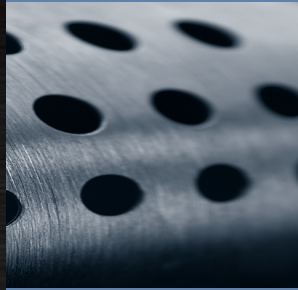


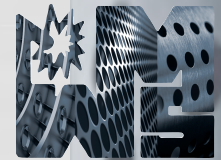
CONSUMABLE WELDING PRODUCTS CATALOG

Volume C



WELDING
MATERIAL
SALES

www.weldingmaterialsales.com



ESSENTIAL INFORMATION

RECOMMENDED SHIELDING GASES for Welding Material Sales Alloy Filler Metals

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

* Mild Steel, Stainless Steel, Build Up and Hardfacing

AVAILABLE PACKAGING

MIG Welding Wires

DESCRIPTION	AVAILABLE WEIGHT	AVAILABLE PACKAGING
4" Plastic spool	1/2#, 1# and 2#	Shrink wrap, chipboard carton, corrugated carton, plastic clamshell and paper can
8" Plastic spool	1#, 2#, 3#, 5#, 10#, 11# and 12.5#	Chipboard carton, corrugated carton and plastic clamshell
12" Spools - Masonite, plastic and wire basket	25#, 30# and 33#	Corrugated carton
14" Spools and coils	50# and 60#	Corrugated carton
Drums / Barrels	250#, 550# and 880#	Standard, recyclable and continuous

TIG & Gas Welding Rods (14", 18", 20" & 36")

AVAILABLE WEIGHT	AVAILABLE PACKAGING
1/2#, 2#, 3# and 5#	Clear plastic tubes with colored endcaps/hangcaps
5#, 10# and 50#	Corrugated boxes
5# and 10#	Paper tubes

STICK Welding Rods (10", 12" & 14")

AVAILABLE WEIGHT	AVAILABLE PACKAGING
1/2# and 1#	Clear plastic tubes with colored endcaps/hangcaps
1/2# and 1#	Plastic clamshells
1/2# and 1#	Vacuum bags
1/2#, 1#, 2#, 5#, 10# and 50#	Corrugated cartons
2# and 5#	Plastic cartons
10# and 50#	Hermetically sealed cans (hsc)

* Welding Material Sales is continuously updating and adding packaging options to meet today's changing market. Please call for an up-to-date list of available packaging.



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WARNING!

PROTECT yourself and others. Read and understand this information. FUMES AND GASES can be hazardous to your health. ARC RAYS can injure eyes and burn skin. ELECTRIC SHOCK can KILL.

- Before use, read and understand the manufacturer's instructions, Material Safety Data Sheets (MSDSs), product specific label and your employer's safety practices.

- This product contains Manganese. Short-term exposure from inhalation of these fumes may result in Metal fume fever characterized by chills, fever, upset stomach, vomiting, irritation of the throat and aching of the body. Long-term overexposure to manganese compounds may affect the central nervous system. Symptoms may be similar to Parkinson's disease and can include slowness, changes in handwriting, gait impairment, muscle spasms and cramps and less commonly, tremor and behavioral changes.

- Use enough ventilation, local exhaust at the arc or both to keep the fumes and gases below the PEL/TLV/OEL's in the worker's breathing zone and the general area.

- Keep your head out of the fumes.

- Wear correct eye, ear and body protection.

- Do not touch live electrical parts.

- Manufactured by HBC.

FIRST AID MEASURES: If symptoms of overexposure to fumes exist, remove to fresh air. In case of arc ray injury or electric shock, employ normal first aid techniques and call a physician IMMEDIATELY. See American National Standard ANSI Z49.1, SAFETY IN WELDING AND CUTTING AND ALLIED PROCESSES, published by the American Welding Society, 550 N.W. LeJeune Rd., Miami, FL, 33126, and OSHA Safety and Health Standards, available from the U.S. Government Printing Office, Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250-7954.

CAUTION: Some of the alloys distributed by Welding Material Sales may contain chemicals known to the state of California to cause cancer or reproductive toxicity. These chemicals are listed under California Prop 65 and are updated periodically by the state of California. For your protection, Welding Material Sales advises that a current list of chemicals be reviewed before purchasing any of our products. A current list as well as additional information can be found at www.oehha.org.



A5.1 | CARBON STEEL

Covered Arc Welding Electrodes

E6010

E6010 is an all position, cellulosic electrode that has a quick-starting, steady, and deep penetrating arc. It produces x-ray quality welds in flat, horizontal, overhead, vertical-up, and vertical-down positions. E6010 was developed for the pipe welding industry and is recommended for welding API grades A25, A, B, and X42 pipe and general structural fabrication.

Typical Applications

- General-purpose fabrication
- Maintenance welding
- Out-of-position X-ray welds
- Construction and shipbuilding
- Pipe welding
- Vertical and overhead plate welding

AWS Specification

AWS A5.1/A5.1M:2004

AWS Classification E6010

Welding Current DCEP

Typical Wire Chemistry

C	0.20
Mn	1.20
Si	1.00
P	*N.S.
S	*N.S.
Ni	0.30
Cr	0.20
Mo	0.30
V	0.08
Combined Limit for Mn+Ni+Cr+Mo+V	*N.S.

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	48
Tensile Strength, ksi	60
Elongation%, min	22

Welding Positions F,V,OH,H

Available Diameters

3/32", 1/8", 5/32" & 3/16"

Operating Range in Amps

3/32"	40 - 80
1/8"	75 - 125
5/32"	110 - 170
3/16"	140 - 215

*N.S. means Not Specified

E6011

E6011 is a mild-steel, all position electrode designed primarily for use on AC power sources. It produces a strong arc force for deep penetration and a fine spray transfer that enhances operator appeal. Fast freezing or rapid solidification of the metal allows welding in the vertical and overhead position. Its light slag eliminates slag holes that are prevalent on some applications with other electrodes. This product can be suited in a wide range of applications.

Typical Applications

- General-purpose fabrication
- Galvanized steel work
- Structural work
- Shipbuilding

AWS Specification

AWS A5.1/A5.1M:2004

AWS Classification E6011

Welding Current AC - DCEP

Typical Wire Chemistry

C	0.20
Mn	1.20
Si	1.00
P	*N.S.
S	*N.S.
Ni	0.30
Cr	0.20
Mo	0.30
V	0.08
Combined Limit for Mn+Ni+Cr+Mo+V	*N.S.

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	48
Tensile Strength, ksi	60
Elongation%, min	22

Welding Positions F,V,OH,H

Available Diameters

3/32", 1/8", 5/32" & 3/16"

Operating Range in Amps

3/32"	40 - 80
1/8"	75 - 125
5/32"	110 - 170
3/16"	140 - 215

*N.S. means Not Specified

E6012

E6012 is a general purpose electrode that offers excellent bridging characteristics, especially for applications with poor fit-up. It has good, stable arc and operates at high currents with low spatter. Extremely versatile, E6012 can be used with both AC and DC power.

Typical Applications

- Farm implements
- General repair
- Machinery Fabrication
- Metal Furniture
- Ornamental Iron
- Sheet metal
- Tanks

AWS Specification

AWS A5.1/A5.1M:2004

AWS Classification E6012

Welding Current AC - DCEN

Typical Wire Chemistry

C	0.20
Mn	1.20
Si	1.00
P	*N.S.
S	*N.S.
Ni	0.30
Cr	0.20
Mo	0.30
V	0.08
Combined Limit for Mn+Ni+Cr+Mo+V	*N.S.

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	48
Tensile Strength, ksi	60
Elongation%, min	17

Welding Positions F,V,OH,H

Available Diameters

3/32", 1/8", 5/32" & 3/16"

Operating Range in Amps

3/32"	35 - 85
1/8"	80 - 140
5/32"	110 - 190
3/16"	140 - 240

*N.S. means Not Specified



A5.1 | CARBON STEEL

Covered Arc Welding Electrodes

E6013

E6013 is a mild-steel, all position, general purpose cellulose-base rod. It operates on AC or DC welding current and works well on low voltage AC machines. E6013 is an excellent choice where there is poor fit-up in the joint. It deposits easily and smoothly producing medium to shallow penetration. Small sizes are well adapted to low heat on thin metals. Medium to heavy slag is easily removed and provides for excellent weld cleaning action during the welding process. E6013 is a great selection for all types of mild steel fabrications or repairs where ease of operation and good bead appearance are required.

Typical Applications

- General-purpose fabrication
- Metal buildings and structures
- Machine parts
- Shaft buildup

AWS Specification

AWS A5.1/A5.1M:2004

AWS Classification E6013

Welding Current AC - DC

Typical Wire Chemistry

C	0.20
Mn	1.20
Si	1.00
P	*N.S.
S	*N.S.
Ni	0.30
Cr	0.20
Mo	0.30
V	0.08
Combined Limit for Mn+Ni+Cr+Mo+V	*N.S.

Typical Mechanical Properties (As Welded)

Yield Strength,ksi	48
Tensile Strength,ksi	60
Elongation%, min	17

Welding Positions F,V,OH,H

Available Diameters

1/16", 5/64", 3/32", 1/8", 5/32" & 3/16"

Operating Range in Amps

1/16"	20 - 40
5/64"	25 - 60
3/32"	45 - 90
1/8"	80 - 130
5/32"	105 - 180
3/16"	150 - 230

*N.S. means Not Specified

SINGLE VALUES LISTED ARE MAXIMUM

E6022

E6022, also known as 'decking rod' is a very fluid electrode that is designed for welding roof decking to support beams with burn-through weld spots. It is also excellent for rapid downhill welding when joining light gauge materials.

Typical Applications

- Roof decking
- Sheet metal

AWS Specification

AWS A5.1/A5.1M:2004

AWS Classification E6022

Welding Current AC - DCEN

Typical Wire Chemistry

C	0.18
Mn	0.25
Si	0.15
P	0.015
S	0.017

Typical Mechanical Properties (As Welded)

Transverse Tensile Strength,ksi	60
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Welding Positions F,H-filllet

Available Diameters

1/8" & 5/32"

Operating Range in Amps

1/8"	110 - 160
5/32"	130 - 190

E7014

E7014 is a high-speed iron powder type electrode that can be used on AC or DC welding current. This electrode has smooth arc characteristics, good arc stability, low spatter and produces medium to low penetration. E7014 offers outstanding slag removal and bead appearance. This rod is ideal for jobs that require high deposition and speed of travel.

Typical Applications

- Ornamental iron
- Machine bases
- Heavy sheet metal
- Frames

AWS Specification

AWS A5.1/A5.1M:2004

AWS Classification E7014

Welding Current AC - DC

Typical Wire Chemistry

C	0.15
Mn	1.25
Si	0.90
S	0.035
P	0.035
Cr	0.20
Ni	0.30
Mo	0.30
V	0.08
Combined Limit for Mn+Ni+Cr+Mo+V	1.50

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	58
Tensile Strength, ksi	70
Elongation%, min	17

Welding Positions F,V,OH,H

Available Diameters

1/16", 5/64", 3/32", 1/8", 5/32" & 3/16"

Operating Range in Amps

1/16"	35 - 60
5/64"	45 - 70
3/32"	80 - 125
1/8"	110 - 160
5/32"	150 - 210
3/16"	200 - 275



A5.1 | CARBON STEEL

Covered Arc Welding Electrodes

E7018/E7018-1

E7018/E7018-1 is a low-hydrogen iron powder type electrode that produces high quality X-ray welds. It can be used in all positions on AC or DC reverse polarity welding current. E7018/E7018-1 is recommended for welding medium grade carbon steels where no preheat is used, and on cold rolled steels normally exhibiting excessive porosity when welded with conventional electrodes.

Typical Applications

- Low-alloy structurals
- Low, medium, and high-carbon steels
- Offshore rigs and power plants
- Steel structures
- Tack welds for tubular wire applications

AWS Specification

AWS A5.1/A5.1M:2004

AWS Classification E7018/E7018-1

Welding Current AC - DC

Typical Wire Chemistry

C	0.15
Mn	1.60
Si	0.75
S	0.035
P	0.035
Cr	0.20
Ni	0.30
Mo	0.30
V	0.08
Combined Limit for Mn+Ni+Cr+Mo+V	1.75

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	58
Tensile Strength, ksi	70
Elongation%, min	22

Welding Positions F,V,OH,H

Available Diameters

3/32", 1/8", 5/32", 3/16" & 1/4"

Operating Range in Amps

3/32"	70 - 110
1/8"	105 - 155
5/32"	130 - 200
3/16"	200 - 275
1/4 "	315 - 400

E7024

E7024 is a high speed, iron powder, heavy coated electrode for high deposition rates on horizontal and down hand welding. Excellent bead appearance and self-cleaning slag give it operator appeal. This electrode has good weldability and superior mechanical properties and is particularly useful in obtaining increased penetration with little or no root porosity in horizontal or positioned fillets.

Typical Applications

- Shipbuilding
- Bridges
- Structural Steels
- Machine bases
- Truck fabrication
- Storage tanks

AWS Specification

AWS A5.1/A5.1M:2004

AWS Classification E7024

Welding Current AC - DC

Typical Wire Chemistry

C	0.15
Mn	1.25
Si	0.90
S	0.035
P	0.035
Cr	0.20
Ni	0.30
Mo	0.30
V	0.08
Combined Limit for Mn+Ni+Cr+Mo+V	1.50

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	58
Tensile Strength, ksi	70
Elongation%, min	17

Welding Positions H-fillet, F

Available Diameters

3/32", 1/8", 5/32", 3/16", 7/32" & 1/4 "

Operating Range in Amps

3/32"	100 - 145
1/8"	140 - 190
5/32"	180 - 250
3/16"	230 - 305
7/32"	275 - 365
1/4 "	335 - 430



A5.2 | CARBON AND LOW ALLOY

Bare Gas Welding Rods

R45

R45 is a general purpose, copper coated, oxy-acetylene gas welding rod used for welding low carbon steels up to 1/4" thick. It is a great selection when ductility and machinability are most important. You do not need a flux when brazing with this product. A neutral flame should be used.

Typical Applications

- Steel sheets, plates
- Pipes, castings
- Structural shapes

AWS Specification

ASW A5.2/A5.2M:2007

AWS Classification R45

Typical Wire Chemistry

C	0.08
Mn	0.50
Si	0.10
P	0.035
S	0.040
Cu	0.30
Cr	0.20
Ni	0.30
Mo	0.20
Al	0.02

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	35
Tensile Strength, ksi	45
Elongation%, min	22

Available Diameters

1/16", 3/32", 1/8" & 5/32"

R60

R60 is a Moly alloyed, high strength, oxy-acetylene gas welding rod used for gas brazing of low carbon and low alloy steels. It is used in applications where a high tensile strength is needed. The high Silicon and Manganese content in the product eliminates the need for flux when welding. A neutral flame should be used.

Typical Applications

- Low carbon and low alloy steels
- Sheets, plates, pipes
- Structural shapes

AWS Specification

ASW A5.2/A5.2M:2007

AWS Classification R60

Typical Wire Chemistry

C	0.15
Mn	0.90 - 1.40
Si	0.10 - 0.35
P	0.035
S	0.035
Cu	0.30
Cr	0.20
Ni	0.30
Mo	0.20
Al	0.02

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	42
Tensile Strength, ksi	60
Elongation%, min	20

Available Diameters

1/16", 3/32", 1/8" & 5/32"



A5.4 | STAINLESS STEEL

Covered Arc Welding Electrodes

E308/308L-16

E308/308L-16 is an extra low carbon electrode for the welding of type 304L, 321, and 347 stainless steels. The controlled ferrite in the weld deposit gives excellent notch toughness at cryogenic temperatures. This electrode deposits a maximum of .04% carbon in the weld metal to minimize the formation of chromium carbides and consequent susceptibility to intergranular corrosion.

AWS Specification

AWS A5.4/A5.4M:2006

AWS Classification E308L/308L-16

Welding Current AC - DCEP

Typical Wire Chemistry

C	0.04
Cr	18.0 - 21.0
Ni	9.0 - 11.0
Mo	0.75
Mn	0.5 - 2.5
Si	1.00
P	0.04
S	0.03
Cu	0.75

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	54
Tensile Strength, ksi	75
Elongation%, min	35

Welding Positions F,V,OH,H

Available Diameters

1/16", 3/32", 1/8" & 5/32"

Operating Range in Amps

1/16"	25 - 35
3/32"	55 - 75
1/8"	75 - 110
5/32"	90 - 140

E309/309L-16

E309/309L-16 stainless steel electrode is ideal for joining stainless steels to themselves or to carbon and low-alloy steels. Carbon content in the weld metal is held to .04% max which gives it increased resistance to intergranular corrosion.

AWS Specification

AWS A5.4/A5.4M:2006

AWS Classification E309/309L-16

Welding Current AC - DCEP

Typical Wire Chemistry

C	0.04
Cr	22.0 - 25.0
Ni	12.0 - 14.0
Mo	0.75
Mn	0.5 - 2.5
Si	1.00
P	0.04
S	0.03
Cu	0.75

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	56
Tensile Strength, ksi	75
Elongation%, min	30

Welding Positions F,V,OH,H

Available Diameters

3/32", 1/8" & 5/32"

Operating Range in Amps

3/32"	55 - 75
1/8"	75 - 110
5/32"	90 - 140

E310-16

E310-16 electrodes are used to weld stainless steels of similar composition in wrought and cast form. It provides you with outstanding performance for the out-of-position welding of 310-type stainless steels, especially when ease of execution and fine weld appearance are required. The weld deposit is fully austenitic, and as such calls for minimum heat input during welding.

AWS Specification

AWS A5.4/A5.4M:2006

AWS Classification E310-16

Welding Current AC - DCEP

Typical Wire Chemistry

C	0.08 - 0.20
Cr	25.0 - 28.0
Ni	20.0 - 22.5
Mo	0.75
Mn	1.0 - 2.5
Si	0.75
P	0.03
S	0.03
Cu	0.75

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	50
Tensile Strength, min ksi	80
Elongation%, min	30

Welding Positions F,V,OH,H

Available Diameters

3/32", 1/8" & 5/32"

Operating Range in Amps

3/32"	55 - 75
1/8"	75 - 110
5/32"	90 - 140



A5.4 | STAINLESS STEEL

Covered Arc Welding Electrodes

E312-16

E312-16 stainless steel electrode is designed for welding dissimilar joints of hardenable steels, steel armor and generally all hard-to-weld steels. Its directional arc and self-detaching slag allows you to weld with ease. The weld deposits exhibit high tensile strength and offer good resistance to abrasion.

AWS Specification
AWS A5.4/A5.4M:2006

AWS Classification E312-16

Welding Current AC - DCEP

Typical Wire Chemistry

C	0.15
Cr	28.0 - 32.0
Ni	8.0 - 10.5
Mo	0.75
Mn	0.5 - 2.5
Si	1.00
P	0.04
S	0.03
Cu	0.75

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	90
Tensile Strength, min ksi	95
Elongation%, min	22

Welding Positions F,V,OH,H

Available Diameters
3/32", 1/8", 5/32" & 3/16"

Operating Range in Amps

3/32"	35 - 70
1/8"	60 - 110
5/32"	65 - 170
3/16"	160 - 205

E316/316L-16

E316/316L-16 is used for welding type 316L or 318 stainless steels. It has a maximum of .04% carbon content in the weld metal, which reduces the possibility of carbide precipitation and consequent intergranular corrosion. This electrode is widely used in the welding of chemical equipment.

AWS Specification
AWS A5.4/A5.4M:2006

AWS Classification E316L/316L-16

Welding Current AC - DCEP

Typical Wire Chemistry

C	0.04
Cr	17.0 - 20.0
Ni	11.0 - 14.0
Mo	2.0 - 3.0
Mn	0.5 - 2.5
Si	1.00
P	0.04
S	0.03
Cu	0.75

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	56
Tensile Strength, min ksi	70
Elongation%, min	30

Welding Positions F,V,OH,H

Available Diameters
3/32", 1/8", 5/32" & 3/16"

Operating Range in Amps

3/32"	55 - 75
1/8"	75 - 110
5/32"	90 - 140
3/16"	160 - 205

E317L-16

E317L-16 produces a weld deposit similar to that of type 317 stainless steel, except the carbon is limited to a maximum of 0.04%. In addition to the resistance to pitting and crevice corrosion, this welding electrode offers good resistance to intergranular corrosion as well.

AWS Specification
AWS A5.4/A5.4M:2006

AWS Classification E317L-16

Welding Current AC - DCEP

Typical Wire Chemistry

C	0.04
Cr	18.0 - 21.0
Ni	12.0 - 14.0
Mo	3.0 - 4.0
Mn	0.5 - 2.5
Si	1.00
P	0.04
S	0.03
Cu	0.75

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	58
Tensile Strength, min ksi	75
Elongation%, min	30

Welding Positions F,V,OH,H

Available Diameters
3/32", 1/8", 5/32" & 3/16"

Operating Range in Amps

3/32"	45 - 80
1/8"	55 - 120
5/32"	65 - 170
3/16"	160 - 205



A5.4 | STAINLESS STEEL

Covered Arc Welding Electrodes

E320LR-16

E320LR-16 is similar in composition to 320 stainless steel but with carbon, silicon, phosphorus, and sulfur controlled to lower limits and columbium and manganese kept to a narrower range. The resulting composition is designed to reduce the possibility of microfissuring. Low heat input is advised when welding with E320LR-16 electrodes.

AWS Specification

AWS A5.4/A5.4M:2006

AWS Classification E320LR -16

Welding Current AC - DCEP

Typical Wire Chemistry

C	0.03
Cr	19.0 - 21.0
Ni	32.0 - 36.0
Mo	2.0 - 3.0
Nb(Cb) PlusTa	8xC, min to 0.40 max
Mn	1.50 - 2.50
Si	0.30
P	0.020
S	0.015
Cu	3.0 - 4.0

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	57
Tensile Strength, min ksi	75
Elongation%, min	30

Welding Positions F,V,OH,H

Available Diameters

3/32", 1/8", 5/32" & 3/16"

Operating Range in Amps

3/32"	45 - 80
1/8"	55 - 120
5/32"	65 - 170
3/16"	160 - 205

E330-16

E330-16 stainless steel welding electrodes are used to weld wrought and cast forms of stainless steel of similar chemical composition which offer good heat and scale resistance above 1800°F. High sulfur environments adversely affect the high temperature performance of E330-16 electrodes. The heat input has to be kept to a minimum during the welding to avoid the possibility of microfissuring.

AWS Specification

AWS A5.4/A5.4M:2006

AWS Classification E330 -16

Welding Current AC - DCEP

Typical Wire Chemistry

C	0.18 - 0.25
Cr	14.0 - 17.0
Ni	33.0 - 37.0
Mo	0.75
Mn	1.0 - 2.5
Si	1.00
P	0.04
S	0.03
Cu	0.75

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	57
Tensile Strength, min ksi	75
Elongation%, min	25

Welding Positions F,V,OH,H

Available Diameters

3/32", 1/8", 5/32" & 3/16"

Operating Range in Amps

3/32"	45 - 80
1/8"	55 - 120
5/32"	65 - 170
3/16"	160 - 205

E347-16

E347-16 delivers outstanding performance, especially for projects that require you to do a lot of out-of-position welding. This electrode allows you to weld stabilized austenitic 18Cr-8Ni steels, including those with grades of either the columbium (347) or titanium (321) type. E347-16 offer excellent resistance to sensitization during high temperature service.

AWS Specification

AWS A5.4/A5.4M:2006

AWS Classification E347-16

Welding Current AC - DCEP

Typical Wire Chemistry

C	0.08
Cr	18.0 - 21.0
Ni	9.0 - 11.0
Mo	0.75
Nb(Cb)PlusTa	8xC, min to 1.00 max
Mn	0.5 - 2.5
Si	1.00
P	0.04
S	0.03
Cu	0.75

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	57
Tensile Strength, min ksi	75
Elongation%, min	30

Welding Positions F,V,OH,H

Available Diameters

3/32", 1/8", 5/32" & 3/16"

Operating Range in Amps

3/32"	45 - 80
1/8"	55 - 120
5/32"	65 - 170
3/16"	160 - 205



A5.4 | STAINLESS STEEL

Covered Arc Welding Electrodes

E410-16

E410-16 is designed to weld stainless steels of similar chemical composition as well as to overlay carbon steels to impart corrosion, erosion, and abrasion resistance. This air-hardening type material calls for a preheat and interpass temperature of not less than 400°F during welding.

AWS Specification
AWS A5.4/A5.4M:2006

AWS Classification E410-16

Welding Current AC - DCEP

Typical Wire Chemistry

C	0.12
Cr	11.0 - 13.5
Ni	0.7
Mo	0.75
Mn	1.0
Si	0.90
P	0.04
S	0.03
Cu	0.75

**Typical Mechanical Properties
(As Welded and post-weld heat treatment between 1550°-1650°F for 2 hrs)**

Yield Strength, ksi	63
Tensile Strength, min ksi	75
Elongation%, min	20

Welding Positions F,V,OH,H

Available Diameters

3/32", 1/8", 5/32" & 3/16"

Operating Range in Amps

3/32"	45 - 80
1/8"	55 - 120
5/32"	65 - 170
3/16"	160 - 205

E410NiMo-16

E410NiMo-16 is an electrode designed to weld materials of similar chemical composition in cast and wrought forms. 300°F preheat and interpass temperatures are recommended when welding with this alloy.

AWS Specification
AWS A5.4/A5.4M:2006

AWS Classification E410NiMo-16

Welding Current AC - DCEP

Typical Wire Chemistry

C	0.06
CR	11.0 - 12.5
Ni	4.0 - 5.0
Mo	0.40 - 0.70
Mn	1.0
Si	0.90
P	0.04
S	0.03
Cu	0.75

**Typical Mechanical Properties
(As Welded and post-weld heat treatment between 1100°-1150°F for 2 hrs)**

Yield Strength, ksi	91
Tensile Strength, min ksi	110
Elongation%, min	15

Welding Positions F,V,OH,H

Available Diameters

3/32", 1/8", 5/32" & 3/16"

Operating Range in Amps

3/32"	45 - 80
1/8"	55 - 120
5/32"	65 - 170
3/16"	160 - 205

E2209-16

E2209-16 is used to weld duplex stainless steels such as UNS Number N31803. The welds offer excellent resistance to stress, corrosion, cracking, and pitting. The micro-structure of the weld metal consists of austenite and ferrite, and the ferrite of weld metal will be lower than the ferrite of type 2205 base metal. When welding of duplex stainless steel, controlled parameters must be used to achieve specified mechanical and corrosion resistance properties.

AWS Specification
AWS A5.4/A5.4M:2006

AWS Classification E2209-16

Welding Current AC - DCEP

Typical Wire Chemistry

C	0.04
Cr	21.5 - 23.5
Ni	8.5 - 10.5
Mo	2.5 - 3.5
Mn	0.5 - 2.0
Si	1.00
P	0.04
S	0.03
N	0.08 - 0.20
Cu	0.75

**Typical Mechanical Properties
(As Welded)**

Yield Strength, ksi	87
Tensile Strength, min ksi	100
Elongation%, min	20

Welding Positions F,V,OH,H

Available Diameters

3/32", 1/8", 5/32" & 3/16"

Operating Range in Amps

3/32"	45 - 80
1/8"	55 - 120
5/32"	65 - 170
3/16"	160 - 205



A5.5 | LOW ALLOY STEEL

Covered Arc Welding Electrodes

E8018-B2

E8018-B2 welding electrode is for higher strength steels with tensile strengths greater than 80,000 pounds. The coating is specially formulated to resist moisture pick-up under conditions of high heat and humidity. This electrode offers resistance to moisture reabsorption which helps prevent hydrogen cracking and aids in elimination of starting porosity.

Applications

- Fab and maintenance of boilers and associated piping
- Welding of 1-1/4Cr-1/2Mo steels
- Welding of 1/2Cr-1/2Mo steels

AWS Specification

AWS A5.5/A5.5M:2006

AWS Classification E8018-B2 H4R

Welding Current AC - DCEP

Welding Position F,V,OH,H

Typical Wire Chemistry

C	0.05 - 0.12
Mn	0.90
S	0.03
P	0.03
Si	0.80
Cr	1.00 - 1.50
Mo	0.40 - 0.65

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	80
Tensile Strength, ksi	67
Elongation%, min	19

Available Diameters

3/32", 1/8", 5/32" & 3/16"

Operating Range in Amps

3/32"	100
1/8"	115 - 155
5/32"	135 - 185
3/16"	200 - 275

E9018-B3

E9018-B3 is a great electrode for welding higher strength piping, castings and forgings. The coating is specially formulated to resist moisture pick-up under conditions of high heat and humidity. E9018-B3 electrode offers resistance to moisture reabsorption which helps prevent hydrogen cracking and aids in elimination of starting porosity.

Applications

- Chrome-Moly pipes
- Boiler work

AWS Specification

AWS A5.5/A5.5M:2006

AWS Classification E9018-B3 H4R

Welding Current AC - DCEP

Welding Position F,V,OH,H

Typical Wire Chemistry

C	0.05 - 0.12
Mn	0.90
P	0.03
S	0.03
Si	0.80
Cr	2.00 - 2.50
Mo	0.90 - 1.20

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	95
Tensile Strength, ksi	90
Elongation%, min	24

Available Diameters

3/32", 1/8", 5/32" & 3/16"

Operating Range in Amps

3/32"	70 - 100
1/8"	115 - 155
5/32"	135 - 185
3/16"	200 - 275

E8018-C1

E8018-C1 is a high quality electrode designed for applications of 2%-4% nickel deposits. The outstanding characteristics of this electrode provides good puddle control with excellent wetting action and tie in. This electrode offers good arc characteristics and easy slag removal. E8018-C1 will provide notch toughness of 20 ft•lbs at -75°F. The coating is specially formulated to resist moisture pick-up under conditions of high heat and humidity. This electrode offers resistance to moisture reabsorption, helps retard hydrogen cracking and aids in elimination of starting porosity. Definitely a preferred electrode with high operator appeal.

Applications

- Shipbuilding
- Storage tanks
- Piping and tanks used in storage of gases

AWS Specification

AWS A5.5/A5.5M:2006

AWS Classification E8018-C1 H4

Welding Current AC - DCEP

Welding Position F,V,OH,H

Typical Wire Chemistry

C	0.12
Mn	1.25
Si	0.80
Ni	2.00 - 2.75
P	0.03
S	0.03

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	87
Tensile Strength, ksi	80
Elongation%, min	19

Available Diameters

3/32", 1/8", 5/32" & 3/16"

Operating Range in Amps

3/32"	70 - 100
1/8"	115 - 155
5/32"	135 - 185
3/16"	200 - 275



A5.5 | LOW ALLOY STEEL Covered Arc Welding Electrodes

E8018-C2

E8018-C2 is an outstanding electrode that is designed for 80,000 tensile strength applications as well as 2%-4% nickel applications. This electrode provides excellent puddle control with good wetting action and tie in. The electrode offers good arc characteristics and easy slag removal.

Applications

- Shipbuilding
- Storage tanks
- Piping and tanks used in storage of gases

AWS Specification

AWS A5.5/A5.5M:2006

AWS Classification E8018-C2 H4

Welding Current AC - DCEP

Welding Position F,V,OH,H

Typical Wire Chemistry

C	0.12
Mn	1.25
Si	0.80
Ni	3.00 - 3.75
P	0.03
S	0.03

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	82
Tensile Strength, ksi	95
Elongation%, min	24

Available Diameters

3/32", 1/8", 5/32" & 3/16"

Operating Range in Amps

3/32"	70 - 100
1/8"	115 - 155
5/32"	135 - 185
3/16"	200 - 275

E8018-C3

E8018-C3 welding electrode is designed for 1% nickel applications as well as 80,000 tensile strength applications. These electrodes provide excellent puddle control with good wetting action and tie in, have good arc characteristics and easy slag removal. WMS 8018-C3 electrodes will provide notch toughness of 20-ft•lbs at 40°F. The coating is specially formulated to resist conditions of high heat and humidity. It is also resistant to moisture reabsorption which helps prevent hydrogen cracking and aids in eliminating starting porosity. These electrodes have high operator appeal.

Applications

- 80,000 tensile steels of both commercial and military applications

AWS Specification

AWS A5.5/A.5M:2006

AWS Classification E8018-C3 H4

Welding Current AC - DCEP

Welding Position F,V,OH,H

Typical Wire Chemistry

C	0.12
Mn	0.40 - 1.25
P	0.03
S	0.03
Si	0.80
Ni	0.80 - 1.10
Cr	0.15
Mo	0.35
V	0.05

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	74
Tensile Strength, ksi	80
Elongation%, min	24

Available Diameters

3/32", 1/8", 5/32" & 3/16"

Operating Range in Amps

3/32"	70 - 100
1/8"	115 - 155
5/32"	135 - 185
3/16"	200 - 275

E10018-D2

E10018-D2 is a high quality electrode used for joining high tensile steels and manganese molybdenum steels. The coating is specially formulated to resist moisture pick-up under conditions of high heat and humidity. This electrode offers resistance to moisture reabsorption which helps prevent hydrogen cracking and aids in elimination of starting porosity. E10018-D2 is specifically designed for applications requiring at least 100 ksi tensile strength, good ductility and crack resistance.

Applications

- Manganese-Moly castings
- Alloy Forgings
- Structure and pressure vessels

AWS Specification

AWS A5.5/A5.5M:2006

AWS Classification E10018-D2 H4R

Welding Current AC - DCEP

Welding Position F,V,OH,H

Typical Wire Chemistry

C	0.15
Mn	1.65 - 2.00
Si	0.80
Mo	0.25 - 0.45
P	0.03
S	0.03
Ni	0.90

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	91
Tensile Strength, ksi	100
Elongation%, min	16

Available Diameters

3/32", 1/8", 5/32" & 3/16"

Operating Range in Amps

3/32"	70 - 100
1/8"	115 - 155
5/32"	135 - 185
3/16"	200 - 275



A5.5 | LOW ALLOY STEEL Covered Arc Welding Electrodes

E9018-M

E9018-M is an electrode used for welding higher strength steels when tensile strength in excess of 90 ksi is required. The coating on this electrode is specially formulated to resist moisture pick-up in conditions of high heat and humidity. It's resistance to moisture reabsorption also helps prevent hydrogen cracking and aids in elimination of starting porosity.

Applications

- Joining HY-90, HY-80, T-1 and other high tensile steels

AWS Specification

AWS A5.5/A5.5M:2006

AWS Classification E9018-M H4R

Welding Current DCEP

Welding Position F,V,OH,H

Typical Wire Chemistry

C	0.10
Mn	0.60 - 1.25
P	0.030
S	0.030
Si	0.80
Ni	1.40 - 1.80
Cr	0.15
Mo	0.35
V	0.05

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	84
Tensile Strength, ksi	90
Elongation%, min	24

Available Diameters

3/32", 1/8", 5/32" & 3/16"

Operating Range in Amps

3/32"	70 - 100
1/8"	115 - 155
5/32"	135 - 185
3/16"	200 - 275

E11018-M

E11018-M is an outstanding electrode designed for use in Military applications which require weld joints with 116 ksi minimum tensile strength. This electrode provides excellent puddle control with good wetting action and tie in. E11018M offers good arc characteristics and easy slag removal.

Applications

- Joining HY-80, HY-90, HY-100, and T-1 steels
- Applications requiring 116 ksi minimum tensile strength

AWS Specification

AWS A5.5/A5.5M:2006

AWS Classification E11018-M H4R

Welding Current DCEP

Welding Position F,V,OH,H

Typical Wire Chemistry

C	0.10
Mn	1.30 - 1.80
P	0.030
S	0.030
Si	0.60
Cr	0.40
Mo	0.25 - 0.50
Ni	1.25 - 2.50
V	0.05

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	103
Tensile Strength, ksi	116
Elongation%, min	23.4

Available Diameters

3/32", 1/8", 5/32" & 3/16"

Operating Range in Amps

3/32"	70 - 100
1/8"	115 - 155
5/32"	135 - 185
3/16"	200 - 275

E12018-M

E12018-M is an outstanding electrode designed for use in applications which require weld joints with 110 ksi minimum tensile strength. This electrode provides excellent puddle control with good wetting action and tie in. The coating is specially formulated to resist moisture pick-up under conditions of high heat and humidity. This electrode offers resistance to moisture reabsorption which helps prevent hydrogen cracking and aids in elimination of starting porosity.

Applications

- Applications requiring 120,000 psi minimum tensile strength

AWS Specification

AWS A5.5/A5.5M:2006

AWS Classification E12018-M H4R

Welding Current DCEP

Welding Position F,V,OH,H

Typical Wire Chemistry

C	0.10
Mn	1.30 - 2.25
Si	0.60
Cr	0.30 - 1.50
Ni	1.75 - 2.50
Mo	0.30 - 0.55
P	0.030
S	0.030
V	0.05

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	119
Tensile Strength, ksi	110
Elongation%, min	20

Available Diameters

3/32", 1/8", 5/32" & 3/16"

Operating Range in Amps

3/32"	70 - 100
1/8"	115 - 155
5/32"	135 - 185
3/16"	200 - 275



A5.5 | LOW ALLOY STEEL Covered Arc Welding Electrodes

E7010-P1

E7010-P1 is an excellent all-position, cellulosic mild steel electrode providing strong, dependable, X-ray quality welds. It delivers great arc stability and the best penetration possible when welding 5L, 5LX and X52-X65 pipes. This welding electrode is ideal for vertical-down welding in both single and multi-pass operations.

Applications

- High-yield pipe steels
- Drill platforms
- Shipbuilding
- Storage tanks

AWS Specification

AWS A5.5/A5.5M:2006

AWS Classification E7010-P1

Welding Current DCEP

Welding Position F,V,OH,H

Typical Wire Chemistry

C	0.20
Mn	1.20
Si	0.60
P	0.03
S	0.03
Ni	1.00
Mo	0.50
Cr	0.30
V	0.10

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	70
Tensile Strength, ksi	70
Elongation%, min	22

Available Diameters

1/8", 5/32" & 3/16"

Operating Range in Amps

1/8"	75 - 125
5/32"	110 - 170
3/16"	140 - 215

E8010-P1

E8010-P1 is an excellent all-position, cellulosic mild steel electrode providing strong, dependable, X-ray quality welds. It delivers great arc stability and the best penetration possible when welding pipe steels with silicon contents of up to 0.30. It's also great for welding X56-X70 pipe. This welding electrode is ideal for vertical-down welding in both single and multi-pass operations.

Applications

- High-yield pipe steels
- Drill platforms
- Shipbuilding
- Storage tanks

AWS Specification

AWS A5.5/A5.5M:2006

AWS Classification E8010-P1

Welding Current DCEP

Welding Position F,V,OH,H

Typical Wire Chemistry

C	0.20
Mn	1.20
Si	0.60
P	0.03
S	0.03
Ni	1.00
Mo	0.50
Cr	0.30
V	0.10

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	72
Tensile Strength, ksi	80
Elongation%, min	19

Available Diameters

1/8", 5/32" & 3/16"

Operating Range in Amps

1/8"	75 - 125
5/32"	110 - 170
3/16"	140 - 215



A5.6 | COPPER AND COPPER ALLOY Covered Arc Welding Electrodes

ECu

ECu is a pure copper electrode used for joining and build-up on copper parts requiring corrosion resistance and thermal and/or electrical conductivity. A preheat of 750°-1100°F should be used for thicker sections. Use as large an electrode as possible and maintain a short arc.

Applications

- Joining and build-up of copper parts

AWS Specification

AWS A5.6/A5.6M:2008

AWS Classification ECu

Welding Current DCEP

Welding Position F,H,V-up,OH

Typical Wire Chemistry

Mn	0.10
Al	0.10
Si	0.10
Fe	0.20
Pb	0.01
Cu (including Ag)	REM
OTHER	0.50

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	27
Tensile Strength, ksi	33
Elongation%, min	3

Available Diameters

1/8", 5/32" & 3/16"

Operating Range in Amps

1/8"	100 - 130
5/32"	140 - 170
3/16"	170 - 200

ECuMnNiAl

ECuMnNiAl (Nickel Manganese Aluminum Bronze) is a universal copper based welding electrode which safely repairs all grades of aluminum bronzes. It has a very high strength and provides excellent wear resistance. This electrode resists corrosion, cavitation, erosion, and metal-to-metal wear. Preheat is not required when welding with this electrode. Clean slag thoroughly between passes.

Applications

- Joining and surfacing parts subject to service in marine/seawater environments

AWS Specification

AWS A5.6/A5.6M:2008

AWS Classification ECuMnNiAl

Welding Current DCEP

Welding Position F

Typical Wire Chemistry

Mn	11.0 - 14.0
Si	1.5
Ni	1.5 - 3.0
Fe	2.0 - 4.0
Al	6.0 - 8.5
Pb	0.02
Cu (including Ag)	REM
OTHER	0.50

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	65
Tensile Strength, ksi	96
Elongation%, min	20

Available Diameters

1/8", 5/32" & 3/16"

Operating Range in Amps

1/8"	90 - 130
5/32"	105 - 155
3/16"	135 - 210

ECuSn-C

ECuSn-C (Phos-Bronze C) welding electrode is excellent for joining copper base alloys not only to themselves but to stainless steel, cast iron, and steels. This electrode may be used on AC current and as an electric brazing rod.

Applications

- Joining coppers to themselves as well as stainless steel, cast iron, and steel

AWS Specification

AWS A5.6/A5.6M:2008

AWS Classification ECuSn-C

Welding Current AC - DCEN

Welding Position F

Typical Wire Chemistry

Sn	7.0 - 9.0
Fe	0.25
P	0.05 - 0.35
Al	0.01
Pb	0.02
Cu (including Ag)	REM
OTHER	0.50

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	30
Tensile Strength, ksi	50
Elongation%, min	18

Available Diameters

3/32", 1/8" & 5/32"

Operating Range in Amps

3/32"	75 - 105
1/8"	100 - 135
5/32"	120 - 160



A5.6 | COPPER AND COPPER ALLOY

Covered Arc Welding Electrodes

ECuNi

ECuNi (Alloy 187) is a copper-nickel, all-position, electrode of SMAW of wrought or cast alloys of similar composition as well as 80 Cu + 20 Ni and 90 Cu + 10 Ni alloys. It is also used for the clad side of copper-nickel clad steels. This filler metal is widely used in marine applications because of its good resistance to the corrosive elements of seawater.

AWS Specification

AWS A5.6/A5.6M:2008

AWS Classification ECuNi

Welding Current DCEP

Welding Positions F,V,OH,H

Typical Wire Chemistry

Ni	29.0 - 33.0
Mn	1.00 - 2.50
Si	0.50
Fe	0.40 - 0.75
Ti	0.50
P	0.020
Pb	0.02
Cu (including Ag)	REM
OTHER	0.50

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	37
Tensile Strength, ksi	54
Elongation%, min	28

Available Diameters

3/32", 1/8", 5/32" & 3/16"

Operating Range in Amps

3/32"	65 - 75
1/8"	80 - 110
5/32"	100 - 140
3/16"	110 - 160

ECuAl-A2

ECuAl-A2 (Aluminum Bronze A-2) high strength welding electrode is great for repairing all grades of aluminum bronzes. It resists corrosion, cavitation, erosion, and metal to metal wear. It is also excellent for overlays on cast irons, steels and copper.

Applications

- Joining and surfacing parts in marine/seawater environments

AWS Specification

AWS A5.6/A5.6M:2008

AWS Classification ECuAl-A2

Welding Current DCEP

Welding Position F,H

Typical Wire Chemistry

Si	1.5
Fe	0.50 - 5.0
Al	6.5 - 9.5
Pb	0.02
Cu (including Ag)	REM
OTHER	0.50

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	77
Tensile Strength, ksi	35
Elongation%, min	27

Available Diameters

1/8", 5/32" & 3/16"

Operating Range in Amps

1/8"	90 - 130
5/32"	105 - 155
3/16"	135 - 210



A5.7 | COPPER AND COPPER ALLOY

Bare Rods and Electrodes

ERCu

ERCu (Deoxidized Copper) is a filler metal containing 98% or more copper with small amounts of Phosphorus and Silicon used for joining copper to itself or with galvanized or mild steel where high strength joints are not required. This easy flowing alloy produces weld deposits that match the color of copper, are electrically conductive and porosity free.

Applications

- Joining copper pipes, tanks, and copper fittings
- Joining deoxidized copper
- Overlaying steel surfaces to resist corrosion

AWS Specification

AWS A5.7/A5.7M:2007

AWS Classification

ERCu

Welding Current

AC - DCEP

Typical Wire Chemistry

Cu (including Ag)	98.0 min
Sn	1.0
Mn	0.50
Si	0.50
P	0.15
Al	0.01
Pb	0.02
OTHER	0.50

Typical Mechanical Properties (As Welded)

Melting Point	1967°F
Yield Strength, ksi	8
Tensile Strength, ksi	25
Elongation%, min	25

Available Diameters MIG with Operating Range in Amps

.035"	100 - 200
.045"	100 - 250
1/16"	250 - 400

Available Diameters TIG/Oxy Rod with Operating Range in Amps

1/16"	70 - 150
3/32"	225 - 400
1/8"	225 - 400

ERCuSi-A

Silicon Bronze (ERCuSi-A) is primarily used for MIG, TIG, and gas welding of copper, copper-silicon and copper-zinc base metals to themselves and to steel. It is an excellent choice for joining plain or galvanized sheet steel metal as well as other coated steels.

Applications

- Surfacing areas subject to erosion
- Joining copper, copper-silicon, and copper-zincs to themselves or steel.

AWS Specification

AWS A5.7/A5.7M: 2007

AWS Classification

ERCuSi-A

Welding Current

AC - DCEP

Typical Wire Chemistry

Zn	1.0
Sn	1.0
Mn	1.5
Fe	0.50
Si	2.8 - 4.0
Al	0.01
Pb	0.02
Cu (including Ag)	REM
OTHER	0.50

Typical Mechanical Properties (As Welded)

Melting Point	1866°F
Tensile Strength, ksi	50
Elongation%, min	65

Available Diameters MIG with Operating Range in Amps

.023"	100 - 140
.030"	130 - 150
.035"	145 - 185
.045"	195 - 215
1/16"	260 - 280

Available Diameters TIG/Oxy Rod with Operating Range in Amps

1/16"	70 - 150
3/32"	150 - 200
1/8"	230 - 400

ERCuSn-A

Phos Bronze A (ERCuSn-A) is a copper-zinc bronze containing approximately 5% tin and up to 0.35% phosphorus added as a deoxidizer used to weld bronze and brass. It can also be used to weld copper if the presence of tin in the weld metal is not objectionable.

Applications

- Overlaying of steel
- Joining of 509-519 series tin-bronze base metals

AWS Specification

AWS A5.7/A5.7M:2007

AWS Classification

ERCuSn-A

Welding Current

AC - DCEP

Typical Wire Chemistry

Sn	4.0 - 6.0
P	0.10 - 0.35
Al	0.01
Pb	0.02
Cu (including Ag)	REM
OTHER	0.50

Typical Mechanical Properties (As Welded)

Tensile Strength, ksi	35
Brinell Hardness	70 - 85

Available Diameters MIG with Operating Range in Amps

.030"	130 - 140
.035"	140 - 160
.045"	165 - 185
1/16"	285 - 335

Available Diameters TIG/Oxy Rod with Operating Range in Amps

1/16"	100 - 120
3/32"	185 - 205
1/8"	300 - 615



A5.7 | COPPER AND COPPER ALLOY

Bare Rods and Electrodes

ERCuAl-A1

Aluminum Bronze A-1 (ERCuAl-A1) is an iron-free aluminum bronze filler metal used for MIG and TIG overlaying. It is not recommended to be used for joining. Because of its moderate strength it is predominantly used for weld overlay and metalizing in automotive and other manufacturing operations. It can also be used for build-up and repair of bearing and corrosion resistant surfaces.

Applications

- Overlaying of wear resistant surfaces subject to corrosive environment
- Overlaying of tube sheets, refineries, and valve seats in pulp mill

AWS Specification

AWS A5.7/A5.7M:2007

AWS Classification ERCuAl-A1

Welding Current AC - DCEP

Typical Wire Chemistry

Al	6.0 - 8.5
Mn	0.50
Pb	0.02
Si	0.10
Zn	0.20
Cu (including Ag)	REM
OTHER	0.50

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	24
Tensile Strength, min ksi	55
Elongation%, min	30
Brinell Hardness	80 - 110

Available Diameters MIG with Operating Range in Amps

.035"	130 - 200
.045"	185 - 245
1/16"	250 - 400

Available Diameters TIG/Oxy Rod with Operating Range in Amps

1/16"	80 - 120
3/32"	145 - 205
1/8"	300 - 640

ERCuAl-A2

Aluminum Bronze A-2 (ERCuAl-A2) filler metal is an intermediate-strength aluminum bronze alloy used for welding aluminum bronze plate fabrications and for joining dissimilar metals such as cast iron, carbon steels, copper, bronze and copper-nickel materials. It is excellent for building up or overlaying metal for wear and corrosion resistant surfaces. Weld deposits exhibit high mechanical properties, tensile strength, yield strength and hardness.

Applications

- Marine maintenance and repair
- Wear surface reconstruction
- Casting repair
- Joining aluminum bronze of similar composition

AWS Specification

AWS A5.7/A5.7M:2007

AWS Classification ERCuAl-A2

Welding Current AC - DCEP

Typical Wire Chemistry

Al	8.5 - 11.0
Fe	0.5 - 1.5
Pb	0.02
Si	0.10
Zn	0.02
Cu (including Ag)	REM
OTHER	0.50

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	43
Tensile Strength, min ksi	60
Elongation%, min	23
Brinell Hardness	130 - 150

Available Diameters MIG with Operating Range in Amps

.035"	130 - 200
.045"	185 - 245
1/16"	250 - 400

Available Diameters TIG/Oxy Rod with Operating Range in Amps

1/16"	80 - 120
3/32"	145 - 205
1/8"	300 - 640



A5.8 | BRAZING

Filler Metals

RBCuZn-A

Naval Bronze (RBCuZn-A) is a copper-zinc brazing filler metal containing small amounts of tin to improve strength and corrosion resistance in the weld deposit. It is a good choice when the high strength properties of low fuming bronze are not required. A borax-boric acid flux is generally required when brazing with this product.

AWS Specification

AWS A5.8/A5.8M:2011

AWS Classification

RBCuZn-A

Typical Wire Chemistry

Al	0.01
Pb	0.05
Sn	0.25 - 1.00
Cu	57.0 - 61.0
OTHER	.050
Zn	REM

Typical Physical & Mechanical Properties

Melting point	1625°F
Solidification	1610°F
Tensile Strength, ksi	55
Elongation%, min	30
Brinell Hardness	80

Brazing Positions

H,V

Available Diameters

1/16", 3/32", 1/8", 5/32", 3/16" & 1/4"

RBCuZn-B

Nickel Bronze (RBCuZn-B) brazing filler metal is similar to naval bronze but contains manganese and iron which increase the hardness and strength of the weld deposit. It also contains nickel ensuring uniform distribution of the iron in the deposit. A neutral or slightly oxidizing flame and a boric acid/borax type flux should be used.

AWS Specification

AWS A5.8/A5.8M:2011

AWS Classification

RBCuZn-B

Typical Wire Chemistry

Pb	0.05
Fe	0.25 - 1.20
Sn	0.80 - 1.10
Ni (contains Co)	0.20 - 0.80
Al	0.01
Mn	0.01 - 0.50
Si	0.04 - 0.20
Cu	56.0 - 60.0
OTHER	0.50
Zn	REM

Typical Physical & Mechanical Properties

Melting point	1620°F
Solidification	1590°F
Tensile Strength, ksi	65
Elongation%, min	25
Brinell Hardness	92

Brazing Positions

H,V

Available Diameters

1/16", 3/32", 1/8", 5/32", 3/16" & 1/4"

RBCuZn-C

Low fuming bronze (bare and flux coated) is a general-purpose, copper base alloy brazing rod used extensively for gas brazing steel, copper alloys, cast iron, nickel alloys and stainless steel. Its low fuming characteristic and good mechanical properties make this alloy a widely used general-purpose product. Preheating is recommended for some applications and a bronze brazing flux is required if the rod is not coated. This brazing rod has a low melting point making it easily machinable and excellent for sheet metal work. This alloy also possesses high tensile strength and good ductility.

AWS Specification

AWS A5.8/A5.8M:2011

AWS Classification

RBCuZn-C

Typical Wire Chemistry

Si	0.04 - 0.15
Mn	0.01 - 0.50
Al	0.01
Sn	0.80 - 1.10
Fe	0.25 - 1.20
Pb	0.05
Cu	56.0 - 60.0
OTHER	0.50
Zn	REM

Typical Physical & Mechanical Properties

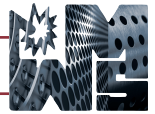
Melting point	1630°F
Solidification	1595°F
Tensile Strength, ksi	71
Yield Strength, ksi	64
Brinell Hardness	96

Brazing Positions

H,V

Available Diameters

1/16", 3/32", 1/8", 5/32", 3/16" & 1/4"



A5.8 | BRAZING

Filler Metals

RBCuZn-D

Nickel Silver (RBCuZn-D) is a pre-coated brazing rod used widely as a replacement for high cost silver brazing alloys when higher brazing temperatures are acceptable. The weld deposits have a very high tensile strength, good ductility and excellent corrosion resistance. Nickel Silver weld deposits are also readily machinable and will not work harden when put into service. A neutral or slightly oxidizing flame is recommended.

Applications

- Brazing tungsten carbides, copper alloys, nickel alloys, stainless and carbon steels
- Brazing steel or cast iron where good color match is desired
- Building up and/or overlaying worn parts such as gear teeth, bearings, and valve seats

AWS Specification

AWS A5.8/A5.8M:2011

AWS Classification RBCuZn-D

Typical Wire Chemistry

Al	0.01
Ni	9.0 - 11.0
Pb	0.05
P	0.25
Si	0.04 - 0.25
Cu	46.0 - 50.0
OTHER	0.50
Zn	REM

Typical Physical & Mechanical Properties

Melting point	1680°F
Solidification	1665°F
Tensile Strength, ksi	70
Elongation%, min	25
Brinell Hardness	120

Brazing Positions H,V

Available Diameters

1/16", 3/32", 1/8", 5/32", 3/16" & 1/4"

BCuP-2

Phos-Copper (BCuP-2) low cost alloy is suitable for most copper-to-copper or brass joints where good fit-up exists, and the assemblies are not subject to vibration or movement. Developed primarily for use on copper, this alloy may also be used on other nonferrous copper base alloys. This product is used extensively on refrigeration units, air conditioning apparatus, electrical conductors, copper and brass pipe fittings, and other copper and brass equipment. By virtue of its phosphorus content, this product is self-fluxing on copper only applications. A flux should be used when brazing brass or bronze with this product.

Applications

- Applications with joint clearance of .001" - .003"
- Refrigeration units
- Electrical conductors
- Copper and brass fittings
- Air conditioning apparatus
- Copper and brass equipment

AWS Specification

AWS A5.8/A5.8M:2011

AWS Classification BCuP-2

Typical Wire Chemistry

P	7.0 - 7.5
OTHER	0.15
Cu	REM

Typical Physical & Mechanical Properties

Melting point	1310°F
Flow point	1460°F
Brazing temperature	1500°F
Color when brazed	Copper Yellow
Density	4.170 Tr. Oz / Cu in
Specific Gravity	7.913

Available Diameters

1/16", 1/8" & 1/4"

BCuP-3

BCuP-3 is a phos-copper-silver alloy suitable for most copper-to-copper or brass joints where close fit-up cannot necessarily be maintained, and the assemblies are not subject to vibration or movement. This product is somewhat more ductile than BCuP-2. Developed primarily for use on copper, this alloy may also be used on other nonferrous copper base alloys. This product is used extensively on refrigeration units, air conditioning apparatus, electrical conductors, copper and brass pipe fittings, and other copper and brass equipment. By virtue of its phosphorus content, this product is self-fluxing on copper only applications. A flux should be used when brazing brass or bronze with this product.

Applications

- Applications with joint clearance of .003" - .006"
- Refrigeration units
- Electrical conductors
- Copper and brass fittings
- Air conditioning apparatus
- Copper and brass equipment

AWS Specification

AWS A5.8/A5.8M:2011

AWS Classification BCuP-3

Typical Wire Chemistry

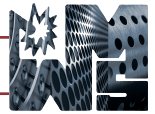
Ag	4.8 - 5.2
P	5.8 - 6.2
OTHER	0.15
Cu	REM

Typical Physical & Mechanical Properties

Melting point	1190°F
Flow point	1480°F
Brazing temperature	1500°F
Color when brazed	Light Copper
Density	4.284 Tr. Oz / Cu in
Specific Gravity	8.129

Available Diameters

1/16", 3/32" & 1/8"



A5.9 | STAINLESS STEEL

Bare, Cored and Stranded Electrodes

stainless steel electrode selection chart

BASE METAL AISI TYPES		COMMON DESIGNATION	RECOMMENDED ALLOY ELECTRODE
AUSTENITIC	201	17-4 Mn	
	202	18-5 Mn	
	301	17-7	
	302	18-8	
	302B	18-8 Si	
	303	18-8 Free Machining	308/308L
	303Se	18-8 Free Machining	
	304	19-9	
	305	18-10	
	308	20-10	
	304L	19-9 L	
	309	24-12	309/309L
	309S	24-12 LC	
	310	25-20	
	310S	25-20	310
	314	25-20	
	312		312
	316	18-12 Mo	316/316L
	316L	18-12 MoL	316L
317	19-13 Mo	317	
321	18-8 Ti	347	
330		330	
347	18-8 Cb	347	
348	18-8 Cb		
MARTENSITIC	403		
	410		
	414		410
	416		
	416Se		
	420		430
	431		309
502		502	
FERRITIC	405		410
	430		
	430F		430
	430FSe		
	442		309
446			



A5.9 | STAINLESS STEEL

Bare, Cored and Stranded Electrodes

ER308/308L

ER308/308L is used for welding types 304, 304L, 308, and 308L stainless steels. It is very similar to type 308, but has a carbon content held to a max of .03% to avoid carbide precipitation. This product can also be used for welding types 321 and 347 stainless steels. This wire is suitable for applications at cryogenic temperatures.

AWS Specification
AWS A5.9/A5.9M:2006

AWS Classification ER308
ER308L

Welding Current DCEP

Typical Wire Chemistry

C	0.08
Cr	19.5 - 22.0
Ni	9.0 - 11.0
Mo	0.75
Mn	1.0 - 2.5
Si	0.30 - 0.65
P	0.03
S	0.03
Cu	0.75

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	59
Tensile Strength, ksi	88
Elongation%, min	39

Welding Positions F,V,OH,H

Available Diameters MIG with Operating Range in Amps

.023"	35 - 70
.030"	50 - 100
.035"	160 - 210
.045"	180 - 250

Available Diameters TIG with Operating Range in Amps

.035"	60 - 90
.045"	80 - 110
1/16"	90 - 130
3/32"	120 - 175
1/8"	150 - 220
5/32"	170 - 350

ER308LSI

ER308LSI has the same analysis as ER308L but with a higher silicon content. The higher silicon content improves arc stability, bead appearance and wetting action. ER308LSI produces exceptionally smooth welds for applications that require a good cosmetic appearance. This product is used primarily with welding grades 304 and 308.

AWS Specification
AWS A5.9/A5.9M:2006

AWS Classification ER308LSI

Welding Current DCEP

Typical Wire Chemistry

C	0.03
Cr	19.5 - 22.0
Ni	9.0 - 11.0
Mo	0.75
Mn	1.0 - 2.5
Si	0.65 - 1.00
P	0.03
S	0.03
Cu	0.75

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	55
Tensile Strength, ksi	85
Elongation%, min	40

Welding Positions F,V,OH,H

Available Diameters MIG with Operating Range in Amps

.023"	35 - 70
.030"	50 - 100
.035"	100 - 150
.045"	150 - 200

Available Diameters TIG with Operating Range in Amps

.035"	60 - 90
.045"	80 - 110
1/16"	90 - 130
3/32"	120 - 175
1/8"	150 - 220
5/32"	170 - 350

ER309/309L

ER309/309L is very similar to type 309 except for the carbon content being lower than .03%. The extra low carbon content provides good resistance to carbide precipitation and intergranular corrosion. ER309L works well for dissimilar joints that undergo heat treatment.

AWS Specification
AWS A5.9/A5.9M:2006

AWS Classification ER309
ER309L

Welding Current DCEP

Typical Wire Chemistry

C	0.12
Cr	23.0 - 25.0
Ni	12.0 - 14.0
Mo	0.75
Mn	1.0 - 2.5
Si	0.30 - 0.65
P	0.03
S	0.03
Cu	0.75

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	58
Tensile Strength, ksi	85
Elongation%, min	36

Welding Positions F,V,OH,H

Available Diameters MIG with Operating Range in Amps

.023"	35 - 70
.030"	50 - 100
.035"	160 - 210
.045"	180 - 250

Available Diameters TIG with Operating Range in Amps

.035"	60 - 90
.045"	80 - 110
1/16"	90 - 130
3/32"	120 - 175
1/8"	150 - 220
5/32"	170 - 350



A5.9 | STAINLESS STEEL

Bare, Cored and Stranded Electrodes

ER309LSI

ER309LSI is similar in composition to ER309L with a higher silicon content, which produces weld beads that are exceptionally smooth due to good wetting action. 309LSI is a great choice when cosmetic appearance is important.

AWS Specification
AWS A5.9/A5.9M:2006

AWS Classification ER309LSI

Welding Current DCEP

Typical Wire Chemistry

C	0.03
Cr	23.0 - 25.0
Ni	12.0 - 14.0
Mo	0.75
Mn	1.0 - 2.5
Si	0.65 - 1.00
P	0.03
S	0.03
Cu	0.75

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	64
Tensile Strength, ksi	87
Elongation%, min	41

Welding Positions F,V,OH,H

Available Diameters MIG with Operating Range in Amps

.023"	35 - 70
.030"	50 - 100
.035"	100 - 150
.045"	150 - 200

Available Diameters TIG with Operating Range in Amps

.035"	60 - 90
.045"	80 - 110
1/16"	90 - 130
3/32"	120 - 175
1/8"	150 - 220
5/32"	170 - 350

ER310

ER310 type stainless steel wire is used for welding base metal in cast or wrought iron form of similar type stainless steel. The weld deposit calls for low heat during welding and is fully austenitic. This filler metal may also be used for dissimilar welding.

AWS Specification
AWS A5.9/A5.9M:2006

AWS Classification ER310

Welding Current DCEP

Typical Wire Chemistry

C	0.08 - 0.15
Cr	25.0 - 28.0
Ni	20.0 - 22.5
Mo	0.75
Mn	1.0 - 2.5
Si	0.30 - 0.65
P	0.03
S	0.03
Cu	0.75

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	60
Tensile Strength, ksi	89
Elongation%, min	34

Welding Positions F,V,OH,H

Available Diameters MIG with Operating Range in Amps

.023"	35 - 70
.030"	50 - 100
.035"	160 - 210
.045"	180 - 250

Available Diameters TIG with Operating Range in Amps

.035"	60 - 90
.045"	80 - 110
1/16"	90 - 130
3/32"	120 - 175
1/8"	150 - 220
5/32"	170 - 350

ER312

ER312 stainless steel wire is used for welding cast alloys of similar composition as well as dissimilar metals including stainless to mild steels. It can also be used for welding high strength steels. This alloy has very high ferrite.

AWS Specification
AWS A5.9/A5.9M:2006

AWS Classification ER312

Welding Current DCEP

Typical Wire Chemistry

C	0.15
Cr	28.0 - 32.0
Ni	8.0 - 10.5
Mo	0.75
Mn	1.0 - 2.5
Si	0.30 - 0.65
P	0.03
S	0.03
Cu	0.75

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	78
Tensile Strength, ksi	109
Elongation%, min	45

Welding Positions F,V,OH,H

Available Diameters MIG with Operating Range in Amps

.023"	35 - 70
.030"	50 - 100
.035"	160 - 210
.045"	180 - 250

Available Diameters TIG with Operating Range in Amps

.035"	60 - 90
.045"	80 - 110
1/16"	90 - 130
3/32"	120 - 175
1/8"	150 - 220
5/32"	170 - 350



A5.9 | STAINLESS STEEL

Bare, Cored and Stranded Electrodes

ER316/316L

ER316/316L is used for welding types 316 and 316L stainless steels. It has a maximum carbon content of .03% to reduce the possibility of formation of intergranular carbide precipitation. This low carbon alloy is not as strong as 316H at elevated temperatures. This filler metal is primarily used for welding low carbon molybdenum bearing austenitic alloys.

AWS Specification
AWS A5.9/A5.9M:2006

AWS Classification ER316
ER316L

Welding Current DCEP

Typical Wire Chemistry

C	0.08
Cr	18.0 - 20.0
Ni	11.0 - 14.0
Mo	2.0 - 3.0
Mn	1.0 - 2.5
Si	0.30 - 0.65
P	0.03
S	0.03
Cu	0.75

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	58
Tensile Strength, ksi	86
Elongation%, min	36

Welding Positions F,V,OH,H

Available Diameters MIG with Operating Range in Amps

.023"	35 - 70
.030"	50 - 100
.035"	160 - 210
.045"	180 - 250

Available Diameters TIG with Operating Range in Amps

.035"	60 - 90
.045"	80 - 110
1/16"	90 - 130
3/32"	120 - 175
1/8"	150 - 220
5/32"	170 - 350

ER316LSI

ER316LSI is similar to ER316L with an increased silicon content that drastically improves the wetting characteristics of the weld producing a very smooth bead. This product is used in applications where a good cosmetic appearance is important.

AWS Specification
AWS A5.9/A5.9M:2006

AWS Classification ER316LSI

Welding Current DCEP

Typical Wire Chemistry

C	0.03
Cr	18.0 - 20.0
Ni	11.0 - 14.0
Mo	2.0 - 3.0
Mn	1.0 - 2.5
Si	0.65 - 1.00
P	0.03
S	0.03
Cu	0.75

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	64
Tensile Strength, ksi	90
Elongation%, min	37

Welding Positions F,V,OH,H

Available Diameters MIG with Operating Range in Amps

.023"	35 - 70
.030"	50 - 100
.035"	100 - 150
.045"	150 - 200

Available Diameters TIG with Operating Range in Amps

.035"	60 - 90
.045"	80 - 110
1/16"	90 - 130
3/32"	120 - 175
1/8"	150 - 220
5/32"	170 - 350

ER317L

ER317L is the low carbon version of ER317 and it is used for welding types 316 and 317 stainless steels. It contains a higher level of molybdenum that offers improved resistance to pitting and crevice corrosion. The lower carbon level also makes the weld metal less susceptible to intergranular corrosion.

AWS Specification
AWS A5.9/A5.9M:2006

AWS Classification ER317L

Welding Current DCEP

Typical Wire Chemistry

C	0.03
Cr	18.5 - 20.5
Ni	13.0 - 15.0
Mo	3.0 - 4.0
Mn	1.0 - 2.5
Si	0.30 - 0.65
P	0.03
S	0.03
Cu	0.75

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	58
Tensile Strength, ksi	84
Elongation%, min	35

Welding Positions F,V,OH,H

Available Diameters MIG with Operating Range in Amps

.023"	35 - 70
.030"	50 - 100
.035"	160 - 210
.045"	180 - 250

Available Diameters TIG with Operating Range in Amps

.035"	60 - 90
.045"	80 - 110
1/16"	90 - 130
3/32"	120 - 175
1/8"	150 - 220
5/32"	170 - 350



A5.9 | STAINLESS STEEL

Bare, Cored and Stranded Electrodes

ER320LR

ER320LR has a composition similar to type 320, except that carbon, silicon, phosphorus, and sulfur levels are kept at lower levels as well as the columbium and manganese being specified at a narrower range. The low melting residuals are limited in this alloy to reduce the possibility of microfissuring. It is for this reason that this alloy is often used for welding type 320 stainless steels.

AWS Specification

AWS A5.9/A5.9M:2006

AWS Classification ER320LR

Welding Current DCEP

Typical Wire Chemistry

C	0.025
Cr	19.0 - 21.0
Ni	32.0 - 36.0
Mo	2.0 - 3.0
Mn	1.5 - 2.0
Si	0.15
P	0.015
S	0.02
Cu	3.0 - 4.0
Nb	8xCmin/0.40max

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	57
Tensile Strength, ksi	86
Elongation%, min	35

Welding Positions F,V,OH,H

Available Diameters MIG with Operating Range in Amps

.023"	35 - 70
.030"	50 - 100
.035"	160 - 210
.045"	180 - 250

Available Diameters TIG with Operating Range in Amps

.035"	60 - 90
.045"	80 - 110
1/16"	90 - 130
3/32"	120 - 175
1/8"	150 - 220
5/32"	170 - 350

ER330

ER330 is used to weld cast and wrought material of similar chemical composition. The weld metal provides excellent scale and heat resistance up to 1800°F. ER330 is a fully austenitic alloy therefore heat input is necessary. High sulfur environments may adversely affect temperature performance.

AWS Specification

AWS A5.9/A5.9M:2006

AWS Classification ER330

Welding Current DCEP

Typical Wire Chemistry

C	0.18 - 0.25
Cr	15.0 - 17.0
Ni	34.0 - 37.0
Mo	0.75
Mn	1.0 - 2.5
Si	0.30 - 0.65
P	0.03
S	0.03
Cu	0.75

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	56
Tensile Strength, ksi	84
Elongation%, min	29

Welding Positions F,V,OH,H

Available Diameters MIG with Operating Range in Amps

.023"	35 - 70
.030"	50 - 100
.035"	160 - 210
.045"	180 - 250

Available Diameters TIG with Operating Range in Amps

.035"	60 - 90
.045"	80 - 110
1/16"	90 - 130
3/32"	120 - 175
1/8"	150 - 220
5/32"	170 - 350

ER347

ER347 is a stainless steel welding wire used in joining types 321 and 347 grades of stainless. The addition of columbium to this alloy reduces the possibility of chromium carbide precipitation and consequent intergranular corrosion.

AWS Specification

AWS A5.9/A5.9M:2006

AWS Classification ER347

Welding Current DCEP

Typical Wire Chemistry

C	0.08
Cr	19.0 - 21.5
Ni	9.0 - 11.0
Mo	0.75
Mn	1.0 - 2.5
Si	0.30 - 0.65
P	0.03
S	0.03
Cu	0.75
Nb	10xCmin/1.0max

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	57
Tensile Strength, ksi	86
Elongation%, min	35

Welding Positions F,V,OH,H

Available Diameters MIG with Operating Range in Amps

.023"	35 - 70
.030"	50 - 100
.035"	160 - 210
.045"	180 - 250

Available Diameters TIG with Operating Range in Amps

.035"	60 - 90
.045"	80 - 110
1/16"	90 - 130
3/32"	120 - 175
1/8"	150 - 220
5/32"	170 - 350



A5.9 | STAINLESS STEEL

Bare, Cored and Stranded Electrodes

ER409Nb

ER409Nb is a ferritic stainless steel welding alloy used to weld types 409 and 409Ti base metals. The addition of columbium leads to a preferential reaction with carbon which interrupts chromium from forming carbides. This improves corrosion resistance, increases strength at high temperatures, and promotes ferritic microstructure.

AWS Specification
AWS A5.9/A5.9M:2006

AWS Classification ER409Nb

Welding Current DCEP

Typical Wire Chemistry

C	0.08
Cr	10.5 - 13.5
Ni	0.6
Mo	0.50
Mn	0.8
Si	1.0
P	0.04
S	0.03
Cu	0.75
Nb	10xCmin/0.75max

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	50
Tensile Strength, ksi	67
Elongation%, min	26

Welding Positions F,V,OH,H

Available Diameters MIG with Operating Range in Amps

.030"	50 - 100
.035"	160 - 210
.045"	180 - 250

Available Diameters TIG with Operating Range in Amps

.035"	60 - 90
.045"	80 - 110
1/16"	90 - 130
3/32"	120 - 175
1/8"	150 - 220
5/32"	170 - 350

ER410

ER410 is used to weld types 403, 405, 410, and 416 grades of stainless. It is also commonly used for welding overlay on carbon steels to resist corrosion, erosion, or abrasion. Because this is an air hardening type of material the joint to be welded should be preheated to 350°F.

AWS Specification
AWS A5.9/A5.9M:2006

AWS Classification ER410

Welding Current DCEP

Typical Wire Chemistry

C	0.12
Cr	11.5 - 13.5
Ni	0.6
Mo	0.75
Mn	0.6
Si	0.5
P	0.03
S	0.03
Cu	0.75

Typical Mechanical Properties (As Welded post heat treatment between 1350° and 1400°F for one hour)

Yield Strength, ksi	78
Tensile Strength, ksi	89
Elongation%, min	24

Welding Positions F,V,OH,H

Available Diameters MIG with Operating Range in Amps

.030"	50 - 100
.035"	160 - 210
.045"	180 - 250

Available Diameters TIG with Operating Range in Amps

.035"	60 - 90
.045"	80 - 110
1/16"	90 - 130
3/32"	120 - 175
1/8"	150 - 220
5/32"	170 - 350

ER410NiMo

ER410NiMo is extensively used to weld cast and wrought material of similar chemical composition. Preheating and interpass temperature of not less than 300°F is required.

AWS Specification
AWS A5.9/A5.9M:2006

AWS Classification ER410NiMo

Welding Current DCEP

Typical Wire Chemistry

C	0.06
Cr	11.0 - 12.5
Ni	4.0 - 5.0
Mo	0.4 - 0.7
Mn	0.6
Si	0.5
P	0.03
S	0.03
Cu	0.75

Typical Mechanical Properties (As Welded post heat treatment between 1100° and 1150°F for one hour)

Yield Strength, ksi	92
Tensile Strength, ksi	118
Elongation%, min	20

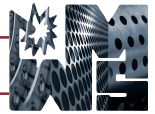
Welding Positions F,V,OH,H

Available Diameters MIG with Operating Range in Amps

.030"	50 - 100
.035"	160 - 210
.045"	180 - 250

Available Diameters TIG with Operating Range in Amps

.035"	60 - 90
.045"	80 - 110
1/16"	90 - 130
3/32"	120 - 175
1/8"	150 - 220
5/32"	170 - 350



A5.9 | STAINLESS STEEL

Bare, Cored and Stranded Electrodes

ER630

ER630 is a precipitation hardening grade of stainless steel used for joining materials of similar chemical composition. Mechanical properties of this alloy are greatly influenced by the heat treatment.

AWS Specification
AWS A5.9/A5.9M:2006

AWS Classification ER630

Welding Current DCEP

Typical Wire Chemistry

C	0.05
Cr	16.00 - 16.75
Ni	4.5 - 5.0
Mo	0.75
Mn	0.25 - 0.75
Si	0.75
P	0.03
S	0.03
Cu	3.25 - 4.00
Nb	0.15 - 0.30

Typical Mechanical Properties (As Welded post heat treatment between 1875° and 1625°F for one hour, followed by precipitation hardening between 1135°F and 1165°F for four hours)

Yield Strength, ksi	135
Tensile Strength, ksi	150
Elongation%, min	10

Welding Positions F,V,OH,H

Available Diameters MIG with Operating Range in Amps

.030"	50 - 100
.035"	160 - 210
.045"	180 - 250

Available Diameters TIG with Operating Range in Amps

.035"	60 - 90
.045"	80 - 110
1/16"	90 - 130
3/32"	120 - 175
1/8"	150 - 220
5/32"	170 - 350

ER2209

ER2209 filler metal is designed to weld duplex stainless steels such as UNS Number N31803. The welds are characterized by high tensile strength and improved resistance to stress corrosion cracking and pitting. The wire is lower in ferrite compared to that of base metal in order to obtain improved weldability.

AWS Specification
AWS A5.9/A5.9M:2006

AWS Classification ER2209

Welding Current DCEP

Typical Wire Chemistry

C	0.03
Cr	21.5 - 23.5
Ni	7.5 - 9.5
Mo	2.5 - 3.5
Mn	0.50 - 2.00
Si	0.90
P	0.03
S	0.03
N	0.08 - 0.20
Cu	0.75

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	93
Tensile strength, ksi	108
Elongation%, min	42

Welding Positions F,V,OH,H

Available Diameters MIG with Operating Range in Amps

.030"	50 - 100
.035"	160 - 210
.045"	180 - 250

Available Diameters TIG with Operating Range in Amps

.035"	60 - 90
.045"	80 - 110
1/16"	90 - 130
3/32"	120 - 175
1/8"	150 - 220
5/32"	170 - 350

ER2553

ER2553 is used primarily to weld duplex stainless steels which contain approximately 25% chromium. It has a 'duplex' microstructure consisting of an austenite-ferrite matrix. This duplex alloy is characterized by high tensile strength, resistance to stress corrosion cracking and improved resistance to pitting.

AWS Specification
AWS A5.9/A5.9M:2006

AWS Classification ER2553

Welding Current DCEP

Typical Wire Chemistry

C	0.04
Cr	24.0 - 27.0
Ni	4.5 - 6.5
Mo	2.9 - 3.9
Mn	1.5
Si	1.0
P	0.04
S	0.03
N	0.10 - 0.25
Cu	1.5 - 2.5

Available Diameters MIG with Operating Range in Amps

.035"	100 - 150
.045"	150 - 200

Available Diameters TIG with Operating Range in Amps

1/16"	90 - 130
3/32"	120 - 175
1/8"	150 - 220
5/32"	170 - 350



A5.10 | ALUMINUM AND ALUMINUM ALLOY

Electrodes and Rods

ER1100

Alloy ER1100 is highly resistant to chemical attack and weathering. It is a relatively soft alloy that is very formable and is used extensively in thin gauge and foil products. It has good welding characteristics and it is also used as a filler alloy for welding purposes. A desirable characteristic of the alloy is the bright finishes obtained by anodizing. Base metals that can be welded are 1060, 1070, 1080, and 3003.

Applications

- Heat Exchangers
- Food Handling Equipment
- Rivets
- Tie Wire
- Metallizing

AWS Specification

AWS A5.10/A5.10M:1999(R2007)

AWS Classification ER1100

Welding Current DCEP

Typical Wire Chemistry

Si	a
Fe	a
Cu	0.05 - 0.20
Mn	0.05
Zn	0.10
OTHER	.15
Al	99.00 min

Typical Properties

Melting range	1190 - 1215°F
Conductivity	59% IACS (- H12)
Density	0.98 lbs/cu in
Anodized color	Gray
Tensile Strength, ksi	13

Welding Positions

All positions

Available Diameters GMAW and suggested Operating Range in Amps

.030"	100 - 120
.035"	110 - 170
3/64"	150 - 190
1/16"	200 - 300
3/32"	320 - 330

Available Diameters GTAW

1/16", 3/32" & 1/8"

a – Silicon plus iron shall not exceed 0.95%

ER4043

ER4043 is a general-purpose type aluminum welding wire. It is one of the oldest and most widely used welding and brazing alloys. This aluminum alloy contains silicon additives, which result in improved fluidity (wetting action) of the weld pool and also produces a weld less sensitive to cracking. Its bright weld finish makes it a popular choice of welders. ER4043 can be used to weld various grades of aluminum.

Applications

- Welding filler wire
- Spray and flame metallizing wire

AWS Specification

AWS A5.10/A5.10M:1999(R2007)

AWS Classification ER4043

Welding Current DCEP

Typical Wire Chemistry

Si	4.5 - 6.0
Fe	0.8
Cu	0.30
Mn	0.05
Mg	0.05
Zn	0.10
Ti	0.20
OTHER	0.15
Al	REM

Typical Properties

Melting range	1170 - 1605°F
Conductivity	42% IACS (- O)
Density	0.097 lbs/cu in
Anodized color	Gray
Tensile Strength, ksi	29

Welding Positions

All positions

Available Diameters GMAW and suggested Operating Range in Amps

.030"	100 - 120
.035"	110 - 170
3/64"	150 - 190
1/16"	200 - 300
3/32"	320 - 330

Available Diameters GTAW

1/16", 3/32", 1/8", 5/32" & 3/16"

ER4047

ER4047 was originally developed as a brazing alloy (718) to take advantage of its low melting point and narrow freezing range. It has a higher silicon content than its counterpart ER4043 which provides for increased fluidity and reduced shrinkage in the weld. ER4047 produces bright and almost smut-free welds. This alloy may be used in applications of sustained elevated temperatures.

Applications

- Welding filler wire

AWS Specification

AWS A5.10/A5.10M:1999(R2007)

AWS Classification ER4047

Welding Current DCEP

Typical Wire Chemistry

Si	11.0 - 13.0
Fe	0.8
Cu	0.30
Mn	0.15
Mg	0.10
Zn	0.20
OTHER	0.15
Al	REM

Typical Properties

Melting range	1070 - 1080°F
Conductivity	41% IACS (- O)
Density	0.096 lbs/cu in
Anodized color	Gray - Black
Tensile Strength, ksi	27

Welding Positions

All positions

Available Diameters GMAW and suggested Operating Range in Amps

.030"	100 - 120
.035"	110 - 170
3/64"	150 - 190
1/16"	200 - 300
3/32"	320 - 330

Available Diameters GTAW

1/16", 3/32", 1/8" & 5/32"



A5.11 | NICKEL AND NICKEL ALLOY

Covered Arc Welding Electrodes

ENiCrFe-2

Alloy A (ENiCrFe-2) electrodes are used for welding of nickel-chromium alloys to themselves as well as for dissimilar welding between various nickel alloys and carbon or stainless steels. There is a large range of applications from cryogenic temperatures up to 1500°F. These electrodes can also be used for overlay cladding where similar alloy is needed.

AWS Specification
A5.11/A5.11M:2010

AWS Classification ENiCrFe-2

Welding Current DCEP

Typical Wire Chemistry

C	0.10
Mn	1.0 - 3.5
Fe	12.0
P	0.03
S	0.02
Si	0.75
Cu	0.50
Ni ^b	62.0 min
Nb(Cb)plus Ta	0.5 - 3.0
Mo	0.5 - 2.5
Co	d
Cr	13.0 - 17.0
OTHER	0.50

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	72
Tensile Strength, ksi	80
Elongation%, min	30

Welding Positions F,V,OH,H

Available Diameters and Operating Range in Amps

3/32"	65 - 75
1/8"	80 - 90
5/32"	100 - 120
3/16"	110 - 130

^b – includes incidental cobalt

d – is 0.12 maximum when specified by purchaser

ENiCrFe-3

Type 182 electrodes (ENiCrFe-3) are used for welding of nickel-chromium-iron alloys to themselves and for dissimilar welding between nickel-chromium-iron alloys and steels. Its high manganese content lessens the possibility of micro fissures and also reduces creep strength which limits its usage up to 900°F. Applications for this alloy include surfacing as well as clad-side welding.

AWS Specification
A5.11/A5.11M:2010

AWS Classification ENiCrFe-3

Welding Current DCEP

Typical Wire Chemistry

C	0.10
Mn	5.0 - 9.5
Fe	10.00
P	0.03
S	0.015
Si	1.0
Cu	0.50
Ni ^b	59.0 min
Ti	1.0
Co	d
Cr	13.0 - 17.0
Nb(Cb)plusTa	1.0 - 2.5
OTHER	0.50

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	53
Tensile Strength, ksi	80
Elongation%, min	30

Welding Positions F,V,OH,H

Available Diameters and Operating Range in Amps

3/32"	65 - 75
1/8"	80 - 90
5/32"	100 - 120
3/16"	110 - 130

^b – includes incidental cobalt

d – is 0.12 maximum when specified by purchaser

ENiCrMo-3

Type 112 (ENiCrMo-3) is an electrode which is used to weld nickel-chromium-molybdenum alloys. Its applications include dissimilar joints between nickel-chromium-molybdenum alloys to either stainless steels, carbon or low alloy steels. It is also used extensively in overlay cladding where similar chemical composition is required on the clad side. This alloy is suitable for applications where the temperature ranges from cryogenic up to 1800°F.

AWS Specification
A5.11/A5.11M:2010

AWS Classification ENiCrMo-3

Welding Current DCEP

Typical Wire Chemistry

C	0.10
Mn	1.0
Fe	7.0
P	0.03
S	0.02
Si	0.75
Cu	0.50
Ni ^b	55.0 min
Co	d
Cr	20.0 - 23.0
Nb(Cb)plusTa	3.15 - 4.15
Mo	8.0 - 10.0
OTHER	0.50

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	89
Tensile Strength, ksi	114
Elongation%, min	34

Welding Positions F,V,OH,H

Available Diameters and Operating Range in Amps

3/32"	65 - 75
1/8"	80 - 90
5/32"	100 - 120
3/16"	110 - 130

^b – includes incidental cobalt

d – is 0.12 maximum when specified by purchaser



A5.11 | NICKEL AND NICKEL ALLOY

Covered Arc Welding Electrodes

ENiCrMo-4

Type C276 (ENiCrMo-4) is used for welding materials of similar composition. This material may also be used for dissimilar welding between nickel base alloys and stainless steels as well as for surfacing and cladding. Offers excellent resistance to stress cracking, pitting and crevice corrosion.

AWS Specification
A5.11/A5.11M:2010

AWS Classification ENiCrMo-4

Welding Current DCEP

Typical Wire Chemistry

C	0.02
Mn	1.0
Fe	4.0 - 7.0
P	0.04
S	0.03
Si	0.2
Cu	0.50
Ni ^b	REM
Co	2.5
Cr	14.5 - 16.5
Mo	15.0 - 17.0
V	0.35
W	3.0 - 4.5
OTHER	0.50

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	78
Tensile Strength, ksi	106
Elongation%, min	39

Welding Positions F,V,OH,H

Available Diameters and Operating Range in Amps

3/32"	65 - 75
1/8"	80 - 90
5/32"	100 - 120
3/16"	110 - 130

^b – includes incidental cobalt

ENiCrMo-10

Alloy C22 (ENiCrMo-10) electrodes are used for welding of nickel-chromium-molybdenum alloys as well as for overlay cladding on carbon, low alloy, or stainless steels. They are also used for dissimilar joints between nickel-chromium-molybdenum alloys and stainless, carbon, or low alloy steels. C22 offers excellent corrosion resistance in oxidizing as well as reducing media in a wide variety of chemical process environments. It also offers spectacular resistance to stress corrosion cracking, pitting, and crevice corrosion.

AWS Specification
A5.11/A5.11M:2010

AWS Classification ENiCrMo-10

Welding Current DCEP

Typical Wire Chemistry

C	0.02
Mn	1.0
Fe	2.0 - 6.0
P	0.03
S	0.015
Si	0.2
Cu	0.50
Ni ^b	REM
Co	2.5
Cr	20.0 - 22.5
Mo	12.5 - 14.5
V	0.35
W	2.5 - 3.5
OTHER	0.50

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	78
Tensile Strength, ksi	114
Elongation%, min	36

Welding Positions F,V,OH,H

Available Diameters and Operating Range in Amps

3/32"	65 - 75
1/8"	80 - 90
5/32"	100 - 120
3/16"	110 - 130

^b – includes incidental cobalt

ALLOYS AT-A-GLANCE

A5.1, CARBON STEEL Covered Arc Welding Electrodes

E6010
E6011
E6012
E6013
E6022
E7014
E7018-1
E7024

A5.2, CARBON AND LOW ALLOY Bare Gas Welding Rods

R45
R60

A5.3, ALUMINUM AND ALUMINUM ALLOY Covered Arc Welding Electrodes

E4043

A5.4, STAINLESS STEEL Covered Arc Welding Electrodes

E308/308L-16
E309/309L-16
E310-16
E312-16
E316/316L-16
317L-16
E320LR-16
E330-16
E347-16
E410-16
E410NiMo-16
E2209-16
E2553-16

A5.5, LOW ALLOY STEEL Covered Arc Welding Electrodes

E8018-B2
E9018-B3
E8018-C1
E8018-C2
E8018-C3
E10018-D2
E9018M
E11018M
E12018M
E7010-P1
E8010-P1

A5.6, COPPER AND COPPER ALLOY Covered Arc Welding Electrodes

ECu (Copper Electrode)
ECuMnNiAl (Nickel-Mang-Aluminum-Bronze)
ECuSn-C (Phos Bronze C)
ECuNi (187)
ECuAl-A2 (Aluminum Bronze)

A5.7, COPPER AND COPPER ALLOY Bare Rods and Electrodes

ERCu (Deox Copper)
ERCuSi-A (Silicon Bronze)
ERCuSn-A (Phos Bronze A)
ERCuAl-A1 (Alum Bronze A1)
ERCuAl-A2 (Alum Bronze A2)

A5.8, BRAZING Filler Metals

RBCuZn-A (Naval Bronze)
RBCuZn-B (Nickel Bronze)
RBCuZn-C (Low Fuming Bronze Bare and Flux Coated)
RBCuZn-D (Nickel Silver)
BCuP-2 (0% Silver)
BCuP-3 (5% Silver)
BCuP-5 (15% Silver)

A5.9, STAINLESS STEEL Bare, Cored and Stranded Electrodes

ER308/308L
ER308LSI
ER309/309L
ER309LSI
ER310
ER312
ER316/316L
ER316LSI
ER317L
ER320LR
ER330
ER347
ER409Nb
ER410
ER410NiMo
ER630
ER2209
ER2553

A5.10, ALUMINUM AND ALUMINUM ALLOY Electrodes and Rods

ER1100
ER4043
ER4047
ER5356

A5.11, NICKEL AND NICKEL ALLOY Covered Arc Welding Electrodes

ENiCrFe-2 (Alloy A)
ENiCrFe-3 (Alloy 182)
ENiCrMo-3 (Alloy 112)
ENiCrMo-4 (Alloy C276)
ENiCrMo-10 (Alloy C22)

A5.12, TUNGSTEN Electrodes for Arc Welding, A5.12

EWP (Pure)
EWCe-2 (2% Ceriated)
EWLa-1 (1.5% Lanthanated)
EWTh-2 (2% Thoriated)
EWZr-0.03 (.03% Zirconiated)

A5.13, SOLID SURFACING Electrodes and Welding Rods, A5.13

ECoCr-A (Cobalt 6)
ECoCr-B (Cobalt 12)

A5.14, NICKEL AND NICKEL ALLOY Bare Electrodes and Welding Rods

ERNiCr-3 (Alloy 82)
ERNiCrMo-3 (Alloy 625)
ERNiCrMo-4 (Alloy C276)
ERNiCrMo-10 (Alloy C22)

A5.15, CAST IRON Welding Electrodes and Rods

ENi-CI (Nickel 99)
ERNi-CI (Nickel 99)
ENiFe-CI (Nickel 55)
ENi55-FCG (Nickel 55 Cored Wire)
ESt (Castarc)

A5.16, TITANIUM AND TITANIUM ALLOY Bare Welding Rods and Electrodes

ERTi-2 (Commercially Pure)
ERTi-5
ERTi-5ELI

A5.18, CARBON STEEL Filler Metals for Gas Shielded Arc Welding

ER70S-2
ER70S-3
ER70S-6
ER70S-7
E70C-6M

A5.19, MAGNESIUM ALLOY Bare Electrodes and Welding Rods

EZA61A
EZA92A

A5.20, CARBON STEEL Flux Cored Arc Welding Electrodes

E71T-1 / 1M
E70T-4
E71T-11
E71T-GS

A5.22, STAINLESS STEEL Flux Cored Arc Welding Electrodes and Flux Cored Rods for GTAW

E308LT1-1/-4
E309LT1-1/-4
E316LT1-1/-4
E308LFC-O
E309LFC-O
E312FC-O
E316LFC-O

A5.24, ZIRCONIUM and ZIRCONIUM ALLOY Bare Welding Electrodes and Rods

ERZr2

A5.28, LOW-ALLOY STEEL Filler Metals for Gas Shielded Arc Welding

ER80S-B2
ER90S-B3
ER80S-B6
ER90S-B9
ER80S-D2
ER100S-1
ER110S-1
ER120S-1

HARDFACING Core, Bare, and Coated Electrodes

55FC-O
58FC-G
HARDCOVER 400
HARDCOVER 410
HARDCOVER 420
HARDCOVER 430
HARDCOVER 440
HARDCOVER 450
HARDCOVER 460
HARDCOVER 470
HARDCOVER 480

TOOL STEEL Filler Metals

A-2
M-2
S-7
H-12
H-13

SPECIALTY ELECTRODES for SMAW and Gouging

1000
3000
4000
5000
6000
7000
8000
AIR CARBON GOUGING ELECTRODES

POINT-OF-PURCHASE DISPLAYS for Filler Metals

TIG & Gas Welding Rod Display
Tungsten Mini-Pack Display
Blue Silver Display
M&R Electrode Display
1lb/2lb MIG Spool Display
5lb Stick Electrode Display