ shielding gas) <table> <tr> <th></th><th>AWS Spec.</th><th>USA 70S-6</th></tr> <tr> <td>Yield strength (psi).....</td><td>60,000 min.</td><td>73,000</td></tr> <tr> <td>Ultimate tensile strength(ksi).....</td><td>72,000 min.</td><td>90,000</td></tr> <tr> <td>Elongation in 2" (%).....</td><td>22 min.</td><td>25</td></tr> <tr> <td>Charpy V-notch at -20°F (ft. lbs.).....</td><td>20 min.</td><td>28</td></tr> <tr> <td>Reduction of area</td><td>-</td><td>60</td></tr> <tr> <td>Average Brinell Hardness</td><td>-</td><td>160</td></tr> </table>		AWS Spec.	USA 70S-6	Yield strength (psi).....	60,000 min.	73,000	Ultimate tensile strength(ksi).....	72,000 min.	90,000	Elongation in 2" (%).....	22 min.	25	Charpy V-notch at -20°F (ft. lbs.).....	20 min.	28	Reduction of area	-	60	Average Brinell Hardness	-	160	TYPICAL MECHANICAL PROPERTIES OF WELD METAL (CO₂ shielding gas) <table> <tr> <th></th><th>AWS Spec.</th><th>USA 70S-6</th></tr> <tr> <td>Yield strength (psi).....</td><td>60,000 min.</td><td>84,000</td></tr> <tr> <td>Ultimate tensile strength(ksi).....</td><td>72,000 min.</td><td>99,000</td></tr> <tr> <td>Elongation in 2" (%).....</td><td>17 min.</td><td>22</td></tr> <tr> <td>Charpy V-notch at -20°F (ft. lbs.).....</td><td>20 min.</td><td>30</td></tr> <tr> <td>Reduction of area</td><td>-</td><td>55</td></tr> <tr> <td>Average Brinell Hardness</td><td>-</td><td>163</td></tr> </table>		AWS Spec.	USA 70S-6	Yield strength (psi).....	60,000 min.	84,000	Ultimate tensile strength(ksi).....	72,000 min.	99,000	Elongation in 2" (%).....	17 min.	22	Charpy V-notch at -20°F (ft. lbs.).....	20 min.	30	Reduction of area	-	55	Average Brinell Hardness	-	163
	AWS Spec.	USA 70S-4																																																															
Yield strength (psi).....	60,000 min.	65,000																																																															
Ultimate tensile strength(ksi).....	72,000 min.	80,000																																																															
Elongation in 2" (%).....	22 min.	30																																																															
Charpy V-notch at -32°F (ft. lbs.) -	-	98																																																															
Reduction of area	-	59																																																															
Average Brinell Hardness	-	130																																																															
	AWS Spec.	USA 70S-6																																																															
Yield strength (psi).....	60,000 min.	73,000																																																															
Ultimate tensile strength(ksi).....	72,000 min.	90,000																																																															
Elongation in 2" (%).....	22 min.	25																																																															
Charpy V-notch at -20°F (ft. lbs.).....	20 min.	28																																																															
Reduction of area	-	60																																																															
Average Brinell Hardness	-	160																																																															
	AWS Spec.	USA 70S-6																																																															
Yield strength (psi).....	60,000 min.	84,000																																																															
Ultimate tensile strength(ksi).....	72,000 min.	99,000																																																															
Elongation in 2" (%).....	17 min.	22																																																															
Charpy V-notch at -20°F (ft. lbs.).....	20 min.	30																																																															
Reduction of area	-	55																																																															
Average Brinell Hardness	-	163																																																															
<div>Other Low Alloy Steel Wires available</div> <div> USA 80S-B2 AWS A5.28 see page 23 USA 80S-B6 AWS A5.28 see page 23 USA 80S-B8 AWS A5.28 see page 23 USA 90S-B3 AWS A5.28 see page 23 </div>																																																																	

Low Alloy/High Strength Steel Wires

USA 100S-1 AWS A5.28 Class ER100S-1	USA 110S-1 AWS A5.28 Class ER110S-1	USA 120S-1 AWS A5.28 Class ER120S-1																																																																																						
<p>DESCRIPTION</p> <p>USA 100S-1 was developed for welding high strength low alloy steel plates such as HY80, HY100 and other similar steels. This wire produces high tensile strength, high impact resistant weld deposits that retain their toughness to -70°F making it suitable for low temperature and critical applications. USA 100S-1 can be welded at an interpass temperature as low as 300°F.</p> <p>TYPICAL APPLICATIONS</p> <p>HY80 and HY100 steels, military vessels, all-position welding.</p> <p>TYPICAL WIRE CHEMISTRY (%)</p> <table><tr><td>C</td><td>0.060</td></tr><tr><td>Mn</td><td>1.650</td></tr><tr><td>Si</td><td>0.350</td></tr><tr><td>P</td><td>0.007</td></tr><tr><td>S</td><td>0.008</td></tr><tr><td>Mo</td><td>0.350</td></tr><tr><td>Ni</td><td>1.750</td></tr><tr><td>Cr</td><td>0.100</td></tr></table> <p>TYPICAL MECHANICAL PROPERTIES OF WELD METAL</p> <table><tr><td>Yield strength (psi).....</td><td>92,000</td></tr><tr><td>Ultimate tensile strength(ksi).....</td><td>105,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>17</td></tr><tr><td>Charpy V-notch at-60°F (ft. lbs.)....</td><td>60</td></tr></table>	C	0.060	Mn	1.650	Si	0.350	P	0.007	S	0.008	Mo	0.350	Ni	1.750	Cr	0.100	Yield strength (psi).....	92,000	Ultimate tensile strength(ksi).....	105,000	Elongation in 2" (%).....	17	Charpy V-notch at-60°F (ft. lbs.)....	60	<p>DESCRIPTION</p> <p>USA 110S-1 is used for welding HY100 and other high strength, low alloy steels. It is most applicable where high strength and ductility to -75°F is required. USA 110S-1 can be welded at an interpass temperature as low as 300°F.</p> <p>TYPICAL APPLICATIONS</p> <p>HY100 and other high strength low alloy steels.</p> <p>TYPICAL WIRE CHEMISTRY (%)</p> <table><tr><td>C</td><td>0.070</td></tr><tr><td>Mn</td><td>1.600</td></tr><tr><td>P</td><td>0.007</td></tr><tr><td>S</td><td>0.009</td></tr><tr><td>Si</td><td>0.450</td></tr><tr><td>Mo</td><td>0.500</td></tr><tr><td>Ni</td><td>2.300</td></tr><tr><td>Cr</td><td>0.300</td></tr></table> <p>TYPICAL MECHANICAL PROPERTIES OF WELD METAL</p> <table><tr><td>Yield strength (psi).....</td><td>98,000</td></tr><tr><td>Ultimate tensile strength(ksi).....</td><td>115,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>16</td></tr><tr><td>Charpy V-notch at-60°F (ft. lbs.).....</td><td>65</td></tr></table> <p>PACKAGING</p> <p>All Sizes are packaged in 10 lb. packs – 5 packs per 50 lb. master carton.</p>	C	0.070	Mn	1.600	P	0.007	S	0.009	Si	0.450	Mo	0.500	Ni	2.300	Cr	0.300	Yield strength (psi).....	98,000	Ultimate tensile strength(ksi).....	115,000	Elongation in 2" (%).....	16	Charpy V-notch at-60°F (ft. lbs.).....	65	<p>DESCRIPTION</p> <p>USA 120S-1 is used for a variety of steels where high strength and ductility and critical. It is designed to give high notch toughness, yield strength and impact resistance. USA 120S-1 can be welded at an interpass temperature as low as 300°F while also offering high ductility to -75°F</p> <p>TYPICAL APPLICATIONS</p> <p>High yield steels such as T-1, HY-100 and other steels in the 100,000 psi YS class, pressure vessels.</p> <p>TYPICAL WIRE CHEMISTRY (%)</p> <table><tr><td>C</td><td>0.070</td></tr><tr><td>Mn</td><td>1.550</td></tr><tr><td>P</td><td>0.006</td></tr><tr><td>S</td><td>0.008</td></tr><tr><td>Si</td><td>0.350</td></tr><tr><td>Mo</td><td>0.550</td></tr><tr><td>Ni</td><td>2.400</td></tr><tr><td>Cr</td><td>0.450</td></tr></table> <p>TYPICAL MECHANICAL PROPERTIES OF WELD METAL</p> <table><tr><td>Yield strength (psi).....</td><td>110,000</td></tr><tr><td>Ultimate tensile strength(ksi).....</td><td>125,000</td></tr><tr><td>Elongation in 2" (%).....</td><td>15</td></tr><tr><td>Charpy V-notch at-60°F (ft. lbs.)....</td><td>70</td></tr></table> <p>WASHINGTON ALLOY 4130 AISI 4130</p> <p>DESCRIPTION</p> <p>Washington Alloy 4130 is a low alloy, cop-per-coated steel wire designed for TIG, MIG and submerged arc welding of heat-treatable, low alloy steels such as the SAE 4100 series and 8630 as well as steel castings with similar hardening characteristics. A pre-heat temperature of 300°F-350°F is required for some of the higher carbon grades in order to prevent cracking. Many other grades can be welded without a preheat.</p> <p>TYPICAL WIRE CHEMISTRY (%)</p> <table><tr><td>C</td><td>0.310</td></tr><tr><td>Mn</td><td>0.520</td></tr><tr><td>P</td><td>0.012</td></tr><tr><td>S</td><td>0.023</td></tr><tr><td>Si</td><td>0.280</td></tr><tr><td>Cr</td><td>0.930</td></tr><tr><td>Mo</td><td>0.200</td></tr></table> <p>TYPICAL MECHANICAL PROPERTIES OF WELD METAL</p> <p>Proper heal treatment will produce a tensile strength of 150,000 to 160,000 psi.</p> <p>RECOMMENDED SHIELDING GAS</p> <p>98% Argon (Ar) and 2% Oxygen (O2) or pure Argon (Ar)</p>	C	0.070	Mn	1.550	P	0.006	S	0.008	Si	0.350	Mo	0.550	Ni	2.400	Cr	0.450	Yield strength (psi).....	110,000	Ultimate tensile strength(ksi).....	125,000	Elongation in 2" (%).....	15	Charpy V-notch at-60°F (ft. lbs.)....	70	C	0.310	Mn	0.520	P	0.012	S	0.023	Si	0.280	Cr	0.930	Mo	0.200
C	0.060																																																																																							
Mn	1.650																																																																																							
Si	0.350																																																																																							
P	0.007																																																																																							
S	0.008																																																																																							
Mo	0.350																																																																																							
Ni	1.750																																																																																							
Cr	0.100																																																																																							
Yield strength (psi).....	92,000																																																																																							
Ultimate tensile strength(ksi).....	105,000																																																																																							
Elongation in 2" (%).....	17																																																																																							
Charpy V-notch at-60°F (ft. lbs.)....	60																																																																																							
C	0.070																																																																																							
Mn	1.600																																																																																							
P	0.007																																																																																							
S	0.009																																																																																							
Si	0.450																																																																																							
Mo	0.500																																																																																							
Ni	2.300																																																																																							
Cr	0.300																																																																																							
Yield strength (psi).....	98,000																																																																																							
Ultimate tensile strength(ksi).....	115,000																																																																																							
Elongation in 2" (%).....	16																																																																																							
Charpy V-notch at-60°F (ft. lbs.).....	65																																																																																							
C	0.070																																																																																							
Mn	1.550																																																																																							
P	0.006																																																																																							
S	0.008																																																																																							
Si	0.350																																																																																							
Mo	0.550																																																																																							
Ni	2.400																																																																																							
Cr	0.450																																																																																							
Yield strength (psi).....	110,000																																																																																							
Ultimate tensile strength(ksi).....	125,000																																																																																							
Elongation in 2" (%).....	15																																																																																							
Charpy V-notch at-60°F (ft. lbs.)....	70																																																																																							
C	0.310																																																																																							
Mn	0.520																																																																																							
P	0.012																																																																																							
S	0.023																																																																																							
Si	0.280																																																																																							
Cr	0.930																																																																																							
Mo	0.200																																																																																							

CO₂ Gas Welding

Welding Conditions:

Since the appearance and properties of CO₂ welds vary broadly in accordance with the welding conditions, select the welding conditions carefully. Welding conditions and their effects are shown in fig. 1.

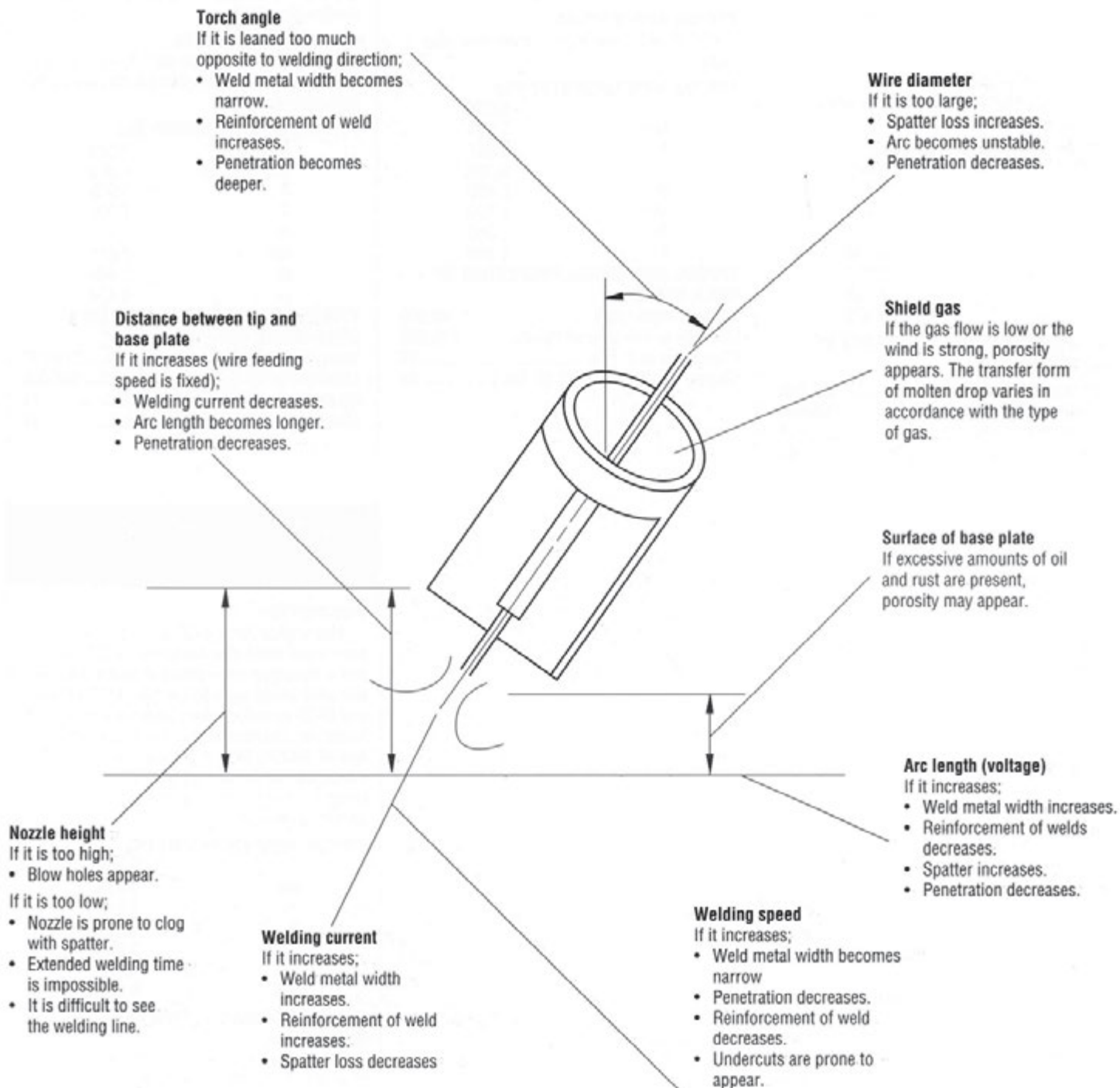


Fig. 1 Welding conditions and their effects

CO₂ Gas Welding

(1) Distance Between Tip and Base Plate

Since the distance between the tip and base plate affects the shape of welds and welding efficiency, keep it within the range described in Table 1.

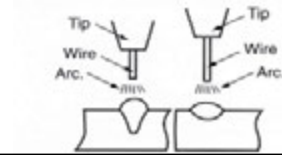


Table 1. RECOMMENDED DISTANCE BETWEEN TIP AND BASE PLATE

Welding Current (amps)	Distance between tip and base plate (in.)	Remark
<250	1/4-5/8	As the current increases, the distance between the tip and base plate should also increase.
>250	5/8 – 1	

(2) Torch Angle

Torch angle and electrode manipulation methods are shown in Fig. 2. The forward method is adopted to Washington Alloy wire in general. But deeper penetration can be achieved by using

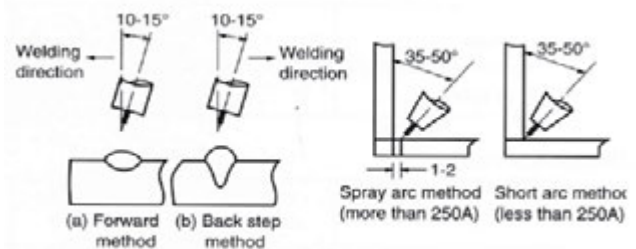


Fig. 2. Torch angle and electrode manipulation methods.

(3) Inclination of Base Plate the back-step method.

In thin plate welding, the slope downward method will provide good results. The difference of weld metal shape in accordance with the variation of the inclination of the base plate is shown in Fig. 3.

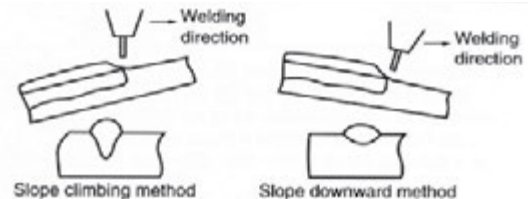


Fig. 3. Variation of weld metal shape

(4) CO₂ Gas Flow

Use CO₂ gas for welding. Flow should be at least 20 liters per minute. Increase the flow or use a wind screen against wind.

PREPARATION OF WELDING

(1) Edge Preparation

Since edge preparation is a key to the results of semi-automatic welding, remember to clean the edge as thoroughly as possible.

(2) Tack Welding

Keep the tacking pitch as shown in Fig. 4 so that the tack weld deposits will be as small as possible. Attach tab plate, (whose classification of steel and plate thickness are the same as those of base plate), to prevent possible problems during welding.

(3) Plate Preparation

Remove oil, paint, water, excessive rust and thick slag that may have adhered to the groove surface.

(4) Storage of Wire

Washington Alloy wire cannot be dried. Since the surface of the wire is plated with copper and rust-proof treated, it is resistant to rust and moisture absorption to some extent. However do not store this material in wet or damp places.

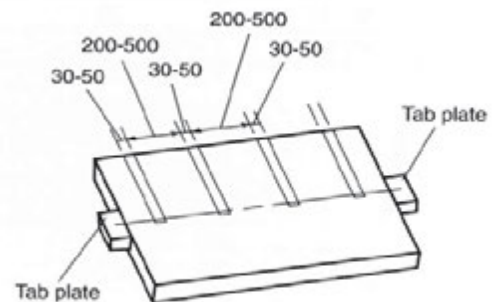


Fig. 4. Tack welding.



Plain Carbon Steel and Low Alloy/High Strength Steel Wires: Standard Wire Sizes and Available Packaging

A) Layer Wound Spool Data:

Package	Wire Size (in.)	Spool dimensions (in.)		
		O.D.	Width	Arbor Hole
2 LB Spools*	.023 – 1/16	4	2	5/8
11 LB Spools	.023 – 1/16	8	2	2
33 LB Spools	.023 – 1/16	12	4	2

B) Layer Wound Coil Data:

Package	Wire Size (in.)	Coil Dimensions (in.)		
		I.D.	Width	O.D.
60 LB Coils	0.35-3/16	12	4	15

C) Production Pail Pack:

Package	Wire Size (in.)	Outside Dimensions of Drum (in)	
		Height	Diameter
550 LBS	.0035	31-7/8	20-3/8
550 LBS	0.045	31-7/8	20-3/8
550 LBS	1/16	31-1/8	27

* Note: 2 lb. Spools are packaged 20 per box (40 lbs. net weight).

10 lb. Spools are packaged 2 per box (20 lbs. net weight).

All spools and coils are individually boxed for maximum protection.

Comparison Chart

Washington Alloy	National Standard	ESAB		Hobart	Lincoln
USA 70S-2	NS-103	65			
USA 70S-3	NS-101	29S/82		HB	L-50
USA 70S-4		85			
USA 70S-6	NS-115	86		HB-28	L-56
USA 80S-D2	NS-102	83		HB-18	LA-90

RECOMMENDED AMPERAGE SETTINGS (AC or DC+)

Diameter	Amperes
.030	40-120
.035	40-235
.045	100-325
1/16	300-525
3/32	500-700

Chemical Composition Requirements for Gas Metal Arc Welding Deposit

Chemical Composition, percent ^a												
AWS Class	Carbon	Man-ganese	Silicon	Phos-phorus	Sulfur	Nickel	Chromium	Molybdenum	Vanadium	Titanium	Zirconium	Aluminum

GROUP A — MILD STEEL ELECTRODES

ER70S-2	0.07	0.90 to 1.40	0.40 to 0.70	0.025	0.035					0.05 to 0.15	0.02 to 0.12	0.05 to 0.15
ER70S-3	0.06 to 0.15	0.90 to 1.40	0.45 to 0.70									
ER70S-4	0.07 To 0.15	1.00 to 1.50	0.65 to 0.85									
ER70S-6	0.07 to 0.15	1.40 to 1.85	0.80 to 1.15									

GROUP B— MANGANESE-MOLYBDENUM AND OTHER LOW ALLOY STEEL RODS AND WIRES

AWSA5.28

ER80S-D2 ^c	0.07 to 0.12	1.6 to 2.1	0.5 to 0.8	0.025	0.025	0.15		0.4 to 0.6				
ER80S-Ni2	0.12	1.25	0.4 to 0.8	0.025	0.025	2 to 2.75						
ER100S-1	0.08	1.25 to 1.8	0.2 to 0.5	0.01	0.01	1.4 to 2.1	0.3	0.25 to 0.55	0.05	0.1	0.1	0.1
ER110S-1	0.09	1.4 to 1.8	0.2 to 0.55	0.01	0.01	1.9 to 2.6	0.5	0.25 to 0.55	0.04	0.1	0.1	0.1
ER120S-1	0.1	1.4 to 1.8	0.25 to 0.6	0.01	0.01	2 to 2.8	0.6	0.3 to 0.65	0.03	0.1	0.1	0.1

Notes:

- Single values shown are maximums.
- Analysis shall be made for the elements for which specific values are shown in this table. If, however, the presence of other elements is indicated in the course of routine analysis, further analysis shall be made to determine that the total of these other elements, except iron, is not present in excess of 0.50.
- The maximum weight of copper in the rod or electrode due to any coating plus the residual copper content in the steel shall not exceed 0.50 for Group A items and 0.25 (or Group B items, with the exception of ER80S-D2 which has a maximum allowable amount of 0.50 copper).
- Other elements, if intentionally added, shall be reported.
- For requirements calling for the "G" classification (ERXXS-G), the electrode must have as a minimum one of either 0.50 percent nickel, 0.30 percent chromium, or 0.20 percent molybdenum. Footnotes:
 - Chemical requirements for solid electrodes are based on as-manufactured composition.
 - The suffixes B2, Ni2, etc. designate the chemical composition of the electrode and rod classification.
 - This composition was formerly classified E70S-1B in the AWS specification A5.18-69.



Mechanical Property Requirements For Gas Metal Arc Welding Deposit

AWS Classification	Shielding Gas	Current and Polarity	Tensile Strength min., psi	Yield Strength at 0.2% Offset, min	Elongation in 2 inches, min. %	Impact properties min
--------------------	---------------	----------------------	----------------------------	------------------------------------	--------------------------------	-----------------------

GROUP A—MILD STEEL ELECTRODES

ER 70S-2 ER 70S-3 ER 70S-4 ER 70S-6	CO ₂	DC reverse polarity	72,000	60,000	22	20 ft/lb at -20°F 20 ft/lb at -0°F not required 20 ft/lb at -20°F
--	-----------------	---------------------	--------	--------	----	---

GROUP B — MANGANESE-MOLYBDENUM AND OTHER LOW ALLOY STEEL RODS AND WIRES

AWS A5.28

ER 80S-D2	CO ₂	DC, reverse polarity	72,000	60,000	17	20 ft/lb at -20°F
ER 80S-Ni2	Ar plus 1-5% O ₂	DC, reverse Polarity	80,000	68,000	24	20 ft/lb at -80°F
ER 100S-1	Ar plus 2% O ₂	DC, reverse Polarity	100,000	88,000	16	50 ft/lb at -60°F
ER 110S-1	Ar plus 2% O ₂	DC, reverse Polarity	110,000	95,000	15	50 ft/lb at -60°F
ER 120S-1	Ar plus 2% O ₂	DC, reverse Polarity	120,000	105,000	14	50 ft/lb at -60°F

Notes:

- As-welded mechanical properties, except for ER80S-Ni2 which is based on Postweld heat treatment as specified in AWS A5.28 (see table 12)
- Shielding gases are designated as follows: AO = argon, plus 1 to 5 percent oxygen; CO₂ = carbon dioxide; A = argon.
- Reverse polarity means electrode is positive; straight polarity means electrode is negative.
- Mechanical properties are determined from an all-weld-metal tension-test specimen.
- For each increase of one percentage point in elongation over the minimum, the yield strength or tensile strength, or both, may decrease 1,000 psi to a minimum of 70,000 psi for the tensile strength and 58,000 psi for the yield strength.

Courtesy: American Welding Society AWS ANSI/AWS A5.18 and AWS A5.28.

SUBMERGED ARC WELDING WIRES

USA EH14 AWS A5.17 Class EH14

DESCRIPTION AND APPLICATION

USA EH14 is a high manganese submerged arc wire used for single pass or multiple pass butt and fillet welds on low alloy or mild carbon steels. This wire will produce weld deposits which exhibit mechanical properties greater than USA EL12 or EM12K and equal to or greater than those of the base metal. USA EH14 will yield tensile strengths of up to 90,000 psi with an elongation of 30%. High speed welding can be achieved even over rust and mill scale which may be present on the base metal. USA EH14 is used in the fabrication of heavy bridge sections, boilers, pressure vessels, shipbuilding and other steel structures.

TYPICAL WIRE CHEMISTRY (%)

C	0.140
Mn	2.000
Si	0.030
P	0.017
S	0.024

MECHANICAL PROPERTIES

USA EH14 is capable of producing tensile strengths of up to 90,000 psi with an elongation of up to 30%, however these figures will vary according to the base metal and flux used.

USA EM13K AWS A5.17 Class EM13K

DESCRIPTION AND APPLICATIONS

USA EM13K is the submerged arc wire equivalent to USA 70S-3 CO₂ wire, therefore many characteristics are similar. USA EM13K contains a higher level of silicon than other submerged arc wires making it suitable for high speed, single pass welding of dirty or rusty mild steel plates. The increased silicon content reduces porosity by deoxidizing the weld pool and provides excellent wetting action, straighter bead edges and easy slag removability. More common applications would include welding of ships and barges, automobile bodies, railcars, building and bridges.

TYPICAL WIRE CHEMISTRY (%)

C	0.100
Mn	1.000
Si	0.550
P	0.012
S	0.012

MECHANICAL PROPERTIES

USA EM13K is capable of producing tensile strengths of up to 75,000 psi with an elongation of 31%, however these figures will vary according to the base metal and flux used.

USA EL12 AWS A5.17 Class EL 12

DESCRIPTION AND APPLICATIONS

USA EL12 was specifically developed for butt and heavy fillet welds on mild and medium carbon steels where "restrained" weld-ments are required. This wire contains less carbon, manganese and silicon than many other submerged arc wires, therefore yielding less strength but providing greater resistance to cracking. USA EL12 is a general purpose wire which (dependent upon the flux) may be used for both single pass and multiple pass welding. Weld deposits have excellent impact properties, a fine bead appearance and are machinable. Typical applications would include ships, bridges, machinery and structural steels. USA EL12 is particularly suited for welding sulfur banded steels.

TYPICAL WIRE CHEMISTRY (%)

C	0.110
Mn	0.450
Si	0.010
P	0.017
S	0.024

MECHANICAL PROPERTIES

USA EL12 is capable of producing tensile strengths of up to 70,000 psi with an elongation of 30%, however these figures will vary according to the base metal and flux used.

USA EM12K AWS A5.17 Class EM12K

DESCRIPTION

USA EM12K submerged arc wire contains higher levels of carbon, manganese and silicon than USA EL12. The increased carbon content gives this wire greater tensile strength, while the increased manganese and silicon content yields improved deoxidation properties. USA EM12K will produce weld deposits with minimal porosity even over rust and mill scale that may be present on the base metal. This wire is primarily used for single pass butt and fillet welds on mild and low alloy steel plates up to 1/2" thick. More specific applications would include ASTM A537, A283, Grades A, B, or C. Since USA EM12K offers high strength/low porosity welds on many steel alloys, it is the most cost-efficient submerged arc wire to stock.

TYPICAL WIRE CHEMISTRY (%)

C	0.150
Mn	1.100
Si	0.250
P	0.017
S	0.024

WASHINGTON ALLOY WP380 FLUX AWS A5.17 AWS A5.23

DESCRIPTION AND APPLICATIONS

Washington Alloy WP 380 is a non-alloyed, neutral (slightly basic), calcium-silicate fused flux. WP380 is designed for joining and cladding applications for use with a very broad range of filler metals and base metals. WP 380 is extensively used in joining low alloy creep-resistant Cr-Mo steels for use at elevated temperatures, duplex and super-duplex stainless steels, martensitic and ferritic straight chromium stainless steels (including Ni-Mo grades), austenitic Cr-Ni stainless steels (including ELC grades), high alloy Cr-Ni-Mo steels, joining high alloy Cr-Ni-Mo steels to low-alloy steels (dissimilar joints), 8-10% Ni steels, 9% Cr steels (P91) and for joining or cladding with nickel alloys such as ERNiCrMo-2 (Ni 625) and ERNiCrMo-4 (Ni C-276).

PHYSICAL PROPERTIES & CHEMISTRY

Basicity:	1.3 (Bonischewski Scale)
Chemistry:	SiO ₂ + Ti O ₂ 32%
	CaO + MgO 35%
	Al ₂ O ₃ 3%
	CaF ₂ 20%

PACKAGING

Fiber reinforced heavy wall plastic 44.1 lb. bags with both ends heat sealed. Pallet weight: 2,204.62 lbs. (910.00 Kg)



Submerged Arc Welding Wires

Standard Wire Sizes and Available Packaging

COIL DATA

Package	Wire Sizes (in.)	I.D.	Coil Dimensions (in.) Width	O.D.
60 LB Coils	.035-3/16	12	4	15

REEL DATA

Package	Wire Sizes (in.)	Reel Dimensions (in.) Flange Width
250 LB Reels	.035 - 1/8	22
550 LB Reels	.035 - 1/8	30

ER 70S-2 ER 70S-3 ER 70S-4 ER 70S-6	CO ₂	DC reverse polarity	72,000	60,000	22	20 ft/lb at -20°F 20 ft/lb at -0°F not required 20 ft/lb at -20°F
--	-----------------	---------------------------	--------	--------	----	--

Standard diameters are (in.): .035 - .045 - 1/16 - 5/64 - 3/32 - 1/8 - 5/32 - 3/16 - 7/32 - 1/4 - 5/16

Comparison Chart

(AWSA5.17)

Washington Alloy	ESAB	Lincoln	
EL12 EM12K EM13K/ER70S-3 EH14	80 29, 81 29S 36	L-60 L-61,66 L-50 —	

CHEMICAL-COMPOSITION REQUIREMENTS FOR SUBMERGED-ARC WIRES

AWS Classification	Chemical Composition, percent						
	Carbon	Manganese	Silicon	Sulfur	Phosphorus	Copper ²	Total other Elements
Low Manganese Class EL12	.07 to 0.15	0.35 to 0.60	0.05	0.035	0.03	0.30	0.50
Medium Manganese Classes EM12K EM13K	0.07 to 0.15 0.07 to 0.19	0.85 to 1.25 0.90 to 1.40	0.15 to 0.35 0.45 to 0.70				
High Manganese Class EH14	0.10 to 0.18	1.75 to 2.25	0.05				

a. The copper limit is independent of any copper or other suitable coating which may be applied to the electrode.

Note 1: Analysis shall be made for the elements for which specific values are shown in this table. If, however, the presence of other elements is indicated in the course of routine analysis, further analysis shall be made to determine that the total of these other elements is not present in excess of the limits specified for "Total Other Elements" in the last column of the table.

Note 2: Single values shown are maximum percentages.

STEEL RODS FOR GAS AND TUNGSTEN INERT GAS WELDING

USA RG45 AWS A5.2 Class RG45	USA RG60 AWS A5.2 Class RG60
DESCRIPTION USA RG45 is a copper coated gas welding rod that is used for welding ordinary low carbon steel up to 1/4" thick. It is recommended where ductility and machinability are most important. USA RG45 produces high quality welds which are ductile and free of porosity. This rod is excellent for steel sheets, plates, pipes, castings and structural shapes. No flux required.	DESCRIPTION USA RG60 is used to produce high tensile strength quality welds on low carbon and low alloy steels such as sheets, plates, pipes of grades A and B analysis and structural shapes. It is recommended for critical welds that must respond to the same annealing and heat treatment as regular grades of cast steel. The high silicon and manganese composition removes impurities from the molten metal thereby eliminating the need for flux.
TYPICAL CHEMICAL ANALYSIS (%) C 0.080 max. Mn 0.500 max. Si 0.100 max. P 0.035 max. S 0.040 max.	TYPICAL CHEMICAL ANALYSIS (%) C 0.15 max. Mn 0.90-1.40 Si 0.10-0.35 P 0.035 max. S 0.035 max.
TYPICAL MECHANICAL PROPERTIES OF WELD METAL (as welded) Ultimate tensile strength (psi).....52,000 Elongation in 2" (%).....22	TYPICAL MECHANICAL PROPERTIES OF WELD METAL (as welded) Ultimate tensile strength (psi).....62,000-67,000 Elongation in 2" (%).....20-25