

CONSUMABLE WELDING PRODUCTS CATALOG

Volume D



WELDING
MATERIAL
SALES

www.weldingmaterialsales.com

ALLOYS AT-A-GLANCE

A5.1 CARBON STEEL

Covered Arc Welding Electrodes

E6010
E6011
E6012
E6013
E6022
E7014
E7018-1
E7018AC
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
E317L-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-C3
E10018-D2
E9018M
E11018M
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
ER5554
ER5556

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

EWP (Pure)
EWCe-2 (2% Ceriated)
EWLa-1.5 (1.5% Lanthanated)
EWTh-2 (2% Thoriated)
EWZr-.03 (.03% Zirconiated)
EWG (Multi-Mix)

A5.13 SOLID SURFACING

Electrodes and Welding Rods

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)
ERNiCu-7 (Alloy 60)

A5.15 CAST IRON

Welding Electrodes and Rods

ENi-Cl (Nickel 99)
ERNi-Cl (Nickel 99)
ENiFe-Cl (Nickel 55)
ERNiFe-Cl (Nickel 55)
ENi55FC-G (Nickel 55)
Cored Wire)
ESt (Castarc)

A5.16 TITANIUM AND TITANIUM ALLOY

Bare Welding Rods and Electrodes

ERTi-2 (Commercially Pure)
ERTi-5
ERTi-23

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

ERAZ61A
ERAZ92A

A5.20 CARBON STEEL

Flux Cored Arc Welding Electrodes

E71T-1C/1M
E71T-9C/9M
E70T-4
E71T-11
E71T-GS

A5.21 COBALT

Bare Electrodes and Rods for Surfacing

ERCoCr-A
ERCoCr-E

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
ER80S-B8
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
P-20
S-7
H-12
H-13

SPECIALTY ELECTRODES

Welding and Brazing Alloys

1000
3000
4000
5000
6000
7000
8000
5000T
TRIPLE PLAY

MAINTENANCE AND REPAIR ALLOYS

COMPARISON CHART

Welding, Brazing, Soldering and Metal Working

GOUGING ELECTRODES

Gouging Carbon



ABOUT WMS



Welding Material Sales was founded in 1978 by William C. De Paul, who was involved primarily in the sale and distribution of specialized welding consumables.

In 1984, Mr. De Paul saw a growing need for small spools of welding wire. These spools would later be used with the new MIG welders that were being introduced into the US market via Italy. An all out effort was organized to design the production equipment that would enable the company to produce and sell these spools. Welding Material Sales soon grew to become one of the major suppliers of the MIG small spooled welding wire and further expanded their facility in 1989 to meet the growing demands of the economy (for this product). In 1992 Welding Material Sales expanded again, allowing the company to introduce a new product line of manual electrodes and TIG welding wire. In addition to the new product line, the company developed a Point of Purchase display that would be sold in the welding distributor market for their retail store operations.

In 1998 another 8,500 sq.ft. expansion was needed to meet the companies growing demands. Soon, the company grew to become one of the largest independent suppliers of retail and commercially packed welding consumables. Today the company employs approximately 50 people of whom 80% are production personnel - proudly assembling in the USA!

WMS offers the welding industry's most complete line of welding and brazing filler metals, MIG consumables, and entry level welding equipment. WMS also specializes in small point of purchase packaging with corresponding merchandising display systems. Blue Demon brand products are available for shipment and/or will call from any of our four warehouses across the country. Private label and custom packaging are available to all customers.

Welding Material Sales, Inc. is committed to providing consistent quality, value-based products to its customers at the highest level of customer satisfaction available.



FRANCIS JOSEPH GAGNEPAIN IV



**WELDING
MATERIAL
SALES**

www.weldingmaterialsales.com

Welding Material Sales, Inc.
Your Source for Welding Consumables

**1340 Reed Road, P.O. Box 786
Geneva, Illinois 60134**

**t 630.232.6421
f 888.733.1512**

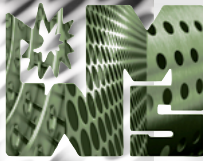


Welding Material Sales
is committed to providing
quality service to all its
customers and prepares
to continue its growth by
maintaining all levels of
customer satisfaction.

**WMS – Your source for
welding consumables.**

LEGAL DISCLAIMER

Welding Material Sales, Inc. 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. All chemical and mechanical properties referenced in this catalog are according to AWS specifications, and are current as of the time of publication. Minimum or maximum values are noted accordingly and are not intended for specification purposes. Welding Material Sales, Inc. assumes no liability for results or damages incurred from the use of any information contained herein, in whole or in part.



ESSENTIAL INFORMATION

SELECTION OF SHIELDING GASES for GMAW with short Circuit transfer

Metal	Shielding Gas	Advantages
Carbon Steel	75% Argon / 25% CO ₂	Less than 1/8" thick; high welding speeds without burn-through; minimum distortion and spatter. More than 1/8" thick: minimum spatter, clean weld appearance; good puddle control in vertical and overhead positions.
	Steel	Offers less spatter, less distortion and better puddle control than 75% Argon / 25% CO ₂
	CO ₂	Deeper penetration; faster welding speeds.
Low Alloy Steel	60-70% Helium / 25-35% Argon / 4-5% CO ₂	Minimum reactivity; excellent toughness; excellent arc stability; wetting characteristics and bead contour, little spatter.
	Steel Extra	Out performs all gases on dirty steel. Excellent on mill scale, painted or oily material. Allows higher travel speed for automated applications.
	Steel	Fair toughness; excellent arc stability; wetting characteristics and bead contour; little spatter.
Stainless Steel	90% Helium / 7.5% Argon/ 2.5% CO ₂	No effect on corrosion resistance; small heat-affected zone; no undercutting; minimum distortion.
	Stain	Smoother arc with lower heat input and less spatter.

SELECTION OF SHIELDING GASES for GMAW with Spray Transfer

Metal	Shielding Gas	Advantages
Aluminum	Argon	0 to 1" thick; best metal transfer and arc stability; least spatter. Also for GMAW-Pulse Spray.
	Alum	1/8 to 1" thick. Better penetration and oxide removal. Much less ozone creation than with straight Argon
	25% Argon/75% Helium	1 to 3" thick: higher heat input than straight Argon; improved fusion characteristics with 5XXX series Al-Mg alloys. Over 3" thick; highest heat input; minimizes porosity.
Magnesium	Argon	Excellent cleaning action.
Carbon Steel/ Low Alloy Steel	Argon/2-5% Oxygen	Improves arc stability; produces a more fluid and controllable weld puddle; good coalescence and bead contour, minimizes undercutting; permits higher speeds than pure Argon. Also for GMAW-Pulse Spray.
	Steel	Low-energy mix ideal for thinner gauge material (up to 1/8" thick).
	CO ₂	High-speed mechanized welding; low cost manual welding.
	Argon/5% CO ₂	For faster freezing puddle with GMAW-Pulse Spray.
Stainless Steel	Argon /1% Oxygen	Improves arc stability; produces a more fluid and controllable weld puddle; good coalescence and bead contour, minimizes undercutting on heavier stainless steels. Also for GMAW-Pulse Spray.
	Argon / 2% Oxygen	Provides better arc stability, coalescence and welding speed than 1% Oxygen mixture for thinner stainless steel material. Also for GMAW-Pulse Spray.
	Stain	Versatile two-component gas for spray and pulse spray.
Copper, Nickel and their Alloys	Argon	Provides good wetting; decreases fluidity of weld metal for thickness up to 1/8".
	Argon/Helium	Higher heat inputs of 50 & 75% Helium mixtures offset high heat dissipation of heavier gauges.
Titanium	Argon	Good arc stability; minimum of weld contamination; inert gas backing is required to prevent air-contamination on back of weld area.

ESSENTIAL INFORMATION



APPROXIMATE RODS PER POUND for 36" TIG/GAS Welding Rods

ALLOY	.035"	.045"	1/16"	3/32"	1/8"	5/32"	3/16"
ER308L	103 EA	62 EA	32 EA	14 EA	8 EA	5 EA	4 EA
ER309L	103 EA	62 EA	31 EA	14 EA	8 EA	5 EA	4 EA
ER312L	103 EA	62 EA	32 EA	14 EA	8 EA	5 EA	4 EA
ER316L	103 EA	62 EA	32 EA	14 EA	8 EA	5 EA	4 EA
ER4043	N/A	170 EA	94 EA	42 EA	23 EA	15 EA	11 EA
ER5356	N/A	170 EA	96 EA	42 EA	24 EA	15 EA	11 EA
ER70S2	103 EA	62 EA	32 EA	14 EA	8 EA	5 EA	4 EA
ER80S-D2	103 EA	62 EA	32 EA	14 EA	7 EA	5 EA	4 EA
ERAZ61A	N/A	N/A	156 EA	56 EA	34 EA	N/A	N/A
ERAZ92A	N/A	N/A	156 EA	56 EA	34 EA	N/A	N/A
ERNi99	N/A	N/A	28 EA	13 EA	7 EA	4 EA	N/A
ERTI-2	176 EA	110 EA	56 EA	25 EA	14 EA	N/A	N/A
RBCuZn-C (LFBB)	N/A	N/A	28 EA	13 EA	7 EA	5 EA	4 EA
RBCuZn-C (LFBFC)	N/A	N/A	43 EA (18")	11 EA	6 EA	5 EA	3 EA
RG45	N/A	N/A	32 EA	14 EA	8 EA	5 EA	4 EA
RG60	N/A	N/A	32 EA	14 EA	8 EA	5 EA	4 EA
SILBRZ	103 EA	62 EA	30 EA	13 EA	7 EA	4 EA	N/A

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#, 4#, 5#, 10#, 11# and 12.5#	Chipboard carton, corrugated carton and plastic clamshell
12" Spools - Masonite, plastic and wire basket	16#, 25#, 30#, 33# and 44#	Corrugated carton
14" Spools and coils	50#, 55# and 60#	Corrugated carton
Drums / Barrels	250#, 400#, 550# and 880#	Standard, recyclable and continuous

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

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

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

AVAILABLE WEIGHT	AVAILABLE PACKAGING
1/2#, 1#, POP	Clear plastic tubes
1/2#, 1#, POP	Plastic clamshells
1/2#, 1# and 5#	Vacuum bags
1/2#, 1#, 2#, 5#, 10# and 50#	Corrugated cartons
5# and 10#	Plastic tubes
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.

**TABLE OF CONTENTS** (by AWS Specification number)**A5.1
CARBON STEEL**

Covered Arc Welding Electrodes

E6010	6
E6011	6
E6012	6
E6013	7
E6022	7
E7014	7
E7018-1	8
E7018AC	8
E7024	8

**A5.2
CARBON AND LOW ALLOY**

Bare Gas Welding Rods

R45	9
R60	9

**A5.3
ALUMINUM AND ALUMINUM ALLOY**

Covered Arc Welding Electrodes

E4043	10
-------------	----

**A5.4
STAINLESS STEEL**

Covered Arc Welding Electrodes

E308/308L-16	11
E309/309L-16	11
E310-16	11
E312-16	12
E316/316L-16	12
317L-16	12
E320LR-16	13
E330-16	13
E347-16	13
E410-16	14
E410NiMo-16	14
E2209-16	14
E2553-16	15

**A5.5
LOW ALLOY STEEL**

Covered Arc Welding Electrodes

E8018-B2	16
E9018-B3	16
E8018-C1	16
E8018-C3	17
E10018-D2	17
E9018M	17
E11018M	18
E7010-P1	18
E8010-P1	18

**A5.6
COPPER AND COPPER ALLOY**

Covered Arc Welding Electrodes

ECu (Copper Electrode)	19
ECuMnNiAl (Nickel-Mang-Aluminum-Bronze)	19
ECuSn-C (Phos Bronze C)	19
ECuNi (187)	20
ECuAl-A2 (Aluminum Bronze)	20

**A5.7
COPPER AND COPPER ALLOY**

Bare Rods and Electrodes

ERCu (Deox Copper)	21
ERCuSi-A (Silicon Bronze)	21
ERCuSn-A (Phos Bronze A)	21
ERCuAl-A1 (Alum Bronze A1)	22
ERCuAl-A2 (Alum Bronze A2)	22

**A5.8
BRAZING**

Filler Metals

RBCuZn-A (Naval Bronze)	23
RBCuZn-B (Nickel Bronze)	23
RBCuZn-C (Low Fuming Bronze Bare and Flux Coated)	23
RBCuZn-D (Nickel Silver)	24
BCuP-2 (0% Silver)	24
BCuP-3 (5% Silver)	24
BCuP-5 (15% Silver)	25

**A5.9
STAINLESS STEEL**

Bare, Cored and Stranded Electrodes

ER308/308L	27
ER308LSI	27
ER309/309L	27
ER309LSI	28
ER310	28
ER312	28
ER316/316L	29
ER316LSI	29
ER317L	29
ER320LR	30
ER330	30
ER347	30
ER409Nb	31
ER410	31
ER410NiMo	31
ER630	32
ER2209	32
ER2553	32

**A5.10
ALUMINUM AND ALUMINUM ALLOY**

Electrodes and Rods

ER1100	33
ER4043	33
ER4047	33
ER5356	34
ER5554	34
ER5556	34

**A5.11
NICKEL AND NICKEL ALLOY**

Covered Arc Welding Electrodes

ENiCrFe-2 (Alloy A)	35
ENiCrFe-3 (Alloy 182)	35
ENiCrMo-3 (Alloy 112)	35
ENiCrMo-4 (Alloy C276)	36
ENiCrMo-10 (Alloy C22)	36

**A5.12
TUNGSTEN**

Electrodes for Arc Welding

EWp (Pure)	38
EWce-2 (2% Ceriated)	38
EWLa-1.5 (1.5% Lanthanated)	38
EWTh-2 (2% Thoriated)	39
EWZr-.03 (.03% Zirconiated)	39
EWG (Multi-Mix)	39

**A5.13
SOLID SURFACING**

Electrodes and Welding Rods

ECoCr-A (Cobalt 6)	40
ECoCr-B (Cobalt 12)	40

**A5.14
NICKEL AND NICKEL ALLOY**

Bare Electrodes and Welding Rods

ERNiCr-3 (Alloy 82)	41
ERNiCrMo-3 (Alloy 625)	41
ERNiCrMo-4 (Alloy C276)	41
ERNiCrMo-10 (Alloy C22)	42
ERNiCu-7 (Alloy 60)	42

**A5.15
CAST IRON**

Welding Electrodes and Rods

ENi-CI (Nickel 99)	43
ERNi-CI (Nickel 99)	43
ENiFe-CI (Nickel 55)	43
ERNiFe-CI (Nickel 55)	44
ENi55FC-G (Nickel 55 Cored Wire)	44
ESt (Castarc)	44



TABLE OF CONTENTS (by AWS Specification number)

A5.16

TITANIUM AND TITANIUM ALLOY

Bare Welding Rods and Electrodes

ERTi-2 (Commercially Pure)	45
ERTi-5	45
ERTi-23	45

A5.18

CARBON STEEL

Filler Metals for Gas Shielded

Arc Welding

ER70S-2	46
ER70S-3	46
ER70S-6	47
ER70S-7	47
E70C-6M	48

A5.19

MAGNESIUM ALLOY

Bare Electrodes and Welding Rods

ERAZ61A	49
ERAZ92A	49

A5.20

CARBON STEEL

Flux Cored Arc Welding Electrodes

E71T-1C/1M	50
E71T-9C/9M	50
E70T-4	50
E71T-11	51
E71T-GS	51

A5.21

COBALT

Bare Electrodes and Rods for Surfacing

ERCoCr-A	52
ERCoCr-E	52

A5.22

STAINLESS STEEL

Flux Cored Arc Welding Electrodes and Flux Cored Rods for GTAW

E308LT1-1/4	53
E309LT1-1/4	53
E316LT1-1/4	53
E308LFC-O	54
E309LFC-O	54
E312FC-O	54
E316LFC-O	55

A5.24

ZIRCONIUM and ZIRCONIUM ALLOY

Bare Welding Electrodes and Rods

ERZr2	56
-------------	----

A5.28

LOW-ALLOY STEEL

Filler Metals for Gas Shielded

Arc Welding

ER80S-B2	57
ER90S-B3	57
ER80S-B6	57
ER80S-B8	58
ER90S-B9	58
ER80S-D2	58
ER100S-1	59
ER110S-1	59
ER120S-1	59

HARDFACING

Core, Bare, and Coated Electrodes

55FC-O	61
58FC-G	61
HARDCOVER 400	61
HARDCOVER 410	62
HARDCOVER 420	62
HARDCOVER 430	62
HARDCOVER 440	63
HARDCOVER 450	63
HARDCOVER 460	63
HARDCOVER 470	64
HARDCOVER 480	64

TOOL STEEL

Filler Metals

A-2	65
M-2	65
P-20	65
S-7	66
H-12	66
H-13	66

SPECIALTY ELECTRODES

Welding and Brazing Alloys

1000	67
3000	67
4000	67
5000	68
6000	68
7000	68
8000	69
5000T	69
TRIPLE PLAY	69

MAINTENANCE & REPAIR ALLOYS

COMPARISON CHART

Welding, Brazing,
Soldering and Metal Working70 & 71

GOUGING ELECTRODES

Gouging Carbon	72
----------------------	----

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, Safety Data Sheets (SDSs), 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
- Light gauge materials

AWS Classification E6022

Welding Current AC - DCEN - DCEP

Typical Wire Chemistry

C	0.04
Mn	1.17
Si	0.15
P	0.013
S	0.013

Typical Mechanical Properties (As Welded)

Tensile Strength,min ksi	60
Yield Strength,ksi	N/A
Elongation in 2" (%)	N/A

Welding Positions F,H-fillet

Available Diameters

1/8" & 5/32"

Operating Range in Amps

1/8"	110 - 150
5/32"	150 - 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. This alloy is moisture resistant.

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

E7018AC

E7018AC is highly recommended for applications using small 208/230V, single phase AC welders. With good operator appeal and excellent striking characteristics, it has a stable arc. A great choice for skip and tack welds. Self-removing slag in most applications.

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/E7018AC

Welding Current AC - DCEP - DCEN

Typical Wire Chemistry

C	0.15
Mn	1.60
Si	0.75
P	0.035
S	0.035
Ni	0.30
Cr	0.20
Mo	0.30
V	0.08
Combined Limit for Mn+Ni+Cr+Mo+V	1.75
Diffusible Hydrogen	8.0

Typical Mechanical Properties (As Welded)

Yield Strength, min ksi	58
Tensile Strength, min ksi	70
Elongation in 2"(%), min	22

Welding Positions F,V,OH,H,V-Up

Available Diameters

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

Operating Range in Amps

3/32"	70 - 110
1/8"	90 - 165
5/32"	125 - 220

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

AWS 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	*N.S.
Tensile Strength, ksi	45
Elongation%, min	*N.S.

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

AWS 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"

**A5.3 | ALUMINUM AND ALUMINUM ALLOY**

Covered Arc Welding Electrodes

E4043

E4043 is a general purpose aluminum electrode for arc welding aluminum alloys. The arc is stable and operates at low temperatures with a minimum of spatter and fuming. The welds are strong, dense, and free of porosity on both production and maintenance applications. E4043 is a great choice when welding heat-treated aluminum parts. This welding rod may also be used in brazing applications.

Typical Applications

- Arc welding aluminums alloyed with copper, silicon, and magnesium.
- Excellent for joining dissimilar grades of aluminum.

AWS Specification

AWS A5.3/A5.3M:1999(R2007)

AWS Classification E4043

Welding Current DCEP

Typical Wire Chemistry

Si	4.5 - 6.0
Cu	0.30
Fe	0.8
Mg	0.05
Mn	0.05
Zn	0.10
Al	REM
Be	0.0008
Ti	0.20

**Typical Mechanical properties
(As Welded)**

Yield Strength, ksi	20
Tensile Strength, ksi	14
Elongation%, min	18

Welding Positions F,H

Available Diameters

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

Operating Range in Amps

5/64"	20 - 60
3/32"	50 - 80
1/8"	70 - 120
5/32"	110 - 150



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 microstructure 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



A5.4 | STAINLESS STEEL

Covered Arc Welding Electrodes

E2553-16

E2553-16 is an electrode which is designed to run on a direct current with reverse polarity as well as alternating current. This electrode is used for the welding of Ferralium 255 and duplex stainless steels which contain approximately 25% chromium. The weld metal deposit of these electrodes has a "duplex" microstructure which consists of an austenite-ferrite matrix. E2553-16 weld deposit combines an increased tensile strength with an improved resistance to pitting, corrosive attack and to stress corrosion cracking.

AWS Specification

AWS A5.4/A5.4M:2006

AWS Classification E2553-16

Welding Current AC - DCEP

Typical Wire Chemistry

C	0.06
Cr	24.0 - 27.0
Ni	6.5 - 8.5
Mo	2.9 - 3.9
Mn	0.5 - 1.5
Si	1.00
P	0.04
S	0.03
N	0.10 - 0.25
Cu	1.5 - 2.5

Typical Mechanical Properties (As Welded)

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

**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	67
Tensile Strength, ksi	80
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-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 E8018-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

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



A5.5 | LOW ALLOY STEEL

Covered Arc Welding Electrodes

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	98 - 110
Tensile Strength, ksi	100
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

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.

Applications

- 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

Bar 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	29
Tensile Strength, ksi	8
Elongation%, min	29

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 bare bronze (LFBB) and Low fuming flux coated (LFBFC) 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
Elongation%, min	25
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 bare flux 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"



A5.8 | BRAZING

Filler Metals

BCuP-5

BCuP-5 is a phos-copper-silver alloy ideal for most copper-to-copper or brass joints where close fit-up does not exist and where agitation and vibration in service are involved. Containing approximately 15% silver, this product has long been the standard in the refrigeration industry. 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 .002" - .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-5

Typical Wire Chemistry

Ag	14.5 - 15.5
P	4.8 - 5.2
OTHER	0.15
Cu	REM

Typical Physical & Mechanical Properties

Melting point	1190°F
Flow point	1475°F
Brazing temperature	1500°F
Color when brazed	Light Copper
Density	4.415 Tr. Oz / Cu in
Specific Gravity	8.378

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
MARTENSITIC	321	18-8 Ti	347
	330		330
	347	18-8 Cb	347
	348	18-8 Cb	
	403		
	410		
	414		410
	416		
FERRITIC	416Se		
	420		430
	431		309
	502		502
	405		410
	430		
	430F		430
	430FSe		
	442		
	446		309



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 MIG - DCEP
TIG - DCEN

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 MIG - DCEP
TIG - DCEN

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 MIG - DCEP
TIG - DCEN

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** MIG - DCEP
TIG - DCEN**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** MIG - DCEP
TIG - DCEN**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** MIG - DCEP
TIG - DCEN**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 .08% 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 MIG - DCEP
TIG - DCEN

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 MIG - DCEP
TIG - DCEN

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 MIG - DCEP
TIG - DCEN

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** MIG - DCEP
TIG - DCEN**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** MIG - DCEP
TIG - DCEN**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** MIG - DCEP
TIG - DCEN**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 niobium 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 MIG - DCEP
TIG - DCEN

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 MIG - DCEP
TIG - DCEN

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 MIG - DCEP
TIG - DCEN

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

MIG - DCEP
TIG - DCEN

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

MIG - DCEP
TIG - DCEN

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

MIG - DCEP
TIG - DCEN

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 - GMAW
AC - GTAW

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 for welders. ER4043 can be used to weld various grades of aluminum.

Applications

- Welding filler wire
- Spray and flame metalizing wire

AWS Specification

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

AWS Classification ER4043

Welding Current DCEP - GMAW
AC - GTAW

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 - GMAW
AC - GTAW

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"

**A5.10 | ALUMINUM AND ALUMINUM ALLOY****Electrodes and Rods****ER5356**

ER5356 is a general-purpose type aluminum alloy which is typically chosen for its relatively high shear strength. In addition, it also offers excellent corrosion resistance when exposed to salt water. ER5356 should be considered for welding 5000 series aluminum base metals.

Applications

- Welding filler wire

AWS Specification

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

AWS Classification ER5356

Welding Current DCEP - GMAW
AC - GTAW

Typical Wire Chemistry

Si	0.25
Fe	0.40
Cu	0.10
Mn	0.05 - 0.20
Mg	4.5 - 5.5
Cr	0.05 - 0.20
Zn	0.10
Ti	0.06 - 0.20
OTHER	0.15
Al	REM

Typical Properties

Melting range	1060 - 1175°F
Conductivity	29% IACS (- O), 27% IACS (- H18)
Density	0.096 lbs/cu in
Anodized color	White
Tensile Strength,ksi	38

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"

ER5554

ER5554 is an aluminum filler typically used on 5454 and similar base metal that may be used in chemical tanks and other storage where 150°F may be found.

Applications

- Welding filler wire

AWS Specification

AWS A5.10/A5.10M:1999

AWS Classification ER5554

Welding Current DCEP - GMAW
AC - GTAW

Typical Wire Chemistry

Si	0.25
Fe	0.40
Cu	0.10
Mn	0.50 - 1.0
Mg	2.4 - 3.0
Cr	0.05 - 0.20
Zn	0.25
Ti	0.05 - 0.20
OTHER	0.05
Al	REM

Typical Properties

Melting range	1155 - 1195°F
Conductivity	29% IACS (- O), 27% IACS (- H18)
Density	0.094 lbs/cu in
Anodized color	White
Tensile Strength,ksi	32 - 35

Welding Positions F,V,OH,H

Available Diameters GMAW and suggested Operating Range in Amps

.030"	60 - 175
.035"	70 - 185
3/64"	125 - 260
1/16"	170 - 300
3/32"	275 - 400

Available Diameters GTAW

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

ER5556

ER5556 is an aluminum filler with higher levels of magnesium and zinc than 5356 which will yield increased crack resistance, tensile strength and good ductility. Commonly used on 5154, 5454 and 6456.

Applications

- Welding filler wire

AWS Specification

AWS A5.10/A5.10M:1999

AWS Classification ER5556

Welding Current DCEP - GMAW
AC - GTAW

Typical Wire Chemistry

Si	0.25
Fe	0.40
Cu	0.10
Mn	0.05 - 1.0
Mg	4.7 - 5.5
Cr	0.05 - 0.20
Zn	0.25
Ti	0.05 - 0.20
OTHER	0.05
Al	REM

Typical Properties

Melting range	1065 - 1175°F
Conductivity	29% IACS (- O), 27% IACS (- H18)
Density	0.096 lbs/cu in
Anodized color	White
Tensile Strength,ksi	46

Welding Positions F,V,OH,H

Available Diameters GMAW and suggested Operating Range in Amps

.030"	60 - 175
.035"	70 - 185
3/64"	125 - 260
1/16"	170 - 300
3/32"	275 - 400

Available Diameters GTAW

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



A5.11 | NICKEL AND NICKEL ALLOY

Covered Arc Welding Electrodes

ENiCrFe-2

Alloy A (ENiCrFe-2) electrodes are used for welding of nickel-chromium-iron 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

**A5.12 | TUNGSTEN**

Electrodes for Arc Welding

RED	EWTh-2	GOOD TOUGHNESS DC APPLICATIONS DOESN'T MAINTAIN BALL FOR AC	AC:7 DC:10	AC:9 DC:10	THORIATED
GREEN	EWP	BALLS EASILY FOR AC SPITS AT HIGH CURRENTS	AC:7 DC:N/R	AC:N/R DC:N/R	NONE
BLUE	EWL _a -2	GOOD FOR ALL PURPOSE AC & DC WELDING APPLICATIONS	AC:8 AC:8	AC:8 DC:8	LANTHANATED
BROWN	EWZr-1	AC WELDING ONLY GOOD TOUGHNESS	AC:10 DC:N/R	AC:N/R DC:N/R	ZIRCONIATED
PINK	EWG	BEST SUITED FOR ALL PURPOSE AC & DC WELDING APPLICATIONS	AC:8 DC:8	AC:8 DC:8	CERIATED LANTHANATED VITRIUM OTHERS
WHITE	EWZr-8	AC WELDING ONLY GOOD TOUGHNESS	AC:10 DC:N/R	AC:N/R DC:N/R	ZIRCONIATED
YELLOW	EWTh-1	DC-LOW AMPERAGE APPLICATIONS	AC:6 DC:9	AC:6 DC:9	THORIATED
GOLD	EWL _a -1.5	BEST SUITED FOR DC APPLICATIONS	AC:8 DC:7	AC:8 DC:7	LANTHANATED
GRAY	EWCe-2	GOOD FOR ALL PURPOSE TUNGSTEN FOR BOTH AC/DC	AC:8 DC:8	AC:8 DC:8	CERIATED
BLACK	EWL _a -1	DC LOW AMPERAGE APPLICATIONS	AC:6 DC:9	AC:6 DC:9	LANTHANATED

N/R: Not Recommended

AC: Aluminum, Magnesium

DC: Steels, Stainless, Inconel, Titanium. Most other metals.

**A5.12 | TUNGSTEN**

Electrodes for Arc Welding

EWP

EWP (Pure) are unalloyed tungsten electrodes (99.5% tungsten minimum) and are non-radioactive. Their current-carrying capacity is lower than those of other tungsten electrodes. They provide good stability when used with AC, either balanced wave or continuously high frequency stabilized. They may be used with DC and also with either Ar or He, or a combination of both, as a shielding gas. They maintain a clean, balled end, which is preferred for aluminum and magnesium welding. These electrodes have reasonably good resistance to contamination of the weld metal by the electrode, although the oxide containing electrodes are superior in this respect. EWP electrodes are generally used on less critical applications, except for welding Al and Mg. The lower cost EWP electrodes can be used for less critical applications where some tungsten contamination of welds is acceptable.

AWS Specification

AWS A5.12M/A5.12:2009

AWS Classification EWP**Color Code** Green**Available diameters**

.020", .040", 1/16", 3/32", 1/8", 5/32", 3/16" & 1/4"

EWCe-2

EWCe-2 (2% Ceriated) electrodes are tungsten electrodes containing about 2% cerium oxide, referred to as ceria. The EWCe-2 electrodes were first introduced into the US market in 1987. Several other grades of this type of electrode are commercially practical, including electrodes containing 1% ceria, but only one grade, EWCe-2, has been incorporated in this specification as having commercial significance. The advantages of tungsten electrodes containing ceria, compared to pure tungsten, include increased ease of starting, improved arc stability, and reduced rate of vaporization or burn-off. Unlike thoria, **ceria is not a radioactive material.** These advantages increase with increased ceria content. These electrodes operate successfully with AC or DC, either polarity.

AWS Specification

AWS A5.12/A5.12M:2009

AWS Classification EWCe-2**Color Code** Gray**Available diameters**

.020", .040", 1/16", 3/32", 1/8", 5/32", 3/16" & 1/4"

EWLα-1.5

EWLα-1.5 designates a tungsten electrode containing 1.3-1.5 wt-% of dispersed lanthanum oxide (La₂O₃) for enhanced arc starting and stability, reduced tip erosion rate, and extended operating current range. These electrodes can be used as non-radioactive substitutes for 2% thoriated tungsten as the operating characteristics are very similar. Lanthanated tungsten can be used for both DC and AC applications.

AWS Specification

AWS A5.12/A5.12M:2009

AWS Classification EWLα-1.5**Color Code** Gold**Available diameters**

.020", .040", 1/16", 3/32", 1/8", 5/32", 3/16" & 1/4"



A5.12 | TUNGSTEN

Electrodes for Arc Welding

EWTh-2

The higher thoria content in the EWTh-2 electrode causes the operating characteristic improvements to be more pronounced than in the lower thoria content EWTh-1. The additional thoria also provides about 20 percent higher current-carrying capacity, longer life and resistance to contamination of the weld. Should it be desired to use these electrodes for AC welding, then balling can be accomplished by briefly, and carefully, welding with DC electrode positive prior to welding with AC. During AC welding, the balled end does not melt and so emission is not as good as from a liquid ball on an EWP electrode. Note: If electrode grinding is used special precautions relative to ventilation should always be considered to avoid ingestion of dust.

AWS Specification

A5.12M/A5.12:2009

AWS Classification EWTh-2

Color Code Red

Available diameters

.020", .040", 1/16", 3/32", 1/8", 5/32", 3/16" & 1/4"

EWZr-.03

.03% zirconiated tungsten electrodes are used for radiographic-quality welding, where tungsten contamination must be minimized. Balls-up easily in AC applications, good arc starting and current capacity. This product is non-radioactive.

AWS Specification

A5.12M/A5.12:2009

AWS Classification EWZr-.03

Color Code Brown

Available diameters

.020", .040", 1/16", 3/32", 1/8", 5/32", 3/16" & 1/4"

EWG (Multi-Mix)

Multi-Mix has been proven to dramatically increase weld quality and service life by offering unsurpassed stability and consistency in every weld. It is non thoriated, non radioactive, and non carcinogenic. It is a proprietary product containing multiple additives of rare earth oxides. Each additive complements others to enhance the welding performance. Being non radioactive, it is a popular replacement to thoriated tungsten. Multi-Mix tungsten electrodes can be used at all current ranges on both DC and AC tig.

AWS Specification

A5.12M/A5.12:2009

AWS Classification EWG

Color Code Pink

Available diameters

.040", 1/16", 3/32", 1/8"

**A5.13 | SOLID SURFACING**

Electrodes and Welding Rods

ECoCr-A

Cobalt Alloy 6 (ECoCr-A) is the most widely used of the wear resistant cobalt based alloys and exhibits good all-round performance. It is regarded as the industry standard for general-purpose wear resistance applications, has excellent resistance to many forms of mechanical and chemical degradation over a wide temperature range, and retains a reasonable level of hardness up to 500°C (930°F). It also has good resistance to impact and cavitation erosion. Cobalt Alloy 6 is ideally suited to a variety of hardfacing processes and can be turned with carbide tooling. Examples include valve seats and gates; pump shafts and bearings, erosion shields and rolling couples. It is often used self-mated.

AWS Specification

AWS A5.13/A5.13M:2010

AWS Classification ECoCr-A**Typical Chemistry**

C	0.7 - 1.4
Mn	2.0
Si	2.0
Cr	25 - 32
Ni	3.0
Mo	1.0
Fe	5.0
W	3.0 - 6.0
Co	REM
OTHER	1.0

Typical Properties

Yield Strength, ksi	101
Tensile Strength, ksi	123
Elongation%, min	<1
Hardness	36 - 45 HRC
Density	0.305 lbs/cu. in.
Melting Range	2340 - 2570°F

Available Diameters

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

ECoCr-B

Cobalt Alloy 12 (ECoCr-B) could be considered an intermediate alloy between Cobalt Alloy 6 and Cobalt Alloy 1. It contains a higher fraction of hard, brittle carbides than Cobalt Alloy 6, and has increased resistance to low-angle erosion, abrasion, and severe sliding wear while retaining reasonable impact and cavitation resistance. Cobalt Alloy 12 is often used self-mated or running against Cobalt Alloy 6 or 1. The higher tungsten content provides better high-temperature properties compared to Cobalt Alloy 6, and it can be used at temperatures up to about 700°C. Cobalt Alloy 12 is typically used for cutting tools that need to withstand abrasion, heat and corrosion. Examples include industrial knives for cutting carpets, plastics, paper and synthetic fibers; and saw tips in the timber industry. It is also used for control plates in the beverage industry, pump vanes, bearing bushes and narrow-neck glass mold plungers; and for hardfacing of engine valves, pinch rollers in the metal-processing industries, and rotor blade edges.

AWS Specification

AWS A5.13/A5.13M:2010

AWS Classification ECoCr-B**Typical Chemistry**

C	1.0 - 1.7
Mn	2.0
Si	2.0
Cr	25 - 32
Ni	3.0
Mo	1.0
Fe	5.0
W	7.0 - 9.5
Co	REM
OTHER	1.0

Typical Properties

Yield Strength, ksi	84
Tensile Strength, ksi	107
Elongation%, min	<1
Hardness	45-51 HRC
Density	0.308 lbs/cu. in.
Melting Range	2192 - 2489°F

Available Diameters

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



A5.14 | NICKEL AND NICKEL ALLOY

Bare Electrodes and Welding Rods

ERNiCr-3

Nickel Alloy 82 (ERNiCr-3) is used for MIG, TIG, and SAW welding of base metals such as ASTM B163, B166, B167 and B168. It is also used for alloys which have UNS Number N06600. It is one of the most used nickel alloys whose applications range from cryogenic to high temperatures. This filler metal can also be used for dissimilar welding applications between various nickel alloys and stainless or carbon steels, as well as for overlaying.

AWS Specification

AWS A5.14/A5.14M:2009

AWS Classification ERNiCr-3

Welding Current DCEP

Typical Wire Chemistry

C	0.10
Mn	2.5 - 3.5
Fe	3.0
P	0.03
S	0.015
Si	0.50
Cu	0.50
Ni ^b	67.0 min
Co	d
Ti	0.75
Cr	18.0 - 22.0
Nb(Cb)plus Ta	2.0 - 3.0
OTHER	0.50

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	52
Tensile Strength, ksi	80
Elongation%, min	38

Welding Positions F,V,OH,H

Available Diameters MIG and suggested operating range in Amps

.035"	150 - 190
.045"	180 - 220
1/16"	200 - 250

Available Diameters TIG and suggested Operating Range in Amps

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

^b – includes incidental cobalt

^d – is 0.12 maximum when specified by purchaser

ERNiCrMo-3

Nickel Alloy 625 (ERNiCrMo-3) is used for MIG, TIG, and SAW welding of nickel-chrome-molybdenum alloys. This very versatile filler metal can be used for welding of dissimilar joints between nickel-chrome-molybdenum alloys and stainless or carbon or low alloy steels. It can also be used for cladding as well as for spraying applications. Nickel Alloy 625 with low iron is preferred in applications where dilution of iron must be controlled to a minimum. The high alloy content of Nickel Alloy 625 enables it to withstand highly corrosive environments. The combination of nickel and chromium provides resistance to reducing conditions. With the addition of molybdenum in this alloy, it also offers resistance to stress corrosion cracking, pitting, and crevice corrosion.

AWS Specification

AWS A5.14/A5.14M:2009

AWS Classification ERNiCrMo-3

Welding Current DCEP

Typical Wire Chemistry

C	0.10
Mn	0.50
Fe	5.0
P	0.02
S	0.015
Si	0.50
Cu	0.50
Ni ^b	58.0 min
Al	0.40
Ti	0.40
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	85
Tensile Strength, ksi	110
Elongation%, min	27

Welding Positions F,V,OH,H

Available Diameters MIG and suggested Operating Range in Amps

.035"	150 - 190
.045"	180 - 220
1/16"	200 - 250

Available Diameters TIG and suggested Operating Range in Amps

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

ERNiCrMo-4

Nickel Alloy C276 (ERNiCrMo-4) is used for welding materials of similar chemical composition (UNS Number N10276) as well as dissimilar materials of nickel base alloys, steels and stainless steels. This alloy can also be used for cladding steel with nickel-chrome-molybdenum weld metal. The higher molybdenum content provides great resistance to stress corrosion cracking, pitting, and crevice corrosion.

AWS Specification

AWS A5.14/A5.14M:2009

AWS Classification ERNiCrMo-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	0.08
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	81
Tensile Strength, ksi	100
Elongation%, min	40

Welding Positions F,V,OH,H

Available Diameters MIG and suggested Operating Range in Amps

.035"	150 - 190
.045"	180 - 220
1/16"	200 - 250

Available Diameters TIG and suggested Operating Range in Amps

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

^b – includes incidental cobalt

**A5.14 | NICKEL AND NICKEL ALLOY****Bare Electrodes and Welding Rods****ERNiCrMo-10**

Nickel Alloy C22 (ERNiCrMo-10) is used for welding materials of similar chemical composition as well as dissimilar joints between nickel-chrome-molybdenum alloys and stainless or carbon or low alloy steels. The high molybdenum content provides great resistance to stress corrosion cracking, pitting, and crevice corrosion. This alloy is suitable for a variety of chemical process environments.

AWS Specification

AWS A5.14/A5.14M:2009

AWS Classification ERNiCrMo-10**Welding Current** DCEP**Typical Wire Chemistry**

C	0.015
Mn	0.50
Fe	2.0 - 6.0
P	0.02
S	0.010
Si	0.08
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	82
Tensile Strength, ksi	100
Elongation%, min	38

Welding Positions F,V,OH,H**Available Diameters MIG and suggested Operating Range in Amps**

.035"	150 - 190
.045"	180 - 220
1/16"	200 - 250

Available Diameters TIG and suggested Operating Range in Amps

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

^b – includes incidental cobalt**ERNiCu-7**

Nickel Alloy 60 is used for MIG, TIG, and SAW welding of copper alloys. It is used for joining base materials such as UNS number NO4400, NO4405 and NO5500. This alloy can be used for dissimilar welding applications using various nickel-copper alloys to nickel 200 and to copper-nickel alloys. This can be used for MIG overlay on steel after a first layer with nickel 208.

Applications

- Marine

AWS Specification

AWS A5.14/A5.14M:2009

AWS Classification ERNiCu-7**Welding Current** DCEP**Typical Wire Chemistry**

C	0.03
Mn	0.50
Fe	1.0
P	0.02
S	0.015
Si	0.30
Cu	0.30
Ni ^b	REM
Co	1.0
Cr	36.0 - 39.0
Mo	0.50
Ti	0.25 - 0.75
Nb(Cb)+Ta	0.25 - 1.00
OTHER	0.50
Al	0.75 - 1.20

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	*N.S.
Tensile Strength, ksi	70
Elongation%, min	*N.S.

Welding Positions F,V,OH,H**Available Diameters MIG and suggested Operating Range in Amps**

.035"	150 - 190
.045"	180 - 220
1/16"	200 - 250

Available Diameters TIG and suggested Operating Range in Amps

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

^b – includes incidental cobalt



A5.15 | CAST IRON

Welding Electrodes and Rods

ENi-CI

Nickel 99 (ENi-CI) welding electrode is designed for welding gray iron castings to themselves as well as joining them to mild or stainless steels. It is also used to repair castings. With the high nickel content, the welds are easily machined. A preheat and interpass temperature of not less than 350°F is recommended during welding.

AWS Specification

AWS A5.15-90 (R2006)

AWS Classification ENi-CI

Welding Current DCEP

Typical Wire Chemistry

C	2.0
Mn	2.5
Si	4.0
S	0.03
Fe	8.0
Ni	85 min
Cu	2.5
Al	1.0
OTHER	1.0

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	38 - 60
Tensile Strength, ksi	40 - 65
Elongation%, min	3 - 6

Welding Positions F,V,OH,H

Available Diameters and Operating Range in Amps

3/32"	85
1/8"	85 - 110
5/32"	110 - 140
3/16"	120 - 160

ERNi-CI

ERNi-CI (Nickel Alloy 99) is used for TIG and MIG welding of cast iron. This wire is extensively used to repair gray iron castings. It can also be used for overlay and build-up applications. Dilution from the casting influences the mechanical properties of the metal. Due to the high nickel content, the welds are readily machinable. A preheat and interpass temperature of 350°F min is recommended during welding.

AWS Specification

AWS A5.15-90 (R2006)

AWS Classification ERNi-CI

Welding Current DCEP

Typical Wire Chemistry

C	1.0
Mn	2.5
Si	0.75
S	0.03
Fe	4.0
Ni	90 min
Cu	4.0
OTHER	1.0

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	36
Tensile Strength, ksi	66
Elongation%, min	40

Welding Positions F,V,OH,H

Available Diameters MIG and suggested Operating Range in Amps

.035"	150 - 190
.045"	180 - 220
1/16"	200 - 250

Available Diameters TIG and suggested Operating Range in Amps

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

ENiFe-CI

Nickel 55 (ENiFe-CI) welding electrode is designed for welding gray iron castings to themselves as well as joining them to mild steel. It can also be used to repair castings. The welds are moderately hard and require carbide tipped tools for post weld machining. A preheat and interpass temperature of not less than 350°F is recommended during welding.

AWS Specification

AWS A5.15-90 (R2006)

AWS Classification ENiFe-CI

Welding Current DCEP

Typical Wire Chemistry

C	2.0
Mn	2.5
Si	4.0
S	0.03
Fe	REM
Ni	45 - 60
Cu	2.5
Al	1.0
OTHER	1.0

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	43 - 63
Tensile Strength, ksi	58 - 84
Elongation%, min	6 - 8

Welding Positions F,V,OH,H

Available Diameters and Operating Range in Amps

3/32"	70 - 90
1/8"	100 - 135
5/32"	130 - 180
3/16"	190 - 220

**A5.15 | CAST IRON****Welding Electrodes and Rods****ERNiFe-Cl**

ERNiFe-Cl is a filler metal used for TIG and MIG welding of cast iron. It is also used to repair the castings. The weld metal of ERNi-55 is harder than that of ERNi-99. A preheat interpass temperature of 350°F minimum is recommended during welding, without which the weld and heat affected zones could develop cracks.

AWS Specification *N.S.

AWS Classification ERNiFe-Cl

Typical Wire Chemistry

C	0.05
Mn	0.25
Si	0.15
Fe	0.75
Ni	0.5 - 2.5

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	62
Tensile Strength, ksi	89
Elongation%, min	35

Available Diameters MIG and suggested Operating Range in Amps

.035"	160 - 180
.045"	180 - 220
1.16"	210 - 250

Available Diameters TIG and suggested Operating Range in Amps

.035"	160 - 180
.045"	180 - 220
1.16"	210 - 250

Recommended shielding gas

75% Argon + 25% Helium

or

50% Argon + 50% Helium

Ni55FC-G

Ni55FC-G is a composite metal cored wire for repair and joining of cast iron materials. The deposit, which is approximately 53% iron and 45% nickel, provides an excellent match for the coefficient of expansion exhibited by cast irons. Cracking is minimized because thermal stresses caused by the heat of welding are minimized. The light slag is easily removed enhancing visual weld inspection. The fact that this is a continuous electrode will improve the operating factor and minimize unnecessary stops and starts. This electrode can replace covered electrodes such as AWS ENiFe-Cl or ENiFe-Cl-A. It may be used for repair welds or for joining various types of cast irons. Cast irons may be welded to steel and other ferrous and non-ferrous materials with this product. The machinability of the weld deposit is comparable to the matching covered electrode.

AWS Class none

Welding Current DCEP

Typical Wire Chemistry

C	2.0
Mn	2.5
Si	4.0
S	0.03
Fe	REM
Ni	45 - 60
Cu	2.5
Al	1.0 - 3.0
OTHER	1.0

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	43 - 63
Tensile Strength, ksi	58
Brinell Hardness BHN	165 - 218
Elongation%, min	4 - 12

Welding Positions F,V,OH,H

Available Diameters and suggested Operating Range in Amps

.035"	160
.045"	230
1/16"	300
3/32"	350

Recommended shielding gas

98% Argon, 2% Oxygen

ESi

Castarc (ESi) is a nickel free cast iron problem solving electrode. It seals in porosity generating contaminants prior to finish welding with nickels. This is a great choice for non-machinable welds on machine bases, furnace grates and exhaust manifolds. This alloy has a perfect color match to cast iron.

AWS Specification A5.15

AWS Classification ESi

Welding Current DCEP

Typical Wire Chemistry

C	0.15
Mn	0.60
Si	0.15
S	0.04
P	0.04
Fe	REM

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	50
Tensile Strength, ksi	62
Elongation%, min	20
Brinell Hardness	250 - 400

Welding Positions F,V,OH,H

Available Diameters and suggested Operating Range in Amps

3/32"	45 - 85
1/8"	70 - 125
5/32"	95 - 150



A5.16 | TITANIUM AND TITANIUM ALLOY

Bare Welding Rods and Electrodes

ERTi-2

ERTi-2 (Commercially Pure) Titanium is a TIG, MIG and submerged arc filler metal used for welding commercial pure titanium alloys commonly found in applications requiring high temperature resistance and resistance to chemical reagents. Although there are four grades of Commercial Pure Titanium filler metals, C.P. Grade 2 (ERTi-2) is the most popular because of its good balance of strength, formability and weldability. The most common applications of ERTi-2 are the aircraft industry, where tensile strength and weight ratios are very critical. Other uses would include cryogenic and petrochemical applications such as chemical process heat exchangers, pressure vessels and piping systems, pulp bleaching systems, electro chemical and chemical storage tanks.

AWS Specification

AWS A5.16/A5.16M:2007

AWS Classification ERTi-2

Welding Current DCEP

Typical Wire Chemistry

C	0.03
O	0.08 - 0.16
H	0.008
N	0.015
Fe	0.12
Ti	REM

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	40
Tensile Strength, ksi	50
Elongation%, min	20

Available Diameters and suggested Operating Range in Amps

1/16"	180
3/32"	190
1/8"	205

ERTi-5

ERTi-5 (formerly 6AL/4V) is a TIG, MIG and submerged arc filler metal used for welding 6% Aluminum – 4% Vanadium alloys. The weld deposits of this alloy exhibit high fatigue strength, toughness, ductility and are heat treatable. Widely used in the cryogenic, petrochemical and aircraft industry. Aircraft uses would include the airframes; turbine engine parts such as the blades, discs, wheels and spacer rings. Other applications would include industrial fans, pressure vessels, compressor blades and rocket motor cases.

AWS Specification

AWS A5.16/A5.16M:2007

AWS Classification ERTi-5

Welding Current DCEP

Typical Wire Chemistry

C	0.05
O	0.12 - 0.20
H	0.015
N	0.03
Fe	0.22
Al	5.5 - 6.75
V	3.5 - 4.5
Ti	REM

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	120
Tensile Strength, ksi	130
Elongation%, min	10

Available Diameters and suggested Operating Range in Amps

1/16"	180
3/32"	190
1/8"	205

ERTi-23

ERTi-23 (formerly ERTi-5ELI) Grade 23 titanium is a higher-purity ('extra-low interstitial') version of Grade 5, with lower specified limits on iron and the interstitial elements C and O. It is an alpha-beta alloy. It is used in many high strength industrial applications such as shafts where very high strength and better toughness are desired. This grade is often specified for marine and offshore energy production components that are exposed to low temperature seawater due to higher fracture toughness values.

AWS Specification

AWS A5.16/A5.16M:2007

AWS Classification ERTi-23

Welding Current GTAW - DCEN
with EWth-2 truncated conical tip

Welding Current GMAW - DCEP
Short Circuit

Typical Wire Chemistry

C	0.03
O	0.03 - 0.11
H	0.005
N	0.012
Fe	0.20
Al	5.5 - 6.5
V	3.5 - 4.5

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	110
Tensile Strength, ksi	120

Available Diameters TIG and suggested Operating Range in Amps

1/16"	100 - 185
3/32"	150 - 250
1/8"	200 - 375

Recommended shielding gas
Argon (cfh)

Available Diameters MIG and suggested Operating Range in Amps

.030"	100 - 195
.035"	165 - 285
.045"	250 - 360

Recommended shielding gas
Ar & Ar + He (cfh)

**A5.18 | CARBON STEEL**

Filler Metals for Gas Shielded Arc Welding

ER70S-2

ER70S-2 is a premium MIG & TIG wire for welding on all grades of mild and carbon steels, producing quality welds with minimal porosity. It is a triple deoxidized wire (Zirconium, Titanium, and Aluminum) making it an excellent choice for welding over rust and mill scale. No flux is required with this product. This wire is available spooled or in cut-length form.

Typical Applications

- Pipes and offshore drilling rigs
- Structural steel work

AWS Specification

AWS A5.18/A5.18M:2007

AWS Classification ER70S-2

Welding Current for MIG process

DCEP (Electrode Positive, Reverse Polarity)

Welding Current for TIG process

DCEN

Typical Wire Chemistry

C	0.07
Mn	0.90 - 1.40
Si	0.40 - 0.70
P	0.025
S	0.035
Ni	0.15
Cr	0.15
Mo	0.15
V	0.03
Cu	0.50
Ti	0.05 - 0.15
Zr	0.02 - 0.12
Al	0.05 - 0.15

Typical Mechanical Properties (As Welded)

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

Welding Positions F,V,OH,H

Available Diameters MIG and suggested Operating Range in Amps

.023"	35 - 70
.030"	50 - 100
.035"	50 - 150
.045"	50 - 350

Available Diameters TIG

.035", .045", 1/16", 3/32", 1/8" & 5/32"

ER70S-3

ER70S-3 is a general purpose MIG wire suitable for many carbon steel welding applications. It is a silicon and manganese deoxidized wire making it excellent for general fabrication. This product requires a shielding gas.

Typical Applications

- General fabrication
- Metal furniture
- Sheet metal
- Ornamental iron fabrication
- Farm equipment
- Auto frames

AWS Specification

AWS A5.18/A5.18M:2007

AWS Classification ER70S-3

Welding Current for MIG process

DCEP (Electrode Positive, Reverse Polarity)

Welding Current for TIG process

DCEN

Typical Wire Chemistry with 100% CO₂ shielding gas

C	0.06 - 0.15
Mn	0.90 - 1.40
Si	0.45 - 0.75
P	0.025
S	0.035
Ni	0.15
Cr	0.15
Mo	0.15
V	0.03
Cu	0.50

Typical Wire Chemistry with Argon + 20% CO₂ shielding gas

C	0.08
Si	0.45
Mn	1.06
P	0.014
S	0.01

Typical Mechanical Properties (As Welded) with 100% CO₂ shielding gas

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

Typical Mechanical Properties (As Welded) with Argon + 20% CO₂ shielding gas

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

Welding Positions F,V,OH,H

Available Diameters MIG and suggested Operating Range in Amps

.023"	35 - 70
.030"	50 - 120
.035"	50 - 140
.045"	70 - 350
1/16"	120 - 450

Available Diameters TIG

.035", .045", 1/16", 3/32", 1/8" & 5/32"



A5.18 | CARBON STEEL

Filler Metals for Gas Shielded Arc Welding

ER70S-6

ER70S-6 is a mild steel welding wire that contains higher levels of manganese and silicon than other standard grades of MIG wire to produce high quality welds when used on dirty, oily, or rusty steel. The high silicon content increases the fluidity of the weld pool, thus creating a smoother bead appearance and resulting in minimal post-weld grinding. This wire is engineered to provide porosity-free, x-ray quality welds at the highest tensile strength (as welded) of all the plain carbon steel wires. This product requires a shielding gas: CO₂ and/or CO₂ mix.

Typical Applications

- General shop applications with poor fit-up or rusty, oily plates
- Steel castings or forging salvage
- Home projects
- Sheet metal
- Tanks
- Construction work

AWS Specification

AWS A5.18/A5.18M:2005

AWS Classification ER70S-6

Welding Current for MIG process

DCEP (Electrode Positive, Reverse Polarity)

Welding Current for TIG process

DCEN

Typical Wire Chemistry as welded with 100% CO₂ shielding gas

C	0.06 - 0.15
Mn	1.40 - 1.85
Si	0.80 - 1.15
P	0.025
S	0.035
Ni	0.15
Cr	0.15
Mo	0.15
V	0.03
Cu	0.50

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	58
Tensile Strength, ksi	70
Elongation, % min	22
Impact Value (J) @ -20°C	102
Impact Value (J) @ -29°C	89
Impact Value (J) @ -40°C	70

Welding Positions F,V,OH,H

Available diameters and suggested Operating Range in Amps

.023"	30 - 100
.030"	40 - 140
.035"	50 - 200
.045"	50 - 350
1/16"	120 - 550

Available Diameters gas and TIG rod

.035", .045", 1/16", 3/32", 1/8" & 5/32"

ER70S-7

ER70S-7 is a general purpose MIG wire suitable for many carbon steel welding applications but with substantially greater manganese content than ER70S-3 welding alloy. The higher manganese provides slightly better wetting and weld appearance with slightly higher tensile and yield strengths as well. These combined properties permit increased speed when compared to S-3 product. Under equivalent welding conditions, ER70S-7 produces a weld hardness lower than ER70S-6 but higher than ER70S-3.

Typical Applications

- High tensile strength steels for automobiles
- Rolling stock
- Electrical appliances
- Machinery
- Air conditioners
- Light gauge steels
- Pipes
- Steel frames

AWS Specification

AWS A5.18/A5.18M:2005

AWS Classification ER70S-7

Welding Current for MIG process

DCEP (Electrode Positive, Reverse Polarity)

Welding Current for TIG process

DCEN

Typical Wire Chemistry with Argon + 2% Oxygen

C	0.07 - 0.15
Mn	1.50 - 2.00
Si	0.50 - 0.80
P	0.025
S	0.035
Ni	0.15
Cr	0.15
Mo	0.15
V	0.03
Cu	0.50

Typical Wire Chemistry with Argon + 20% CO₂ shielding gas

C	0.09
Si	0.75
Mn	1.67
P	0.015
S	0.01

Typical Mechanical Properties (As Welded) with Argon + 2% Oxygen shielding gas

Yield Strength, ksi	68
Tensile Strength, ksi	82
Elongation%, min	27

Typical Mechanical Properties (As Welded) with Argon + 20% CO₂ shielding gas

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

Welding Positions F,V,OH,H

Available Diameters MIG and suggested Operating Range in Amps

.023"	35 - 70
.030"	50 - 100
.035"	100 - 150
.045"	150 - 200
1/16"	250 - 500

Available Diameters TIG

.035", .045", 1/16", 3/32", 1/8" & 5/32"

**A5.18 | CARBON STEEL**

Filler Metals for Gas Shielded Arc Welding

E70C-6M

E70C-6M metal-cored welding wire combines the efficiencies of solid (GMAW) wires with the high productivity rates of flux-cored (FCAW) wires - low fume generation rates, high efficiencies, no slag to clean or remove - with all the advantages cored wires have over solid wires - no "cold lap" or lack of sidewall fusion, pure spray achievement with 75-80% argon/balance carbon dioxide, faster travel speeds for a given fillet size. E70C-6M is well suited to applications where higher manganese and silicon levels are essential, such as in the presence of heavy mill scale or mild contaminants, or when improved wetting of the weld bead is desired. This product excels in general purpose welding, but is equally superior in higher demand situations as in heavier sheet metal fabrication, structural work, pipe welding and welding of hot water heaters.

AWS Specification

AWS A5.18/A5.18:M2005

AWS Classification E70C-6M**Welding Current** DCEP**Typical Mechanical Properties:
(As Welded with 75% Ar / 25% CO₂)**

Tensile Strength, ksi	70
Yield Strength, ksi	58
Elongation%, min	22
CVN (ft - lb ft) @ - 20°F	46

Welding Positions F,H**Typical wire chemistry**

C	0.12
Mn	1.75
Si	0.90
S	0.03
P	0.03
Ni	0.50
Cr	0.20
Mo	0.30
V	0.08
Cu	0.50

**Available Diameters and suggested
Operating Range in Amps**

.035"	160 - 250
.045"	180 - 330
.052"	220 - 460
1/16"	240 - 520
5/64"	240 - 550
3/32"	350 - 550
1/8"	450 - 625



A5.19 | MAGNESIUM ALLOY

Bare Electrodes and Welding Rods

ERAZ61A

ERAZ61A magnesium welding alloy is a good choice when welding magnesium base metals of similar chemical composition. It produces superior joints with the maximum tensile strengths offered by these alloys. Cleanliness of both the filler metal and base metal is extremely important when welding with magnesium. Flux is NOT required for TIG or MIG welding processes of ERAZ61A magnesium alloy. Although Oxy-acetylene welding of this alloy is uncommon it can be done and should be limited to single-pass welding on thin gauge magnesium materials.

AWS Specification

ANSI/AWS A5.19-92 (R2006)

AWS Classification ERAZ61A

Welding Current GTAW - AC/DCEP
GMAW - DCEP

Typical Wire Chemistry

Al	5.8 - 7.2
Be	0.0002 - 0.0008
Mn	0.15 - 0.5
Zn	0.40 - 1.5
Cu	0.05
Fe	0.005
Ni	0.005
Si	0.05
Mg	REM
OTHER	0.30

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	30
Tensile Strength, ksi	44
Elongation%, min	16
Brinell Hardness	60
Melting Point °F	1140

Available diameters MIG and suggested Operating Range in Amps

.040"	25 - 50
1/16"	70 - 175
3/32"	115 - 210

Available Diameters TIG and suggested Operating Range in Amps

3/32"	35 - 125
1/8"	160
5/32"	175

ERAZ92A

ERAZ92A magnesium welding alloy is a good choice when welding magnesium base metals of similar chemical composition. It produces superior joints with the maximum tensile strengths offered by these alloys. Cleanliness of both the filler metal and base metal is extremely important when welding with magnesium. Flux is NOT required for TIG or MIG welding processes of ERAZ92A magnesium alloy. Although Oxy-acetylene welding of this alloy is uncommon it can be done and should be limited to single-pass welding on thin gauge magnesium materials.

AWS Specification

ANSI/AWS A5.19-92 (R2006)

AWS Classification ERAZ92A

Welding Current GTAW - AC/DCEP
GMAW - DCEP

Typical Wire Chemistry

Al	8.3 - 9.7
Be	0.0002 - 0.0008
Mn	0.15 - 0.5
Zn	1.7 - 2.3
Cu	0.05
Fe	0.005
Ni	0.005
Si	0.05
Mg	REM
OTHER	0.30

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	14
Tensile Strength, ksi	25
Elongation%, min	2
Brinell Hardness	65
Melting Point °F	1110

Available diameters MIG and suggested Operating Range in Amps

.040"	25 - 50
1/16"	70 - 175
3/32"	115 - 210

Available Diameters TIG and suggested Operating Range in Amps

3/32"	35 - 125
1/8"	160
5/32"	175

**A5.20 | CARBON STEEL**

Flux Cored Arc Welding Electrodes

E71T-1C/1M

E71T-1C/1M is an all-position, flux cored welding wire, which is intended for single and multiple pass welding of low-alloy and carbon steel where a minimum 70 ksi tensile strength and good notch toughness is required. It is an excellent general purpose welding wire. This wire has very low fume, stable arc, good slag removal and excellent mechanical properties.

Typical Applications

- Buff and fillet welding of hulls and storage tanks.
- Structural steel
- Farm machinery
- Construction equipment
- General carbon steel fabrication

AWS Specification

AWS A5.20/A5.20M:2005

AWS Classification

E71T-1C, 1M

Welding Current

DCEP (Electrode Positive, Reverse Polarity)

Typical Wire Chemistry

C	0.12
Mn	1.75
Si	0.90
S	0.03
P	0.03
Cr	0.20
Ni	0.50
Mo	0.30
V	0.08
Cu	0.35

Typical Mechanical Properties

Yield Strength, ksi	58
Tensile Strength, ksi	70 - 95
Elongation%, min	22
Minimum Charpy	
V-Notch Impact Energy	
20ft•lbf@0°F	

Welding Positions

All positions

Available Diameters and suggested Operating Range in Amps

.035"	100 - 250
.045"	200 - 300
.052"	100 - 330
1/16"	150 - 400

E71T-9C/9M

E71T-9C/9M is a gas shielding flux-cored wire for 490MPa high strength steel, can use both CO₂ and 75-80%Ar + 20-25% CO₂ shielding gas. Outstanding all position weldability, few spatter, soft and stable arc, thin slag, easy slag removal, great penetration, high x-ray passing rate.

Typical Applications

- Shipbuilding
- Off-shore platform
- Steel structure
- Boiler and engineering machinery

AWS Specification

AWS A5.20M

AWS Classification

E71T9-APEX

Welding Current

DCEP (Electrode Positive, Reverse Polarity)

Typical Wire Chemistry

C	0.120
Mn	1.75
Si	0.90
S	0.03
P	0.03
Cr	0.20
Ni	0.50
Mo	0.30
V	0.08

Typical Mechanical Properties

Yield Strength, MPa	390
Tensile Strength, MPa	490 - 670
Elongation%, min	22

Welding Positions

F, V, OH, H

Available Diameters and suggested Operating Range in Amps

1.2	150 - 320
1.4	170 - 400
1.6	200 - 450

E70T-4

E70T-4 is a self-shielded, flux cored electrode designed for use in the multiple pass welding of carbon steels. This electrode is intended for flat position welding of grooves and fillets and horizontal fillet welding with extremely high deposition rates. This filler metal is ideally suited for welding applications where gas-shielded electrodes may have problems, such as outdoors or in windy conditions. These would typically be light gauge steel plate fabrication or general purpose fabrication of carbon steels. It is also a good choice in poor fit up situations or when extended stick-outs must be used in hard-to reach areas.

AWS Specification

AWS A5.20/A5.20M:2005

AWS Classification

E70T-4

Welding Current

DCEP (Electrode Positive, Reverse Polarity)

Typical Wire Chemistry

C	0.30
Mn	1.75
Si	0.60
S	0.03
P	0.03
Cr	0.20
Ni	0.50
Mo	0.30
V	0.08
Al	1.8
Cu	0.35

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	58
Tensile Strength, ksi	70 - 95
Elongation%, min	22

Welding Positions

H, F

Available Diameters and suggested Operating Range in Amps

5/64"	250
3/32"	350
7/64"	400
1/8"	450



A5.20 | CARBON STEEL

Flux Cored Arc Welding Electrodes

E71T-11

E71T-11 is a self-shielding flux cored wire used for welding carbon steels. This product does not require a shielding gas and can be used in limited multi-pass welding operations. The bead appearance is not equal to a gas-shielded product, but the benefits of not having to use gas makes this product popular. E71T-11 operates on straight polarity only (DCEN).

Typical Applications

- Butt, lap and fillet welds on steel 16 gauge through 1/2"
- Assembly and maintenance welding
- Machine parts
- Tanks
- Prefab construction
- Light structurals
- Short assembly welds
- Railroad car repairs

AWS Specification

AWS A5.20/A5.20M:2005

AWS Classification E71T-11

Welding Current

DCEN (Electrode Negative, Straight Polarity)

Typical Wire Chemistry

C	0.30
Mn	1.75
Si	0.60
S	0.03
P	0.03
Cr	0.20*
Ni	0.50*
Mo	0.30*
V	0.08*
Al	1.8*
Cu	0.35*

* Only included if intentionally added

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	58
Tensile Strength, ksi	70 - 95
Elongation%, min	20

Welding Positions F,H,V-down,OH

Available Diameters and suggested Operating Range in Amps

.030"	40 - 100
.035"	100 - 130
.045"	140 - 180
1/16"	175 - 300

E71T-GS

E71T-GS is an all-position, single-pass, flux cored welding wire designed to weld carbon steel. The unique quality of this product is that you do not have to use a shielding gas. E71T-GS produces smooth arc action, low spatter, full slag coverage, and easy slag removal. The bead appearance is not equal to a gas-shielded product, but the benefits of not having to use gas makes this product extremely popular.

** Make sure your power source is set properly for a good, non-porous weld.*

Typical Applications

- Lap and butt welds on galvanized sheet metal
- Repair of automobile sheet metal
- Joining of galvanized roofing sheet metal
- Prefab building fabrication
- Tanks
- Ornamental iron
- Farm implement repairs
- General fabrication

AWS Specification *N.S.

AWS Classification E71T-GS

Welding Current DCEN (Straight Polarity)

Typical Wire Chemistry

The composition of weld metal is not particularly meaningful since electrodes of these classifications are intended only for single-pass welds. Dilution from the base metal in such welds is usually quite high.

Typical Mechanical Properties (As Welded)

Tensile Strength, ksi	70 min
-----------------------	--------

Welding Positions F,H,V,OH

Available Diameters

.030", .035", .045", .052", 1/16" & 5/64"

Available Diameters and suggested Operating Range in Amps

.030"	40 - 100
.035"	100 - 130
.045"	140 - 180
.052"	140 - 180
1/16"	175 - 300
5/64"	190 - 310

**A5.21 | COBALT****Bare Electrodes and Rods for Surfacing****ERCoCr-A**

ERCoCr-A (Cobalt #6) bare rod provides resistance to many forms of chemical and mechanical degradation over a wide temperature range. It bonds well with all weldable grade steels, including stainless.

Typical Applications

- Shear blades
- Fluid flow valves
- Extrusion screws
- Roll bushings

AWS Specification

AWS A5.21/A5.21M:2011

AWS Classification ERCoCr-A

Welding Current DCEN

Typical Wire Chemistry
(As per AWS A5.21, single values are maximum)

C	0.7 - 1.4
Mn	1.0
Si	2.0
Cr	26 - 32
Ni	3.0
Mo	1.0
Fe	3.0
W	3.0 - 6.0
Co	Rem
OTHER	.50

Typical Mechanical Properties
(As Welded)

Tensile Strength, ksi	*N.S
Yield Strength, ksi	*N.S
Elongation%, min	*N.S

Welding Positions F,H,V,OH

ERCoCr-E

ERCoCr-E (Cobalt #21) bare rod provides a low austenitic type deposit with excellent work hardenable, high temperature, strength, and impact resistance. It is a good choice for valve trim and steam and fluid control valve bodies and seals. It bonds well to all weldable steels, including stainless steel.

Typical Applications

- Steam valves
- Hot shears
- Chemical and petrochemical valves
- Forging dies
- Cavation repair

AWS Specification

AWS A5.21/A5.21M:2011

AWS Classification ERCoCr-E

Welding Current DCEN

Typical Wire Chemistry
(As per AWS A5.21, single values are maximum)

C	0.15 - 0.45
Mn	1.5
Si	1.5
Cr	25 - 30
Ni	1.5 - 4.0
Mo	4.5 - 7.0
Fe	3.0
W	0.50
Co	Rem
OTHER	.50

Typical Mechanical Properties
(As Welded)

Tensile Strength, ksi	*N.S
Yield Strength, ksi	*N.S
Elongation%, min	*N.S

Welding Positions F,H,V,OH



A5.22 | STAINLESS STEEL

Flux Cored Arc Welding Electrodes and Flux Cored Rods for GTAW

E308LT1-1/-4

E308LT1-1/-4 is a titania type, all-position, flux-cored wire designed for MAG welding of low carbon 18%Cr-8%Ni stainless steels including AISI 304, 304L, 304LN, ASTM A157 Gr. C9; A320 Gr. B8C or D. It may also be used for welding types 321 and 347 if service temperature does not exceed 500°F (260°C). This wire provides excellent weldability and increased creep resistance at elevated temperatures.

AWS Specification

AWS A5.22/A5.22M:2010

AWS Classification E308LT1 -1/-4

Welding Current GMAW - DCEP

Typical Wire Chemistry (As welded with 100% CO₂ shielding gas)

C	0.04
Cr	18.0 - 21.0
Ni	9.0 - 11.0
Mo	0.75
Mn	0.5 - 2.5
Si	1.0
P	0.04
S	0.03
Cu	0.75

Typical Mechanical Properties (As Welded)

Tensile Strength, ksi	75
Elongation%, min	35

Welding Positions F,H,OH,V-Down

Available Diameters and suggested Operating Range in Amps

.035"	70 - 160
.045"	100 - 120
.063"	160 - 260

E309LT1-1/-4

E309LT1-1/-4 is a titania type, all-position, flux-cored wire designed for MAG welding of low carbon 22% Cr-12% Ni stainless steels. It is also used for dissimilar weld joints between high strength, mild steels and low-alloyed QT-steels, stainless, ferritic Cr- and austenitic Cr-Ni-steels, manganese steels. The weld metal contains comparatively much more ferrite in their austenitic, therefore providing better weldability together with superior heat and corrosion resistance.

AWS Specification

AWS A5.22/A5.22M:2010

AWS Classification E309LT1-1/-4

Welding Current GMAW - DCEP

Typical Wire Chemistry (As welded with 100% CO₂ shielding gas)

C	0.04
Cr	22.0 - 25.0
Ni	12.0 - 14.0
Mo	0.75
Mn	0.5 - 2.5
Si	1.0
P	0.04
S	0.03
Cu	0.75

Typical Mechanical Properties (As Welded)

Tensile Strength, ksi	75
Elongation%, min	30

Welding Positions F,V,OH

Available Diameters and suggested Operating Range in Amps

.035"	70 - 160
.045"	100 - 220
.063"	160 - 260

E316LT1-1/-4

E316LT1-1/-4 is a titania type, all-position, flux-cored wire designed for MAG welding of low carbon 18% Cr- 12% Ni - 2% Mo stainless steels. This wire has low carbon content which gives good resistance to most types of corrosion of the weld metal. It also has self-detaching slag, spray-like arc transfer, excellent weldability and increased creep resistance at elevated temperatures. Common grades joined with this alloy include AISI 316L, 316Ti and 316Cb.

AWS Specification

AWS A5.22/A5.22M:2010

AWS Classification E316LT1-1/-4

Welding Current GMAW - DCEP

Typical Wire Chemistry (As welded with 100% CO₂ shielding gas)

C	0.04
Cr	17.0 - 20.0
Ni	11.0 - 14.0
Mo	2.0 - 3.0
Mn	0.5 - 2.5
Si	1.0
P	0.04
S	0.03
Cu	0.75

Typical Mechanical Properties (As Welded)

Tensile Strength, ksi	70
Elongation%, min	30

Welding Positions F,H,OH,V-Down

Available Diameters and suggested Operating Range in Amps

.035"	70 - 160
.045"	100 - 240
.063"	160 - 260

**A5.22 | STAINLESS STEEL**

Flux Cored Arc Welding Electrodes and Flux Cored Rods for GTAW

E308LFC-O

E308LFC-O is the self-shielding tubular version of solid ER308L stainless steel welding wire. The benefit of using this wire is that it does not require a shielding gas. It may be used for welding all 300 series stainless up to and including 308L. It can be used for welding 430 stainless.

AWS Specification

AWS A5.22/A5.22M:2010

AWS Classification E308LFC-O**Welding Current** DCEP**Typical Wire Chemistry
(As Welded)**

C	0.04
Mn	0.5 - 2.5
Si	1.0
Cr	19.5 - 22.0
Ni	9.0 - 11.0
Mo	0.75
P	0.04
S	0.03
Cu	0.75

Welding Positions F,H**Available Sizes**

.035", .045", 1/16" & 5/64"

Operating Range in Amps

.035"	75 - 100
.045"	150 - 200
1/16"	180 - 250
5/64"	250 - 300

E309LFC-O

E309LFC-O is a self-shielding variety of ER309L stainless steel welding wire. It requires no shielding gas and works well when joining 309L to itself or other mild steels.

AWS Specification

AWS A5.22/A5.22M:2010

AWS Classification E309LFC-O**Welding Current** DCEP**Typical wire chemistry
(As Welded)**

C	0.04
Mn	0.5 - 2.5
Si	1.0
Cr	23.0 - 25.5
Ni	12.0 - 14.0
Mo	0.75
P	0.04
S	0.03
Cu	0.75

Welding Positions F,H**Available Sizes**

.035", .045", 1/16" & 5/64"

**Available Diameters and suggested
Operating Range in Amps**

.035"	75 - 100
.045"	150 - 200
1/16"	180 - 250
5/64"	250 - 300

E312FC-O

E312FC-O is a 312 type flux-cored stainless steel welding wire that does not require a shielding gas. It maintains all of the properties of a regular 312 wire and is excellent for joining dissimilar metals.

AWS Specification

AWS A5.22/A5.22M:2020

AWS Classification E312FC-O**Welding Current** DCEP**Typical wire chemistry
(As Welded)**

C	0.1
Mn	1.5
Si	0.75
Cr	29
Ni	9
Mo	0.1
Fe	BAL

Welding Positions F,H**Available Sizes**

.035", .045", 1/16" & 5/64"

**Available Diameters and suggested
Operating Range in Amps**

.035"	75 - 100
.045"	150 - 200
1/16"	180 - 250
5/64"	250 - 300



A5.22 | STAINLESS STEEL

Flux Cored Arc Welding Electrodes and Flux Cored Rods for GTAW

E316LFC-O

E316LFC-O is a self-shielding flux core version of solid ER316L stainless steel welding wire. It has a low carbon content and is used for welding type 316 series stainless steel.

AWS Specification

AWS A5.22/A5.22M:2010

AWS Classification E316LFC-O

Welding Current DCEP

Typical wire chemistry (As Welded)

C	0.08
Mn	.5 - 2.5
Si	1.0
Cr	18.0 - 20.5
Ni	11.0 - 14.0
Mo	2.0 - 3.0
P	0.04
S	0.03
Cu	0.75

Welding Positions F,H

Available Sizes

.035", .045", 1/16" & 5/64"

Available Diameters and suggested Operating Range in Amps

.035"	75 - 100
.045"	150 - 200
1/16"	180 - 250
5/64"	250 - 300

**A5.24 | ZIRCONIUM AND ZIRCONIUM ALLOY**

Bare Welding Electrodes and Rods

ERZr-2

ERZr-2 (Zirconium) welding alloy is widely used in the chemical processing industry. It is used in chemical processes that require alternate contact with strong acids and alkalis. This alloy has excellent corrosion resistance to many chemical solutions. It also has excellent resistance to corrosive attack in most organic and mineral acids, strong alkalis, and some molten salts. ERZr-2 can be machined, welded and fabricated using the same equipment as processes used in fabrication of stainless steel, nickel-based alloys and titanium.

AWS Specification

AWS A5.24/A5.24M:2005

AWS Classification ERZr-2**Welding Current** DCEP**Typical wire chemistry
(As Welded)**

Zr+Hf	99.0 min
Hf	4.5
Fe+Cr	0.20
H	0.005
N	0.015
C	0.03
O	0.11 - 0.15

**Typical mechanical properties
(As Welded)**

Yield Strength, ksi	30
Tensile Strength, ksi	55
Elongation%, min	16

Available Diameters

.045", 1/16", 3/32" & 1/8"



A5.28 | LOW-ALLOY STEEL

Filler Metals for Gas Shielded Arc Welding

ER80S-B2

ER80S-B2 (formerly 515) is for gas metal arc and gas tungsten arc welding of 1-1/4 chrome - 1/2 molybdenum steels. Preheat and post-weld heat treatments are usually required.

Applications

- Boilers
- Material handling machines
- Pipelines
- Chemical and petrochemical industry

AWS Specification

AWS A5.28/A5.28M:2005

AWS Classification ER80S-B2

Welding Current for MIG process

GMAW - DCEP
GTAW - DCEN

Typical Wire Chemistry

C	0.07 - 0.12
Mn	0.40 - 0.70
Si	0.40 - 0.70
P	0.025
S	0.025
Ni	0.20
Cr	1.20 - 1.50
Mo	0.40 - 0.65
Cu	0.35
OTHER	0.50

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	68
Tensile Strength, ksi	80
Elongation%, min	19

Welding Positions F,V,OH

Available Diameters MIG and suggested Operating Range in Amps

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

Available Diameters TIG

.035", .045", 1/16", 3/32" & 1/8"

ER90S-B3

ER90S-B3 (formerly 521) is used for welding 2-1/4 chrome - 1 molybdenum steels, frequently piping in the petroleum industry and for elevated temperature service. Preheat is necessary and a post-weld heat treatment is usually required.

Applications

- Boilers
- Pipelines
- Steam boilers
- Pressure tanks
- Oil industry
- Thermoelectrical industry
- Chemical and petroleum industry

AWS Specification

AWS A5.28/A5.28M:2005

AWS Classification ER90S-B3

Welding Current for MIG process

GMAW - DCEP
GTAW - DCEN

Typical Wire Chemistry

C	0.07 - 0.12
Mn	0.40 - 0.70
Si	0.40 - 0.70
P	0.025
S	0.025
Ni	0.20
Cr	2.30 - 2.70
Mo	0.90 - 1.20
Cu	0.35
OTHER	0.50

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	78
Tensile Strength, ksi	90
Elongation%, min	17

Welding Positions F,V,OH,H

Available Diameters MIG and suggested Operating Range in Amps

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

Available Diameters TIG

.035", .045", 1/16", 3/32" & 1/8"

ER80S-B6

ER80S-B6 (formerly 502) is designed for welding of materials of similar composition, especially those for high temperature service conditions. This alloy is an air-hardening material and as such calls for preheat and interpass temperatures of 350°F minimum during welding. This alloy is resistant to oxidation, heat, corrosion and wear.

Applications

- Boilers
- Steam boilers
- Pressure tanks
- Oil industry
- Thermoelectrical industry
- Chemical and petroleum industry

AWS Specification

AWS A5.28/A5.28M:2005

AWS Classification ER80S-B6

Welding Current for MIG process

GMAW - DCEP
GTAW - DCEN

Typical Wire Chemistry

C	0.10
Mn	0.40 - 0.70
Si	0.50
P	0.025
S	0.025
Ni	0.60
Cr	4.50 - 6.00
Mo	0.45 - 0.65
Cu	0.35
OTHER	0.50

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	68
Tensile Strength, ksi	80
Elongation%, min	17

Welding Positions F,V,OH,H

Available Diameters MIG and suggested Operating Range in Amps

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

Available diameters TIG

.035", .045", 1/16", 3/32", & 1/8"



A5.28 | LOW-ALLOY STEEL

Filler Metals for Gas Shielded Arc Welding

ER80S-B8

ER80S-B8 is used for joining 9Cr-1Mo air hardening steels for elevated temperature creep service, and with corrosion resistance from steam, not hydrogen gas, and high sulfur crude oils. These include steels such as A335 Grade F9, A336 Grade F9, A217 C12 (Cast). And A199, A220 and A213 Grade T9, used primarily in the petrochemical and refinery industries. A preheat and interpass temperature of not less than 400° should be maintained during welding.

Applications

- Power plants
- Chemical or petro-chemical industry
- Heat exchangers, boilers and piping and pressure vessels

AWS Specification

AWS A5.28/A5.28M:2005

AWS Classification

ER80S-B8

Welding Current for MIG process

GMAW - DCEP

Typical Wire Chemistry

C	0.10
Mn	0.40 - 0.70
Si	0.50
P	0.025
S	0.025
Ni	0.50
Cr	8.00 - 10.50
Mo	0.80 - 1.20
Cu	0.35
OTHER	0.50

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	70
Tensile Strength, ksi	82
Elongation%, min	20

Welding Positions

F,V,OH,H

Available Diameters MIG and suggested Operating Range in Amps

.035"	180 - 230
.045"	250 - 350
1/16"	280 - 400

Available Diameters TIG and suggested Operating Range in Amps

1/16"	50 - 120
3/32"	120 - 200
1/8"	150 - 220

ER90S-B9

ER90S-B9 is designed to weld high temperature steels for hot hydrogen service. This wire is suitable for 9% Chromium steels such as P91, T91 and F91. Applications include steam generation and petrochemical equipment. This alloy contains Vanadium and Niobium which increases the resistance to strain, corrosion and heat oxidation.

Applications

- Thermoelectric power plants
- Turbine rotors
- Petrochemical plants

AWS Specification

AWS A5.28/A5.28M:2005

AWS Classification

ER90S-B9

Welding Current for MIG process

GMAW - DCEP

Typical Wire Chemistry

C	0.07 - 0.13
Mn	1.20
Si	0.15 - 0.50
P	0.010
S	0.010
Ni	0.80
Cr	8.00 - 10.50
Mo	0.85 - 1.20
V	0.15 - 0.30
Al	0.04
Cu	0.20
OTHER	0.50

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	60
Tensile Strength, ksi	90
Elongation%, min	16

Welding Positions

F,V,OH,H

Available Diameters MIG and suggested Operating Range in Amps

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

Available Diameters TIG

.035", .045", 1/16", 3/32" & 1/8"

ER80S-D2

ER80S-D2 is a mild steel solid wire used in situations where porosity is a problem or when you must counter high-sulfur or carbon content in your base metal. It contains high levels of manganese and silicon to provide good wetting as well as good rust and scale tolerance.

Typical Applications

- X-ray quality applications
- High-strength welds
- Steam boilers
- Pressure tanks
- Gas pipes
- Heat exchangers
- Petrochemical industry

AWS Specification

AWS A5.28/A5.28M:2005

AWS Classification

ER80S-D2

Welding Current for MIG process

GMAW - DCEP

Typical Wire Chemistry

C	0.07 - 0.12
Mn	1.60 - 2.10
Si	0.50 - 0.80
P	0.025
S	0.025
Ni	0.15
Mo	0.40 - 0.60
Cu	0.50
OTHER	0.50

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	68
Tensile Strength, ksi	80
Elongation%, min	17

Welding Positions

F,V,OH

Available Diameters MIG and suggested Operating Range in Amps

.030"	90 - 140
.035"	80 - 250
.045"	70 - 350

Available Diameters TIG

.035", .045", 1/16", 3/32" & 1/8"



A5.28 | LOW-ALLOY STEEL

Filler Metals for Gas Shielded Arc Welding

ER100S -1

ER100S -1 welding alloy produces high tensile strength, high impact resistant weld deposits that retain their toughness to -70°F making it suitable for low temperature critical applications.

Typical Applications

- Welding HY80 and HY100 steels
- Petrochemical and building industry
- Structural work
- Industrial equipment
- Cranes
- Tanks
- Material Handling

AWS Specification

AWS A5.28/A5.28M:2005

AWS Classification ER100S-1

Welding Current for MIG process

GMAW - DCEP

Typical Wire Chemistry

C	0.08
Mn	1.25 - 1.80
Si	0.20 - 0.55
P	0.010
S	0.010
Ni	1.40 - 2.10
Cr	0.30
Mo	0.25 - 0.55
V	0.05
Ti	0.10
Zr	0.10
Al	0.10
Cu	0.25
OTHER	0.50

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	88
Tensile Strength, ksi	100
Elongation%, min	16

Welding Positions F,V,OH,H

Available Diameters MIG and suggested Operating Range in Amps

.030"	90 - 140
.035"	100 - 150
.045"	150 - 200

Available Diameters TIG

.035", .045", 1/16", 3/32" & 1/8"

ER110S -1

ER110S -1 is the ideal choice of filler metal when high strength and superior ductility are required at temperatures as low as -75°F.

Typical Applications

- Welding HY100 steels
- Lifting and handling machines
- Bridges
- Tanks
- Transport
- Shipbuilding
- Railway sector
- Mines
- Vibrant Sieves
- Tank lorries

AWS Specification

AWS A5.28/A5.28M:2005

AWS Classification ER110S-1

Welding Current for MIG process

GMAW - DCEP

Typical Wire Chemistry

C	0.09
Mn	1.40 - 1.80
Si	0.20 - 0.55
P	0.010
S	0.010
Ni	1.90 - 2.60
Cr	0.50
Mo	0.25 - 0.55
V	0.04
Ti	0.10
Zr	0.10
Al	0.10
Cu	0.25
OTHER	0.50

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	95
Tensile Strength, ksi	110
Elongation%, min	15

Welding Positions F,V,OH,H

Available Diameters MIG and suggested Operating Range in Amps

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

Available Diameters TIG

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

ER120S -1

ER120S -1 is used for a variety of steels where high strength and ductility are critical. It is designed to provide high notch toughness, yield strength, and impact resistance.

Typical Applications

- Welding all steels in the 100,000 psi range including T-1 and HY100
- Lifting and handling machines
- Bridges
- Tanks
- Transport
- Shipbuilding
- Railway sector
- Mines
- Vibrant Sieves
- Tank lorries

AWS Specification

AWS A5.28/A5.28M:2005

AWS Classification ER120S-1

Welding Current for MIG process

GMAW - DCEP

Typical Wire Chemistry

C	0.10
Mn	1.40 - 1.80
Si	0.25 - 0.60
P	0.010
S	0.010
Ni	2.00 - 2.80
Cr	0.60
Mo	0.30 - 0.65
V	0.03
Ti	0.10
Zr	0.10
Al	0.10
Cu	0.25
OTHER	0.50

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	105
Tensile Strength, ksi	120
Elongation%, min	14

Welding Positions F,V,OH,H

Available Diameters MIG and suggested Operating Range in Amps

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

Available Diameters TIG

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



HARDFACING

Core, Bare, and Coated Electrodes

MIG TUBULAR WIRES

WELDING MATERIAL SALES	HC400	HC410	HC420	HC430	HC440
ALLOY RODS		Wear O Matic 12	40	NICKEL MANG	Wear O Matic 3
STOODY	965, 965AP-G	121	100HC, 101HC	DYNAMANG	SUPER BUILD UP
ESAB				NICKEL MANG	Wear-O-Matic BR
BOHLER			Ledurit 60-FD	BM-FD, OA1000	Dur 350, OA1020
CERTANIUM	246 FC, 281 FC		247 FC	282 FC	
COAST METALS		94A	92A, 93A	95A	
COBALARC	650 FC		100M FC, 100HC FC	MnNi FC	350 FC
CORODUR	595 MIG		55 MO	240 K	400
CRONATRON	7500		7310	7109 MN	
DELORO	Multipass 25-O		Delcrome 100-O	Delstain 10-O	Multipass 4-O
EUTECTIC	4415	4601A	4601, DO-10	3220A, OA3206	
HOBART	Fabtuf 960-O	Wearcor 38-O		150-O	40-O
LINCOLN	Lincore 55	Lincore 50	Lincore 60	Lincore M	Lincore 40
POSTLE	289-SPL, 2898 SPL	282-SPL, 2820 SPL	283-SPL, 2834 SPL	285-SPL, 2850 FCO	287-SPL, 2892 SPL
RANKIN	Ranomatic BX, D	Ranomatic O, F, DD-G	Ranomatic R	Ranomang 1, 2	
REXARC		A-11		NICKEL-MANG	
SELECTRODE	7268	7260	7251	7248	7261
SODOMETAL	A12-O	240-O	255-O	218-O	242-O
STULZ-SICKLES		12 S/A		Manganese XL	Multipass 50 S
UTP		OA2000, OA400	OA2030, OA7130	OA1000	OA1020, OA300
WELDMOLD		334	357	1305	1325
WELDING ALLOYS	HARDFACE L-O	HARDFCE MC-O	HARDFACE HC-O	HARDFACE NM-O	HARDFACE T-O
WASHINGTON ALLOYS	HARDFACE 700	CHROM-TUNG 600	EVERWEAR 800	MANGANESE 900	BUILD-UP 300

STICK ELECTRODES

WELDING MATERIAL SALES	HC450	HC460	HC470	HC480
ALLOY RODS				Wear-Arc NiMn
STOODY		1105	35XHC	Nicro-Mang
ESAB		Wear-Arc 51P	Wear-Arc 40	Wear-Arc NiMn
BOHLER	Fox-Dur 600	Fox-Dur 650Kb	Fox Ledurit 60	Fox Chronos
CERTANIUM		281	284	282
COBALARC				
CORODUR				
CRONATRON		7330	711	777
DELORO				
EUTECTIC		2	5003, N5005, 4004N, 6006	N40
HOBART	FabTuf 960	SmoothArc 600	Smootharc 38	Smootharc MG
LINCOLN			Facexeld 1	Mangjet
POSTLE		21		Postmang
RANKIN		Ranite F		Ranmang 3
REXARC				
SELECTRODE	1263	1260	1251	1248
SODOMETAL	Abrasodur 11		Abrasodur 35	Soudomanganese CN
STULZ-SICKLES				
UTP		6700, 7100	7100	7200
WELDMOLD			Polywear 353	Polyrang 325
WELDING ALLOYS				
WASHINGTON ALLOYS	Chrom-Tung 600	Chrom-Tung 600	Everwear	Manganese 900

MIG WIRES ON 33#/50# SPOOLS and 250#/550# drums - DIAMETERS OF .045", 1/16", 5/64" & 3/32"

STICK ELECTRODE IN 5# PLASTIC CARTONS - DIAMETERS OF 1/8", 5/32" & 3/16"



HARDFACING

Core, Bare, and Coated Electrodes

55FC-O

55FC-O is a self-shielded, flux-core wire that deposits a premium martensitic alloy steel of H-12 tool steel composition. It has excellent resistance to adhesive (metal-to-metal) wear. It also has good resistance to abrasion and impact, and maintains its hardness up to 1000°F. It is designed for use as an overlay on carbon and low alloy steels. Because of its high hardenability, proper preheat may be required for crack-free deposits, particularly on low alloy steels. 55FC-O is formulated to optimize performance on small 110/220V type wire welding machines.

Typical Applications

- Dredge parts
- Earth moving equipment
- Farm equipment

AWS Classification Hardfacing

Welding Current DCEN - DCEP

Typical wire chemistry (As Welded)

C	0.4
Mn	1
Si	2.905
Cr	8.55
Mo	1.5
W	1.4
Fe	BAL

Typical Mechanical Properties (As Welded on 1020 steel)

Hardness on 1 layer, Rc	47
Hardness on 2 layers, Rc	49
Hardness on 3 layers, Rc	53

Welding Positions F,V,OH,H

Available Diameters

.035", .045" & 1/16"

Operating Range in Amps

.035"	80 - 120
.045"	120 - 150
1/16"	150 - 190

58FC-G

58FC-G is a metal-cored, economical hardfacing alloy designed to resist abrasion. This gas-shielded wire can be welded out of position. It is typically used to overlay carbon and low alloy steels, manganese steels, and stainless steels. The welded deposit weathers severe abrasion, moderate impact, and metal-to-metal wear. Hardfacing generally does not require any heat treatment. Preheat and post heat according to the base material where necessary.

Typical Applications

- Dredge parts
- Earth moving equipment
- Farm equipment
- Muller tires
- Extruder worms
- conveyors

AWS Classification Hardfacing

Welding Current DCEP (Reverse Polarity)

Typical wire chemistry (As Welded)

Cr	5
Mn	1
Mo	2
W	1.2
V	0.5
Others	1
Fe	BAL

Typical Mechanical Properties (As Welded on 1020 steel)

Hardness on 1 layer, Rc	52 - 56
Hardness on 2 layers, Rc	53 - 57

Welding Positions F,V,OH,H

Available Diameters and suggested Operating Range in Amps

.035"	80 - 120
.045"	120 - 150
1/16"	150 - 190

HC400

HardCover 400 (HC400) is a tubular, self-shielded wire for metal arc hardfacing. It produces a martensitic weld metal with good abrasion and impact resistance. This alloy is especially applicable in applications of 2-3 layers for wear resistance. HC400 should be considered when good resistance to abrasion and impact in dry or wet environments are required.

Typical Applications

- Bucket teeth, lips, undersides and cutting edges
- Steel mill rolls
- Cable drums
- Sand dredge equipment
- Dragline buckets
- Conveyor chutes

AWS Classification Hardfacing

Welding Current DCEN

Typical wire chemistry (As Welded)

C	0.5
Mn	1.5
Si	2.5
Cr	8.5
Fe	BAL

Typical Mechanical Properties (As Welded)

Hardness on 3 layers, Rc	61
--------------------------	----

Welding Positions F, H

Available Diameters and suggested Operating Range in Amps

.045"	100 - 300
1/16"	150 - 350
3/32"	250 - 400



HARDFACING

Core, Bare, and Coated Electrodes

HC410

HardCover 410 (HC410) is a tubular, self-shielded wire for metal arc hardfacing. It is used for hardfacing components subject to simultaneous abrasive wear and impact.

Typical Applications

- Crusher parts for relatively soft materials
- Brick industry components
- Bucket lips
- Garbage crusher hammers
- Shredders
- Conveyor screws
- Augers
- Wear bars

AWS Classification Hardfacing

Welding Current DCEN

Typical wire chemistry (As welded)

C	3
Mn	1.5
Si	1.5
Cr	15
Fe	BAL

Typical Mechanical Properties (As Welded)

Hardness on 3 layers, Rc	46 - 50
--------------------------	---------

Welding Positions F,H

Available Diameters and suggested Operating Range in Amps

.045"	100 - 300
1/16"	150 - 350
3/32"	250 - 400

HC420

HardCover 420 (HC420) is a tubular, self-shielded, high chromium cast iron for hardsurfacing components subject to extremely severe abrasive wear and moderate impact. The weld deposit contains a high proportion of hard primary chromium carbides in a tough austenitic matrix. HC420 is used for hardfacing components undergoing wear by earth, sand and abrasives.

Typical Applications

- Gyratory crusher cones and mantles
- Catalyst pipes and valves
- Slurry pipes and valve bodies
- Dredge pump bodies
- Sand dredge parts
- Extruder screws
- Mining and earth moving equipment

AWS Classification Hardfacing

Welding Current DCEN

Typical wire chemistry (As welded)

C	5
Mn	1.5
Si	1.5
Cr	27
Fe	BAL

Typical Mechanical Properties (As Welded)

Hardness on 3 layers, Rc	60 - 62
--------------------------	---------

Welding Positions F,H

Available Diameters and suggested Operating Range in Amps

.045"	100 - 300
1/16"	150 - 350
3/32"	250 - 400
1/8"	250 - 500

HC430

HardCover 430 (HC430) is a tubular, self-shielded wire for metal arc hardfacing. It is an austenitic manganese steel type alloy used for build-up and reinforcing manganese steel castings and wear components. It has excellent work hardening properties. The degree of work hardening is dependent on the amount of impact on the rebuilt component. HC430 should be considered when rebuilding 14% manganese steel parts.

Typical Applications

- Reclaiming crusher jaws and rolls
- Gyratory mantles
- Blow bars
- Swing hammers
- Manganese dredge components
- Railroad sections
- Bucket teeth and lips

AWS Classification Hardfacing

Welding Current DCEN

Typical wire chemistry (As welded)

C	1
Mn	14
Si	0.5
Cr	3.5
Ni	1
Fe	BAL

Typical Mechanical Properties (As welded and work hardened)

Hardness on 3 layers, Rc	46
--------------------------	----

Welding Positions F,H

Available Diameters and suggested Operating Range in Amps

.045"	160 - 280
1/16"	200 - 350
3/32"	250 - 450



HARDFACING

Core, Bare, and Coated Electrodes

HC440

HardCover 440 (HC440) is a tubular, self-shielded wire for metal arc hardfacing. It produces a low alloy steel weld deposit for heavy multi-layer build-up work on carbon steel parts. HC440 is used for rebuilding and resurfacing components subject to metal-metal wear and moderate abrasion. The weld deposit is machinable.

Typical Applications

- Build-up of earthmoving equipment such as tractor rollers, idlers, chains and drive sprockets
- Excavator pads
- Electric shovel track carrier rolls
- Steel shafts
- Gears
- Crane wheels
- Steel mill rolls
- Mine car wheels
- Railcar couplings

AWS Classification Hardfacing

Welding Current DCEN

Typical wire chemistry (As Welded)

C	0.15
Mn	1.5
Si	0.8
Cr	1.5
Fe	BAL

Typical Mechanical Properties (As Welded on mild steel)

Hardness on 3 layers	360 HB
----------------------	--------

Welding Positions F,H

Available Diameters and suggested Operating Range in Amps

.045"	120 - 320
1/16"	150 - 350
3/32"	200 - 450

HC450

HardCover 450 (HC450) is a hardfacing electrode well suited for metal to metal wear applications involving steel, manganese steel and cast iron. The weld deposits are very crack resistant and multiple layers are easily applied for thick build-ups. HC450 is intended for impact and moderate abrasion.

Typical Applications

- Especially suited for metal wear applications involving steel, manganese steel and cast iron.

AWS Classification Hardfacing

Welding Current AC - DCEN

Typical wire chemistry (As Welded)

C	.65
Mn	.5
Si	1.2
S	0.04
P	0.03
Cr	9.3
Fe	BAL

Typical Mechanical Properties (As Welded)

Hardness	58 - 60 Rc
----------	------------

Welding Positions F,H

Available Diameters and suggested Operating Range in Amps

1/8"	80 - 120
5/32"	110 - 160
3/16"	140 - 180

HC460

HardCover 460 (HC460) is an economical, general hardfacing electrode where some impact is combined with abrasion. In the as-deposited condition, the microstructure consists of martensite and some carbides. This is a great hardfacing electrode for low open circuit voltage AC welding machines.

Typical Applications

- Surfacing and build-up of worn and new machine parts of cast steel, steel and manganese steel, used for earth borders, caterpillar drives, stampers, shovel teeth, pressure rollers, conveyors, hammer mill parts, crusher jaws, and dredger teeth.

AWS Classification Hardfacing

Welding Current AC - DCEN

Typical wire chemistry (As Welded)

C	0.56
Mn	0.95
Si	0.43
P	0.018
S	0.014
Cr	5.7
Ni	0.03
Mo	0.63
Fe	BAL

Typical Mechanical Properties (As Welded)

Hardness	56 - 58 Rc
----------	------------

Welding Positions F,H

Available diameters and suggested Operating Range in Amps

1/8"	100 - 130
5/32"	150 - 190
3/16"	200 - 260

**HARDFACING**

Core, Bare, and Coated Electrodes

HC470

HardCover 470 (HC470) is a chromium carbide electrode used in smooth overlays for protecting most iron base surfaces against severe abrasive wear and moderate impact. The microstructure of this alloy consists of austenitic alloy matrix and chromium/complex carbides. HC470 is specially formulated to totally eliminate the 'worm tracking' type porosity commonly found in this alloy group.

Typical Applications

- Crusher jaws, hammers, bucket lips and teeth. Wear plates, pins, axles, shafts, cams, eccentrics.

AWS Classification Hardfacing

Welding Current AC - DC

Typical wire chemistry (As Welded)

C	3.8
Ni	0.14
Mn	0.13
Cu	0.09
Si	0.59
S	0.019
P	0.017
Cr	34
Fe	BAL

Typical Mechanical Properties (As Welded)

Hardness	55 - 60 Rc
----------	------------

Welding Positions F,H

Available Diameters and suggested Operating Range in Amps

3/32"	45 - 90
1/8"	80 - 120
5/32"	110 - 160

HC480

HardCover 480 (HC480) is a joining and cladding electrode for manganese steel that can be flame cut. Commonly used in the repair of rail equipment and construction equipment manufactured of manganese steel. The microstructure of this alloy in the as-deposited condition consists of a soft manganese alloy austenite which rapidly work hardens under impact loading. Note – Clean base metal of oils and fatigued sections, and do not allow weld interpass temperature to exceed 500°F.

Typical Applications

- Ideal for railroad frogs, switches, crossings and for wear plates, bucket teeth, bucket lips, and associated manganese steel parts. Also recommended for sheep foot tampers, hammers, crushers, and a variety of parts designated to resist impact.

AWS Classification Hardfacing

Welding Current AC - DCEN

Typical wire chemistry (As Welded)

C	0.6
Ni	3.65
Mn	16
Si	0.08
S	0.01
P	0.015
Cr	3.75
Fe	BAL

Typical Mechanical Properties (As Welded)

Tensile strength, ksi	116
Elongation%, min	38
Work hardness	41 - 54 Rc

Welding Positions F,V-up,DH,H

Available Diameters and suggested Operating Range in Amps

1/8"	90 - 125
5/32"	125 - 170
3/16"	160 - 225

**TOOL STEEL**

Filler Metals

A-2

A-2 Air Hardening Tool Steel produces weld deposits that are completely heat-treatable and have excellent resistance to high abrasion, medium impact, and wear. The deposits are also highly crack resistant and forgeable. Typical applications encountered are trim steels, piercing punches, flange, and forming dies as well as some draw form operations. This alloy is most widely used for general repair of the air hardening grades where a complete heat treat cycle will be used.

Alloy Type

Typical 5% Chromium Air Hardening

Hardness as welded

Rockwell C 58-62

Heat Treatment

A-2 Procedure

Welding Positions

F,V,OH,H

Shielding Gas

Argon (recommended)

Available Diameters

SMAW – 3/32", 1/8", 5/32" & 3/16"
GTAW – .030", .035", .045", 1/16" & 1/8"

M-2

M-2 high speed tool steel is an 8% molybdenum wire that produces hard as welded deposits which retain maximum hardness up to operating temperatures of 1100°F. M-2 has a high toughness characteristic which provides an answer to facing fine edges that must be ground with sharp angles, where danger of edge crumbling or chipping is encountered.

Typical Applications

- High speed wear applications such as blanking dies and shearing blades

Alloy Type

Typical Molybdenum High Speed

Hardness as welded

Rockwell C 59-63

Heat Treatment

M-2 Procedure

Available Diameters

SMAW – 3/32", 1/8", 5/32" & 3/16"
GTAW – .030", .035", .045", 1/16" & 1/8"

P-20

P-20 is a Chrome/Moly mold steel developed to match the wear and polishing qualities of most injection-mold steels. Deposits are dense, tough and machinable.

Typical Applications

- Repair of Cast dies, cores, pins, injection molds, compression molds, transfer molds, prototype molds and dies, holders and backers.

Alloy Type

Typical AISI P-20

Hardness as welded

Rockwell C 34-36

Heat Treatment

P-20 Procedure

Available Diameters

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

**TOOL STEEL**

Filler Metals

S-7

S-7 shock resistant tool steel is a completely heat-treatable weld deposit that is both shock resistant and dense. S-7 is well suited for metal-to-metal wear areas and medium hot and cold working units. S-7 is recommended for welding AISI S-7 tool steel when engineering changes, damaged areas, or machining errors occur. The weld deposit will, in fact, respond to a standard AISI S-7 harden and temper cycle. This product is available in solid and tubular forms.

Typical Applications

- High shock, cold work applications

Alloy Type

Typical AISI S-7

Hardness as welded

Rockwell C 56-60

Heat Treatment

S-7 Procedure

Available Diameters

SMAW – 3/32", 1/8", 5/32" & 3/16"

FCAW – 1/16" & 3/32"

GTAW – .030", .035", .045", 1/16" & 1/8"

H-12

H-12 hot work tool steel electrodes produce chromium-tungsten-molybdenum weld deposits that respond to hot work heat treatment procedures. Weld deposit has excellent resistance to chipping and heavy buildup is possible when necessary. It is excellent for repair of damaged tools and dies in the hot work class, and repair of existing hot work tooling where deposit must be annealed to facilitate machining and rehardening.

Typical Applications

- For use on all "H" series tool steels

Alloy Type

5% Chromium hot work tool steel

Hardness as welded

Rockwell C 54-56

Heat Treatment

H-12 Procedure

Available Diameters

GTAW – .035", .045", 1/16", 3/32" & 1/8"

FCAW – .045" & 1/16"

H-13

H-13 tool steel welding electrode is ideal for water cooled hot working tools. Its 'tungsten-free' weld deposits are homogeneous, porous-free, dense, and may be rehardened and/or annealed.

Typical Applications

- Tools & Dies subject to wear and heat checking

Alloy Type

Tungsten-free 5% Chromium Hot Work Tool Steel

Hardness as welded

Rockwell C 54-57

Heat Treatment

H-13 Procedure

Available Diameters

GTAW – .035", .045", 1/16", 3/32" & 1/8"

FCAW – .045" & 1/16"



SPECIALTY ELECTRODES

Welding and Brazing Alloys

1000

1000 is a universal welding electrode that can be used for all general mild steel welding applications. It can be used in all positions on AC or DC straight polarity welding current. Its self-lifting slag property and ease of handling make this an excellent electrode. This electrode may be bent without flux breakage.

Typical Applications

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

Welding Current AC - DC

Typical Wire Chemistry

Proprietary

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	75
Tensile Strength, ksi	83
Elongation%, min	25

Welding Positions F,V,OH,H

Available Diameters and suggested Operating Range in Amps

1/16"	20 - 40
5/64"	30 - 50
3/32"	50 - 70
1/8"	70 - 110
5/32"	115 - 140
3/16"	150 - 200

3000

3000 is the perfect choice when joining dissimilar metals. This alloy can be used for the repair and joining of all ferrous steels including high-alloy, stainless and tool steels. It can be used in all positions to produce smooth, porosity free welds without undercut or splatter. Special ferrite balanced chemistry also serves as a 'STUD PULLING' electrode.

Typical Applications

- Dissimilar metals
- Repair of tools, dies, springs, carbon steels and pressure vessels
- Rebuilding shafts and blades used in the chemical, construction and mining industries

Welding Current

AC - DC (Electrode positive, Reverse Polarity)

Typical Wire Chemistry

Proprietary

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	94
Tensile Strength, ksi	132
Tensile Strength as work hardened, ksi	186
Elongation%, min	36

Welding Positions F,V,OH,H

Available Diameters and suggested Operating Range in Amps

1/16"	25 - 35
5/64"	30 - 55
3/32"	35 - 70
1/8"	60 - 110
5/32"	75 - 140
3/16"	130 - 200

4000

4000 is a high nickel content electrode with an extruded coating for welding cast irons to themselves, as well as joining them to mild and stainless steels. This electrode is especially suited for welding in deep recesses or close quarters due to the non-conductive flux coating. Welds are produced easily in all positions and deposits are readily machined.

Welding Current AC - DCEP

Typical Wire Chemistry

Proprietary

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	38
Tensile Strength, ksi	55
Elongation%, min	30
Brinell hardness	155
Rockwell B hardness	82 - 84

Welding Positions F,V,OH,H

Available Diameters and suggested Operating Range in Amps

3/32"	70 - 90
1/8"	80 - 120
5/32"	130 - 160

**SPECIALTY ELECTRODES**

Welding and Brazing Alloys

5000

5000 rod can be used to weld a variety of ductile, nodular and malleable cast irons to themselves or for joining cast irons to steel. It produces a dense, moderately hard, crack-resistant weld that requires carbide-tipped tools for machining. This electrode is recommended when the post weld deposit does not need machining. Containing approximately 60% nickel, this rod is ideally suited for the repair of meehanite dies. Note, the flux coating on this rod does NOT contain barium, reducing hazardous fumes.

Welding Current AC - DCEP

Typical Wire Chemistry

Proprietary

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	49
Tensile Strength, ksi	70
Elongation%, min	20
Brinell hardness	180
Rockwell B hardness	88 - 90

Welding Positions F,V,OH,H

Available Diameters and suggested Operating Range in Amps

3/32"	50 - 80
1/8"	70 - 110
5/32"	100 - 140
3/16"	130 - 175

6000

6000 is a universal aluminum electrode for arc welding aluminum alloys. The arc is stable and operates at low temperatures with a minimum of spatter and fuming. The welds are strong, dense and free of porosity on both production and maintenance applications. 6000 is a great choice when welding heat-treated aluminum parts. This rod may also be used in brazing applications.

Welding Current DCEP (Reverse Polarity)

Typical Wire Chemistry

Proprietary

Typical Mechanical Properties (As Welded)

Yield Strength, ksi	20
Tensile Strength, ksi	34
Elongation%, min	18

Welding Positions F, H

Available Diameters and suggested Operating Range in Amps

5/64"	20 - 60
3/32"	50 - 80
1/8"	70 - 120
5/32"	110 - 150

7000

7000 is a general purpose hard-facing electrode that can be used for impact and abrasion overlay applications. It is easy to apply and can be used in single or multi-pass operations. 7000 is a chromium-carbide type electrode for economical smooth overlays. Typical hardness as welded: 55-60 Rc.

Welding Current AC - DCEP

Typical Wire Chemistry

Proprietary

Hardness as welded

Rockwell C 55-60

Welding Positions F, H

Available Diameters and suggested Operating Range in Amps

3/32"	45 - 90
1/8"	80 - 120
5/32"	110 - 160



SPECIALTY ELECTRODES

Welding and Brazing Alloys

8000

8000 chamfer electrode is designed for cutting, gouging and/or beveling all metals including stainless steels, aluminums and copper. It has excellent re-strike capability, the cut is smooth and uniform, and the slag practically falls off. It operates on DC straight polarity and requires high current. 8000 is excellent for the removal of stainless steel joints and overlays. No oxygen is required.

Typical Applications

- Removing unwanted or defective weld metal
- Preparing parts prior to welding
- Removing risers and reducing large areas of metal prior to machining

Welding Current AC - DCEN
(Electrode Negative, Straight Polarity)

Typical Wire Chemistry

Proprietary

Welding Positions F,V,OH

Available Diameters and suggested Operating Range in Amps

3/32"	100 - 170
1/8"	170 - 250
5/32"	220 - 330
3/16"	300 - 450

5000T

5000T is a cast iron tig rod used for repair. This rod has minimal or no pre-heat. It welds copper to steel and stainless steel. It is non-carcinogenic and does not contain nickel.

Typical Applications

- Excellent for welding all cast irons

AWS Classification *N.S.

Welding Current DCEN
(For TIG process) GTAW

Typical Wire Chemistry

C	.05 - .20
Mn	.20 - .50
Si	.15 - .45
S	.080
P	.080
Fe	REM
Al	.07 - 1.2
Cu	.07 - 1.2

Typical Mechanical Properties (As Welded)

Yield Strength, min ksi	60
Tensile Strength, min ksi	72
Elongation 2", min	22

Available Diameters TIG

1/16", 3/32"

Recommended shielding gas

Argon (cfh)

TRIPLE PLAY

Triple Play is the perfect choice for a quick repair of all aluminum and zinc alloys. Solders galvanized metal without the use of flux. Triple Play is stronger than aluminum and harder than mild steel. It has excellent corrosion resistance and is simple to use with only a propane torch.

Typical Applications

- Repair of ladders, lawn furniture, awnings, aluminum radiators, power tools, propellers, castings, boat hulls and hardware accessories.

Typical Wire Chemistry

Proprietary

Physical Data

- Melting range 715° - 730°
- Density 25
- Elongation (in 2") 3%
- Tensile Strength (lbs./sq. inch) 47,000
- Compression Strength (lbs./sq. inch) 60 - 75,000
- Coefficient of Linear Expansion 15.4 x 10%F
- Shear Strength (lbs./sq.inch) 34,000
- Electrical Conductivity 24.9%
- Impact Strength (Charpy) 4 ft. lbs. to break °" bar
- Thermal Conductivity .24 cal/cu.cm
- Hardness (Brinell 100)
- Corrosion Penetration 300 x 10 in 11-R
- Ductability Good
- Specific Gravity 6.7
- Boiling Point (F) 2400
- Solubility in water 0 (solid metal)
- Appearance and order silver, bluish white metal



MAINTENANCE AND REPAIR ALLOYS COMPARISON CHART

For Welding, Brazing, Soldering and Metal Working

WELDING MATERIAL SALES	ALLSTATE	HARRIS WELCO	WASHINGTON ALLOY
BD3000	275;Stud Plus	Super Missileweld	Tensile Weld
BD6000	34	WELCO 26	AL 345
BD1000	83-88	315	83-88
NI-55	8-60	NIC-L-WELD 59	NICKEL55/CASCADE 18A
NI-99	8	NIC-L-WELD 99	NICKEL99/CASCADE 17A
	Monoweld;Steelarc Plus	–	Super500
	Galvover	GAL-VIZ	Galvbar
PHOS BRONZE C	24AC/DC	23	Rainer 3A
EST	6 IMP	28	EST/CASCADE 15A
HC400	Hard-Tuff 56	9	Hardface 700
BD8000	Chamfer Rod	Chamfer Arc	Chamfer Arc Rod
BD8000	Cutting Rod	Cut Rod	Cut Rod
	53;55	52	Alu-Zinc
BD TRIPLE PLAY	Sealcor	Cor-Al	Fluxcored Aluminum
	3	Kast Weld 111	RCI
	Ruf-Kut	Tuf Kut	30/40
310-16	252	P-10	310-16

	CERTANIUM	UTP	HI-ALLOY/INWELD
BD3000	770SP;707	65	500;500ND/SA-1 BLUE
ALUMINUM SMOOTH 340	608	48	35
	–	–	–
NI-55	–	ECONOCAST 55	5; NI-55
NI-99	–	ECONOCAST 99	9; NI-99
	702	612	Marvelweld/909
	Galvoplate	–	Galv Repair
	429	32	122/230;626
	885	81	64
	250	67S	Cobalarc 1
BD8000	100	82	Metal Mover/414
BD8000	101	82-AS	Cut Arc/450
ALUMITE	61	41	155
BD TRIPLE PLAY	68C	AL FC	FluxKored/230
BD5000	81	5	290RCi;296
	21	COMPOSITE TUNGSTEN	105;Cutter Wear
	709	68H	947



MAINTENANCE AND REPAIR ALLOYS COMPARISON CHART

For Welding, Brazing, Soldering and Metal Working

EUTECTIC	X-ERGON	MG	WELDCOTE METALS
680	100XL/1000	Super 600;660	SUPER120
2101;3021	141;Alumi-Arc	400	ALUMINUM SMOOTH 340
–	–	–	SPOT ARC
2-23;232;235;555;3055	Castweld	260	NI-55
24X;240;3099;CASTEC	Castweld HPM	250	NI-99
BEAUTYWELD;777	Duraweld Gold #106	500	88-83
15	–	–	GALVINIZING SOLDER
28-280-2800	157;Arc-Braze	310AC;320DC	2300
27;QUENCHWELD B	–	220	2800
N2;N61;N700;N1003	153;Abrade-X	760	900
EXOTRODE/QUENCHWELD A	161;Arc-Force	570	CHAMFER ARC
Cut Trode #1	Arc-Prep	560	CUT ROD
19;196	243;Alu-Bond	470	ALUMITE
21 FCE	242	420	FLUX-CORED ALUMINUM
14;141;144	–	240	CAST IRON ROD
88;8800;Drill Tec 88	–	788	NI-AG CARBIDE
Staintrode D;670	101	610	P-10

ROCKMOUNT	UNIWELD	CRONATRON	WELDCOTE METALS
BRUTUS A	5000	333;330	SUPER120
NEPTUNE A	4000	510	ALUMINUM SMOOTH 340
–	–	–	SPOT ARC
–	55	211	NI-55
–	99	222	NI-99
TARTAN A	2000	338	88-83
–	–	–	GALVINIZING SOLDER
VENUS A	1900	666	2300
JUPITER NM	3800	235	2800
OLYMPIA A	6300	–	900
ELECTRA	2400	110/1100	CHAMFER ARC
–	–	–	CUT ROD
NEPTUNE S	4200	52;53	ALUMITE
NEPTUNE GCF	–	54C	FLUX-CORED ALUMINUM
JUPITER GC	–	22	CAST IRON ROD
OLYMPIA GT	–	75	NI-AG CARBIDE
GEMINI E	–	377	P-10



GOUGING ELECTRODES

Gouging Carbon

Air Carbon Gouging Electrodes (or carbons) are designed for cutting and gouging metals such as carbon steel, stainless steel, copper, aluminum, and some high temperature alloys. The process is one in which an air-carbon arc torch is used to create an electric arc which melts away the metal, then uses compressed air to "blow" the molten metal out of the groove. Gouging carbons come in both copper coated and plain, and are also available jointed for continuous feeding operations. The copper coating improves conductivity offering more efficient and cooler operation.

Typical chemistry

80% Graphite
20% Copper

Available Diameters

1/8", 5/32", 3/16", 1/4", 5/16", 3/8",
1/2" & 3/4"

Operating Range in Amps

1/8"	100 - 100
5/32"	100 - 200
3/16"	150 - 250
1/4"	200 - 300
5/16"	250 - 350
3/8"	350 - 450
1/2"	700 - 900
5/8"	1000 - 1250
3/4"	900 - 1200



**WELDING
MATERIAL
SALES**

www.weldingmaterialsales.com

Welding Material Sales, Inc.
Your Source for Welding Consumables

**1340 Reed Road
P.O. Box 786
Geneva, Illinois 60134**

**t 630.232.6421
f 888.733.1512**

