WELDING CONSUMABLES

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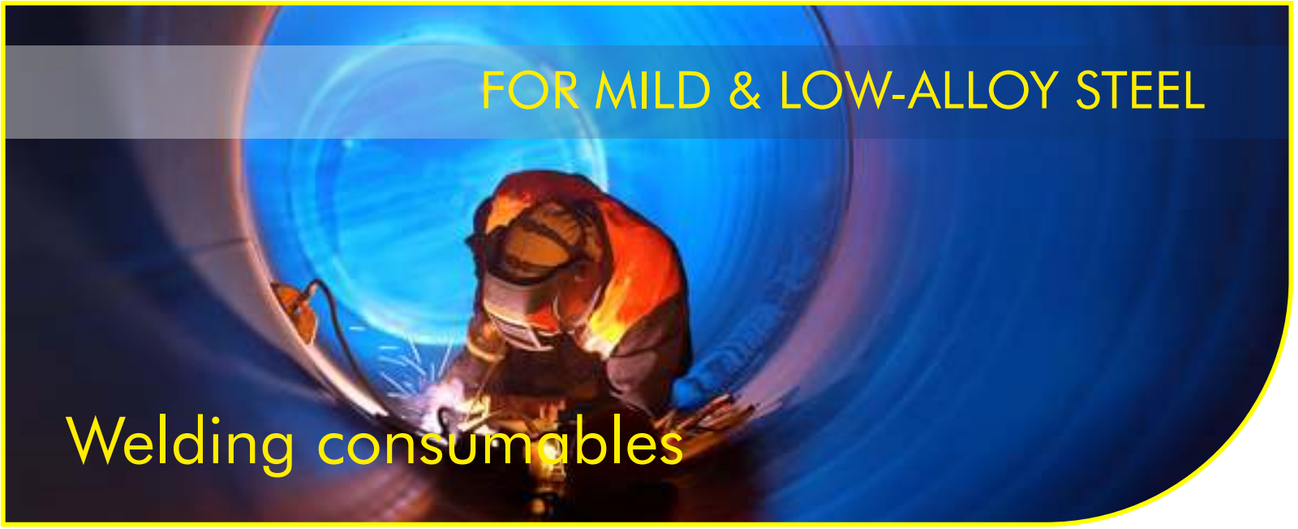


FOR MILD & LOW-ALLOY STEEL

Welding consumables

General description

Low carbon (or mild steel) - is a steel that contains approximately 0.05 - 0.15% of carbon. It has a relatively low tensile strength, but it is easy to form.
Low alloy steel - is a steel with Ni, Cr, Mo, and other alloy elements content of less than 10.5%. It can be divided in several groups:

- high heat resistance steel (Cr-Mo steel);
- low temperature use steel (Ni steel);
- weathering steel;
- high tensile & yield strength steel.

Low carbon and low alloy steels are generally weldable and it is important to know the service, joint configuration and subgroup of the material type. They can be welded by most processes, as long as adequate precautions are taken to avoid defects. It is important to know the composition of the material, either from a mill sheet or a dedicated chemical analysis, as composition influences weldability significantly.

We offer gas shielded welding wires for carbon & low alloy steel applications with excellent technological properties:

- fast melting rate;
- high depositing efficiency;
- little spatter and beautiful seam;
- smooth steady feeding.

Specification

AWS	Chemical composition (%)									
	C	Mn	Si	S	P	Ni	Cr	Mo	Cu	Other
ER70S-2	≤0.07	0.90-1.40	0.40-0.70	≤0.035	≤0.025	≤0.15	≤0.15	≤0.15	≤ 0.50	Al, Zr, Ti
ER70S-3	0.06-0.15	0.90-1.40	0.45-0.75	≤0.035	≤0.025	≤0.15	≤0.15	≤0.15	≤0.50	≤0.50
ER70S-4	0.07-0.15	1.00-1.50	0.65-0.85	≤0.035	≤0.025	≤0.15	≤0.15	≤0.15	≤0.50	≤0.50
ER70S-6	0.06-0.15	1.40-1.85	0.80-1.15	≤0.035	≤0.025	≤0.15	≤0.15	≤0.15	≤0.50	≤0.50
ER70S-7	≤0.15	1.40-1.90	0.55-1.10	≤0.035	≤0.025	≤0.15	≤0.15	≤0.15	≤0.50	≤0.30
ER80S-B2	0.07-0.12	0.40-0.70	0.40-0.70	≤0.025	≤0.025	≤0.20	1.20-1.50	0.40-0.65	≤0.35	≤0.50
ER80S-D2	0.07-0.12	1.60-2.10	0.50-0.80	≤0.025	≤0.025	≤0.15	-	0.40-0.60	≤0.50	≤0.50
ER80S-B6	0.03-0.10	0.40-0.70	0.30-0.50	≤0.025	≤0.025	≤0.30	5.50-6.00	0.50-0.65	≤0.35	≤0.50
ER80S-Ni1	≤0.12	≤1.25	0.40-0.80	≤0.025	≤0.025	0.80-1.10	≤0.15	≤0.35	≤0.35	≤0.50
ER80S-Ni2	≤0.12	≤1.25	0.40-0.80	≤0.025	≤0.025	2.00-2.75	-	-	≤0.35	≤0.50
ER90S-B3	0.07-0.12	0.40-0.70	0.40-0.70	≤0.025	≤0.025	≤0.20	2.30-2.70	0.90-1.20	≤0.35	≤0.50
ER90S-B9	0.07-0.13	≤1.25	0.15-0.30	≤0.010	≤0.010	≤1.00	8.00-9.50	0.80-1.10	≤0.20	≤0.50
ER100S-G	≤0.12	1.70-2.30	0.50-1.00	≤0.030	≤0.030	0.70-1.50	≤0.30	0.40-0.90	≤0.35	≤0.50

**Note: Any other specification is subject to discussion and available upon request.*

Typical mechanical properties of solid wire (MIG/GMAW)

AWS	Shielded Gas	Tensile Strength σ_b (MPa)	Yield Strength $\sigma_{0.2}$ (MPa)	Elongation δ_5 (%)	Impact Value J (°C)
ER70S-2	100% CO_2	550	490	29	80 (-29°C)
	Ar+20%CO_2	610	550	26	50 (-29°C)
ER70S-3	100% CO_2	520	430	33	90 (-18°C)
	Ar+20%CO_2	540	440	30	100 (-18°C)
ER70S-4	100% CO_2	540	470	28	62 (-29°C)
	Ar+20%CO_2	580	475	29	100 (-29°C)
ER70S-6	100% CO_2	550	450	30	70 (-29°C)
	Ar+20%CO_2	580	480	28	80 (-29°C)
ER70S-7	100% CO_2	545	425	29	70 (-29°C)
	Ar+20%CO_2	565	470	28	80 (-29°C)
ER80S-B2	Ar+1-5%O_2	580	500	25	80 (-29°C)
ER80S-D2	100% CO_2	660	590	22	50 (-29°C)
ER80S-B6	100% Ar	625	480	18	70 (20°C)
ER80S-Ni1	Ar+20%CO_2	580	480	31	60 (-60°C)
ER80S-Ni2	Ar+20%CO_2	580	490	24	105 (-60°C)
ER90S-B3	Ar+1-5%CO_2	660	590	20	80 (-29°C)
ER90S-B9	100% Ar	700	500	18	70 (20°C)
ER100S-G	Ar+20%CO_2	770	635	19	100 (-20°C)

Typical applications

ER70S-2, ER70S-3, ER70S-4, ER70S-6, ER70S-7
Suitable for variety of mild and low alloy steel repairs (structural steel, cast steel, pipe material, fine grained steel, ship steel): vehicle, machinery, bridge, constructions, shipbuilding, boiler & pressure vessel, pipe-lines, petrochemical industries, etc).

ER80S-B2, ER80S-D2, ER80S-B6
Suitable for creep and hydrogen resistant steels repairs in high temperature power generation applications: high temperature service pipe, fittings, flanges and valves; pressure vessel forgings; heat exchangers; turbine castings. Service temperature up to 550°C.

ER80S-Ni1, ER80S-Ni2
Suitable for fine grained and low alloyed nickel steels repairs in NACE applications: storage tanks, pipework, process plants. low temperature equipment, etc.

ER90S-B3, ER90S-B9
Suitable for creep and hydrogen resistant steels repairs in the following applications: power plants, elevated temperature piping, oil refineries, coal liquefaction plants, turbine castings, pressure vessels. Service temperature up to 650°C.

ER100S-G
Suitable for high strength steels (with yield strength of 600-700 N/mm²) repairs in different applications: pipework, port machinery, military engineering, etc. Widely used for welding of HY-80 and similar steels.

General description

Stainless steels can be welded using several different procedures such as shielded metal arc welding, gas tungsten arc welding, and gas metal arc welding.
They are slightly more difficult to weld than mild carbon steels. The physical properties of stainless steel are different from mild steel and this makes it weld differently. These differences are:

- Lower melting temperature;
- Lower coefficient of thermal conductivity;
- Higher coefficient of thermal expansion;
- Higher electrical resistance.

The properties are not the same for all stainless steels, but they are the same for those having the same microstructure. Regarding this, stainless steels from the same metallurgical class have the similar welding characteristics and are grouped according to the metallurgical structure with respect to welding.

Our company offers a wide range of stainless steel welding materials according to AWS/EN/GOST standards including MIG/ TIG/ SAW wires and welding strip. Any packing & labeling solution and specification as per customer request are also available.

Specification

AWS	Chemical composition (%)									
	C	Mn	Si	S	P	Ni	Cr	Mo	Cu	Other
ER307	≤0.10	5.00-8.00	0.65-1.00	≤0.030	≤0.030	8.00-10.00	17.00-20.00	≤0.50	≤ 0.50	-
ER308	≤0.08	1.00-2.50	0.30-0.65	≤0.030	≤0.030	9.00-11.00	19.50-22.00	≤0.50	≤0.50	-
ER308L	≤0.03	1.00-2.50	0.30-0.65	≤0.030	≤0.030	9.00-11.00	19.50-22.00	≤0.50	≤0.50	-
ER308LSi	≤0.03	1.00-2.50	0.65-1.00	≤0.030	≤0.030	9.00-11.00	19.50-22.00	≤0.50	≤0.50	-
ER309	≤0.12	1.00-2.50	0.30-0.65	≤0.030	≤0.030	12.00-14.00	23.00-25.00	≤0.50	≤0.50	-
ER309L	≤0.03	1.00-2.50	0.30-0.65	≤0.030	≤0.030	12.00-14.00	23.00-25.00	≤0.50	≤0.50	-
ER309LSi	≤0.03	1.00-2.50	0.65-1.00	≤0.030	≤0.030	12.00-14.00	23.00-25.00	≤0.50	≤0.50	-
ER309Mo	≤0.12	1.00-2.50	0.30-0.65	≤0.030	≤0.030	12.00-14.00	23.00-25.00	2.00-3.00	≤0.50	-
ER309LMo	≤0.03	1.00-2.50	0.30-0.65	≤0.030	≤0.030	12.00-14.00	23.00-25.00	2.00-3.00	≤0.50	-
ER310	0.08-0.15	1.00-2.50	0.30-0.65	≤0.030	≤0.030	20.00-22.50	25.00-28.00	≤0.75	≤0.75	-
ER312	≤0.15	1.00-2.50	0.30-0.65	≤0.030	≤0.030	8.00-10.50	28.00-32.00	≤0.50	≤0.50	-
ER316	≤0.08	1.00-2.50	0.30-0.65	≤0.030	≤0.030	11.00-14.00	18.00-20.00	2.00-3.00	≤0.50	-
ER316L	≤0.03	1.00-2.50	0.30-0.65	≤0.030	≤0.030	11.00-14.00	18.00-20.00	2.00-3.00	≤0.50	-
ER317L	≤0.03	1.00-2.50	0.30-0.65	≤0.030	≤0.030	13.00-15.00	18.50-20.50	3.00-4.00	≤0.75	-
ER347	≤0.08	1.00-2.50	0.30-0.65	≤0.030	≤0.030	9.00-11.00	19.00-21.50	≤0.50	≤0.50	Nb:10xC-1
ER347Si	≤0.08	1.00-2.50	0.65-1.00	≤0.030	≤0.030	9.00-11.00	19.00-21.50	≤0.50	≤0.50	Nb:10xC-1
ER385	≤0.025	1.00-2.50	≤0.50	≤0.030	≤0.030	24.00-26.00	19.50-21.50	4.20-5.20	1.20-2.00	-
ER410	≤0.12	≤0.60	≤0.50	≤0.030	≤0.030	≤0.60	11.50-13.50	≤0.50	≤0.50	-
ER410NiMo	≤0.05	≤0.60	≤0.50	≤0.030	≤0.030	4.00-5.00	11.00-12.50	0.40-0.70	≤0.50	-
ER430	≤0.10	≤0.60	≤0.50	≤0.030	≤0.030	≤0.60	15.50-17.00	≤0.50	≤0.50	-
ER2209	≤0.03	0.50-2.00	≤0.90	≤0.030	≤0.030	7.50-9.50	21.50-23.50	2.50-3.50	≤0.50	N=0.08-0.2

**Note: Any other specification is subject to discussion and available upon request.*

Mechanical properties & Application (MIG/GMAW)

AWS	Tensile Strength σ_b (MPa)	Yield Strength $\sigma_{0.2}$ (MPa)	Elongation δ_5 (%)	Applications
ER307	630	400	40	For welding of mixed combinations of CMn, stainless, hardenable, armour and wear-resistant steels.
ER308	600	410	41	For welding of austenitic CrNi steels, especially in high temperature applications (302, 304, 304H, CF-3, CF-8, 321, 321H, 347).
ER308L	590	400	35	
ER308LSi	570	420	45	
ER309	620	410	35	For welding of high temperature applications (petrochemistry, power stations, industrial furnaces) of CrNi steels (309, 410, 430).
ER309L	600	400	40	Cladding over and welding of stainless steel to carbon & mild steel.
ER309LSi	600	400	35	
ER309Mo	625	400	40	For welding of dissimilar materials between stainless and low alloyed steel; overlay cladding; joining of unalloyed/low-alloyed/cast steel or CrNi/CrNiMo/cast steel to austenitic/cast steel.
ER309LMo	590	400	43	
ER310	610	390	43	For welding of heat resistant Cr- and CrNi steels (25%Cr - 20%Ni).
ER312	710	520	25	For welding of cast alloys, overlay cladding of carbon & low-alloyed steels.
ER316	620	400	40	For welding of CrNiMo and CrNi steels (304, 304L, 321, 316, 316L, 316Ti, 347, etc).
ER316L	600	400	42	
ER317L	600	380	47	For welding of CrNiMo steels of similar composition (316L and 317L).
ER347	620	450	41	For welding of Ti- or Nb stabilized CrNi steels (321 and 347).
ER347Si	650	460	38	
ER385	610	350	35	For welding of NiCrMoCu steels with similar composition (904L).
ER410	540	340	25	For welding of 403, 405, 410 and 416, overlay cladding on carbon steels.
ER410NiMo	820	630	20	For welding of cast and wrought materials of similar composition.
ER430	510	340	20	For welding of 430 and 436 steel.
ER2209	750	600	28	For welding of duplex stainless steels, joints with un- & low-alloyed steel.

General description

Nickel alloys can be joined by all types of welding processes or methods, with the exception of forge welding and oxyacetylene welding. The wrought nickel alloys can be welded under conditions similar to those used to weld austenitic stainless steels. Cast nickel alloys, particularly those with a high silicon content, present difficulties in welding.

The most widely employed processes for welding are gas-tungsten arc welding (GTAW), gas-metal arc welding (GMAW), and shielded metal arc welding (SMAW).

Submerged arc welding (SAW) and electroslag welding (ESW) have limited applicability, as does arc plasma welding (PAW). Although the GTAW process is preferred for welding the precipitation-hardenable alloys, both the GMAW and SMAW processes are also used.

Nickel alloys are usually welded in the solution-treated condition. Precipitation-hardenable (PH) alloys should be annealed before welding if they have undergone any operations that introduce high residual stresses.

Specification

AWS	Chemical composition (%)										
	C	Mn	Si	S	P	Fe	Ni	Cr	Ti	Cu	Other
ERNiCr-3	≤0.10	2.50-3.50	≤0.50	≤0.015	≤0.03	≤3.00	≥67.00	18.00-22.00	≤0.75	≤0.50	Cb+Ta: 2.00-3.00
ERNiCu-7	≤0.15	≤4.00	≤1.25	≤0.015	≤0.02	≤2.50	62.00-69.00	-	1.50-3.00	rest	Al≤1.50
ERNi-1	≤0.15	≤1.00	≤0.75	≤0.015	≤0.03	≤1.00	≥93.00	-	2.00-3.50	≤0.25	Al≤1.50
ERNiCrMo-3	≤0.10	≤0.50	≤0.50	≤0.015	≤0.02	≤5.00	≥58.00	20.00-23.00	≤0.40	≤0.50	Al≤0.40 Mo: 8.00-10.00 Cb+Ta: 3.15-4.15
ERNiCrMo-4	≤0.02	≤1.00	≤0.08	≤0.030	≤0.04	4.00-7.00	rest	14.50-16.50	-	≤0.50	W: 3.00-4.50 Co≤2.50 Mo: 15.00-17.00
ERNiCrMo-7	≤0.015	≤1.00	≤0.08	≤0.030	≤0.04	≤3.00	rest	14.00-18.00	≤0.70	≤0.50	Mo: 14.00-18.00 Co≤2.00 W≤0.50
ERNiCrMo-10	≤0.015	≤0.50	≤0.08	≤0.010	≤0.02	2.00-6.00	rest	20.00-22.50	-	≤0.50	Mo: 12.50-14.50 W: 2.50-3.50 Co≤2.50 V≤0.35
ERNiCrMo-13	≤0.01	≤0.50	≤0.10	≤0.010	≤0.015	≤1.50	rest	22.00-24.00	-	≤0.50	Mo: 15.00-16.50 Al: 0.10-0.40 Co≤0.30
ERNiMo-7	≤0.02	≤1.00	≤0.10	≤0.030	≤0.04	≤2.00	rest	≤1.00	-	≤0.50	Mo: 26.00-30.00 Co≤1.00 W≤1.00
ERNiCrFe-2	≤0.10	1.00-3.50	≤0.75	≤0.02	≤0.03	≤12.00	≥62.00	13.00-17.00	-	≤0.50	Mo: 0.50-2.50 Co≤0.12 Cb+Ta: 0.50-3.00
ERNiCrFe-3	≤0.10	5.00-9.50	≤1.00	≤0.015	≤0.03	≤10.00	≥59.00	13.00-17.00	≤1.00	≤0.50	Cb+Ta: 1.00-2.50 Co≤0.12
ERNiCrFe-11	≤0.10	≤1.00	≤0.50	≤0.015	≤0.03	rest	58.00-63.00	21.00-25.00	-	≤1.00	Al: 1.00-1.70
ERNi-C1	≤0.15	≤0.35	≤0.35	≤0.015	≤0.03	≤0.04	≥99.00	-	-	≤0.25	Other≤1.00
ERNiFeCr-2	≤0.08	≤0.35	≤0.35	≤0.015	≤0.015	rest	50.00-55.00	17.00-21.00	0.65-1.15	≤0.30	Al: 0.20-0.80 Cb+Ta: 4.75-5.50 Mo: 2.80-3.30
ERNiCrCoMo-1	≤0.15	≤1.00	≤1.00	≤0.015	≤0.03	≤3.00	rest	20.00-24.00	≤0.60	≤0.50	Mo: 8.00-10.00 Co: 10.00-15.00 Al: 0.80-1.50

**Note: Any other specification is subject to discussion and available upon request.*

Mechanical properties & Application (MIG/GMAW)

AWS	Tensile Strength σ_b (MPa)	Yield Strength $\sigma_{0.2}$ (MPa)	Elongation δ_5 (%)	Applications
ERNiCr-3	590	360	38	For welding of Ni-based alloys (Alloy 600, 601, 690, 800, 800HT, 330, 80A, 75) and un-&low alloyed heat and creep resistant steel to stainless steel.
ERNiCu-7	530	360	34	For welding of Monel and NiCu alloys to mild and low-alloyed steel.
ERNi-1	460	250	30	For welding of pure Ni and Ni-based alloys, joining with un-&low alloyed steel, surfacing of mild steels.
ERNiCrMo-3	770	520	35	For welding of Ni-based alloys (625, 600, 825, 75, 80A, 20, 800, 254, 904L, 925), dissimilar joints of Ni-based alloys, mild steel, low-alloyed steel, stainless steel.
ERNiCrMo-4	730	540	40	For welding of Alloy C-276 and similar alloys (Ni-based materials alloyed with CrMoW), can be used for welding of Alloy C-22 and C4.
ERNiCrMo-7	700	480	35	For welding of similar NiCrMo alloys and cast alloys.
ERNiCrMo-10	790	560	38	For welding of similar NiCrMo alloys, dissimilar joining between NiCrMo alloys and stainless, carbon or low-alloyed steels.
ERNiCrMo-13	710	400	30	For welding of NiCrMo alloys (Alloy C-4, C-22, C-276, 625, 825) and high Mo stainless steel (904HMo).
ERNiMo-7	760	350	40	For welding of Alloy B2 or for similar alloys.
ERNiCrFe-2	610	500	35	For welding of similar NiCrFe alloys, dissimilar joining with Ni-based alloys, mild and stainless steels.
ERNiCrFe-3	600	490	35	
ERNiCrFe-11	650	430	40	For welding of Alloy 601 or for similar alloys
ERNi-C1	460	250	40	For welding of cast irons.
ERNiFeCr-2	830	620	30	For welding of Alloy 718, 706 and X-750. Mainly used for welding high strength aircraft components and liquid rocket components involving cryogenic temperatures.
ERNiCrCoMo-1	780	610	30	For welding of Alloy 617, dissimilar joining of high-temperature alloys.

FOR ALUMINIUM ALLOYS

Welding consumables

General description

There are more methods of welding for aluminium and its alloys than any other metal, but aluminium has some chemical and physical properties that should be considered while using the various joining process. The properties that affect welding:

- oxide characteristics;
- thermal characteristics;
- electrical characteristics;
- lack of color change when heated;
- mechanical properties and melting temperatures that result from alloying with other metals.

Aluminium oxide melts at about 2050 °C which is much higher than the melting point of base metal and if it is not removed that may effect the incomplete fusion. Hydrogen dissolves very rapidly in molten aluminium and may cause the porosity in aluminium welds.

The thermal conductivity of aluminium is about 6 times that of steel which makes aluminium very sensetive to fluctations in heat input of welding process.

Most of aluminium forms can be welded. Sheet, plate, extrusions, forgings, rod, bar, as well as mold castings can be welded. But conventional die-castings and powder metallurgy parts may suffer from porosity during welding because of internal gas.

The alloy composition is much more significant issue than the form in determining the weldability of aluminium alloy.

Specification

AWS	Chemical composition (%)									
	Al	Si	Fe	Cu	Mn	Mg	Cr	Ti	Zn	Other
ER1070	rest	≤0.20	≤0.25	≤0.04	≤0.03	≤0.03	-	≤0.03	≤0.02	≤0.15
ER1100	rest	≤0.95		0.05-0.20	≤0.05	-	-	-	≤0.10	≤0.15
ER4043	rest	4.50-6.00	≤0.80	≤0.30	≤0.05	≤0.05	-	≤0.20	≤0.10	≤0.15
ER4047	rest	11.00-13.00	≤0.80	≤0.30	≤0.15	≤0.10	-	-	≤0.20	≤0.15
ER4145	rest	9.30-10.70	≤0.80	3.30-4.70	≤0.15	≤0.15	-	-	≤0.20	≤0.15
ER5087	rest	≤0.25	≤0.40	≤0.05	0.70-1.10	4.50-5.20	0.05-0.25	≤0.15	≤0.25	Zr:0.10-0.20 Other≤0.15
ER5183	rest	≤0.40	≤0.40	≤0.10	0.50-1.00	4.30-5.20	0.05-0.25	≤0.15	≤0.25	≤0.15
ER5356	rest	≤0.25	≤0.40	≤0.10	0.05-0.20	4.50-5.50	0.05-0.20	0.06-0.20	≤0.10	≤0.15
ER5554	rest	≤0.25	≤0.40	≤0.10	0.50-1.00	2.40-3.00	0.05-0.20	0.05-0.20	≤0.25	≤0.15
ER5556	rest	≤0.25	≤0.40	≤0.10	0.50-1.00	4.70-5.50	0.05-0.20	0.05-0.20	≤0.25	≤0.15
ER5754	rest	≤0.40	≤0.40	≤0.10	≤0.50	2.60-3.60	≤0.30	≤0.15	≤0.20	≤0.15

**Note: Any other specification is subject to discussion and available upon request.*

Mechanical properties & Application (MIG/GMAW)

AWS	Tensile Strength σ_b (MPa)	Yield Strength $\sigma_{0.2}$ (MPa)	Elongation δ_5 (%)	Applications
ER1070	80	30	40	For welding of pure aluminium alloys with maximum of 0.5% alloying elements (Al99.9, Al99.8, Al99.7, Al99.5, Al99, E-Al).
ER1100	80	30	40	
ER4043	160	100	15	For welding of cast Al-Si and Al-Mg-Si alloys with Si≤7% and up to 2% of alloying components (Al99, Al99.5, AlMgSi0.5, AlMgSi0.7, AlMgSi1, etc)
ER4047	180	80	8	For welding of cast Al-Si and Al-Mg-Si alloys with Si≤12% (AlSi12, AlSi11, AlSi10Mg, AlSi9Mg, AlSi6Cu4, AlSi9Cu3, AlSi7Mg, AlSi6Cu4, etc).
ER4145	180	100	10	For welding of Al-Cu and Al-Cu-Si alloys.
ER5087	300	140	30	For welding of high strength Al alloys and low temperature applications (-196°C) (AlMgSi1, AlMg3, AlMg3Si, AlMg4.5Mn, AlMg5, AlMg5Si, AlMg10, AlZn4.5Mg1, etc).
ER5183	280	150	25	
ER5356	260	120	20	For welding of Al alloys with Mg≥3% (AlMg3, AlMg4.5, AlMg5, AlMg3Si, AlZn4.5Mg1, AlMg4Mn, etc)
ER5554	250	100	18	For welding of AlMg2.7Mn and AlMg5Mn1 alloys.
ER5556	275	125	18	
ER5754	190	80	20	For welding of Al alloys with Mg≤3% (AlMg1, AlMg1.5, AlMg1.8, AlMg2.5, AlMg3, AlMgSi0.5, AlMgSi0.7, AlMgSi0.8, etc)

Welding wire selection criterias

The main criterias for selecting of a welding filler alloy are:

- simplicity of welding;
- weld ductility;
- service temperature;
- tensile strength of the weld;
- corrosion resistance;
- sensitivity to weld cracking;
- color correspondence between the weld and base alloy after anodizing.

In general, non-heat-treatable aluminium alloys can be welded with a filler alloy of the same chemical composition as the base alloy. The heat-treatable aluminium alloys are more complex and sensitive to cracking, that's why a dissimilar alloy filler with higher levels of solute is used.

1xxx series - high purity aluminium alloys are easy to weld with a base alloy filler, alloy ER1070-1100, or aluminium-silicon (Al-Si) alloy filler, like ER4043.

2xxx series - many alloys in this series are not arc weldable. Those that are arc-weldable include 2219, 2014, 2519, 2008, and 2036. Alloy 2319 is a matching filler alloy for 2219 and 2519 and can also be used on the other weldable alloys. Alloys ER4043 and ER4145, which contain copper, can also be used.

3xxx series - moderate strength aluminum–manganese alloys are relatively crack resistant and can be welded easily using either ER4043 or ER5356.

4xxx series - these alloys generaly are found as welding or brazing fillers. ER4047 is usually the best choice as a filler metal.

5xxx series - higher strength aluminum–magnesium alloys (Al-Mg) are the most common structural aluminum sheet and plate alloys. In general, except for the alloy 5052, is to choose a 5xxx filler metal with slightly higher magnesium content than the parent material being welded. For all alloys except 5052, 5xxx alloys should not be welded using 4xxx filler alloys.

6xxx series - are easily welded with aluminium-silicon (Al-Si) type filler alloys, like ER4043 and ER4047. Aluminium-magnesium (Al-Mg) type filler alloys can also be used for welding of low-copper 6xxx alloys when higher shear strength and weld ductility are required.

7xxx series - aluminium-zinc-magnesium alloys (Al-Zn-Mg) are very sensitive to crack during welding. Alloys 7005 and 7039, with a low copper content (<0.1%), have a narrow melting range and can be readily joined with the high magnesium filler alloys ER5356, ER5183 and ER5556. The 7xxx series alloys that possess a substantial amount of copper, such as 7975 and 7178, have a very wide melting range with a low solidus temperature and are extremely sensitive to weld cracking when are welded.

FOR COPPER ALLOYS

Welding consumables

General description

Copper and copper alloys can be joined by welding, brazing and soldering processes. In manufacturing, copper is often joined by welding. The arc welding processes are of primary concern. Arc welding can be performed using shielded metal arc welding (SMAW), gas-tungsten arc welding (GTAW), gas-metal arc welding (GMAW), plasma arc welding (PAW), and submerged arc welding (SAW).

Ar, He or mixtures of the two are used as shielding gases for GTAW, PAW, and GMAW. Generally, Ar is used when manually welding material is less than 3 mm thick, has low thermal conductivity, or both.

SMAW - can be used in welding of a wide range of thickness of copper alloys. Covered electrodes for SMAW of copper alloys are available in standard sizes from 2.4 to 4.8 mm.

GTAW - is well suited for copper and copper alloys because of its intense arc, which produces an extremely high temperature at the joint and a narrow heat-affected zone. Many of the standard tungsten or alloyed tungsten electrodes can be used in GTAW of copper and copper alloys. The most frequent use of GTAW for copper and copper alloys is for thickness less than 3mm.

GMAW - is preferred for section thickness above 3 mm and for the joining of aluminum bronzes, silicon bronzes and copper-nickel alloys.

PAW - is comparable to GTAW process for these alloys. Ar, He or mixtures of the two are used for the welding of all alloys. Hydrogen gas should never be used when welding coppers. PAW two distinct advantages over GTAW:

- the tungsten is concealed and entirely shielded, that greatly reduces contamination of the electrode, particularly for alloys with low-boiling-temperature constituents (brasses, bronzes, phosphor bronzes, and aluminum bronzes);
- the constructed arc plume gives rise to higher arc energies while minimizing the growth of the HAZ.

Specification

AWS	Chemical composition (%)									
	Cu	Si	Fe	P	Mn	Sn	Pb	Al	Zn	Other
ERCu	rest	≤0.50	≤0.05	≤0.15	≤0.50	≤1.00	≤0.02	≤0.01	-	≤0.50
ERCuSn-A	rest	-	≤0.10	0.01-0.40	-	4.00-7.00	≤0.02	≤0.01	≤0.10	≤0.20
ERCuSi-A	rest	2.80-4.00	≤0.50	≤0.02	0.50-1.50	≤1.00	≤0.02	≤0.01	≤1.00	≤0.50
ERCuAl-A1	rest	≤0.10	-	-	≤0.50	-	≤0.02	6.00-8.50	≤0.20	≤0.50
ERCuAl-A2	rest	≤0.10	0.50-1.50	-	-	-	≤0.02	8.50-11.00	≤0.02	≤0.50
ERCuNi	rest	≤0.25	0.40-0.75	≤0.02	≤1.00	-	≤0.02	-	-	Ni: 29.00-32.00 Ti: 0.20-0.50
ERCuNiAl	rest	≤0.10	3.00-5.00	-	0.60-3.50	-	≤0.02	8.50-9.50	≤0.10	Ni:4.00-5.00

**Note: Any other specification is subject to discussion and available upon request.*

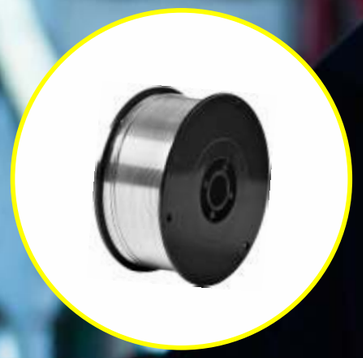
Mechanical properties & Application (MIG/GMAW)

AWS	Tensile Strength σ_b (MPa)	Yield Strength $\sigma_{0.2}$ (MPa)	Elongation δ_5 (%)	Applications
ERCu	220	100	30	For welding of copper and low-alloyed copper alloys.
ERCuSnA	260	150	25	For welding and surfacing of Cu-Sn, Cu-Zn and Cu-Sn-Zn-Pb alloys.
ERCuSi-A	350	120	40	For welding of Cu, Cu-Si, Cu-Zn alloys, surfacing of unalloyed or medium alloyed steels or cast irons. Suitable for joining of galvanized steels.
ERCuAl-A1	430	200	40	For welding of Cu-Al alloys (aluminium bronzes).
ERCuAl-A2	430	185	35	
ERCuNi	400	220	30	For welding of Cu-Ni alloys.
ERCuNiAl	500	390	25	For welding of Cu-Al and Cu-Ni-Al alloys with 7-9% of Al.

PAW of coppers and copper alloys may be performed either autogenously or with filler metal. Filler metal selection is identical to that for GTAW. Welding positions for PAW are identical to those for GTAW. Generally, all information presented for GTAW is applicable to PAW.

SAW - is used for welding of thick gage material, such as pipe formed from heavy plate, and can be achieved by continuous metal-arc operation under a granular flux. Effective deoxidation and slag-metal reactions to form the required weld-metal composition are critical and the SAW process is still under development for copper-base materials, a variation on this, process can be used for weld cladding or hardfacing.

DELIVERY PROGRAMM



SPOOL D100

SPOOL SPECIFICATION:
Outside diameter: 100 mm
Inside diameter: 16 mm
Width: 45 mm
Wire capacity: 1 kg
Coiling: 0.60 - 1.00 mm

SPOOL D200

SPOOL SPECIFICATION:
Outside diameter: 200 mm
Inside diameter: 52 mm
Width: 45 mm
Wire capacity: 5 kg
Coiling: 0.60 - 1.20 mm

SPOOL D300

SPOOL SPECIFICATION:
Outside diameter: 300 mm
Inside diameter: 52 mm
Width: 100 mm
Wire capacity: 15-18 kg
Coiling: 0.60 - 2.40 mm

SPOOL K400

SPOOL SPECIFICATION:
Outside diameter: 400 mm
Inside diameter: 190 mm
Width: 200 mm
Wire capacity: 15-27 kg
Coiling: 2.00 - 5.00 mm

SPOOL D415

SPOOL SPECIFICATION:
Outside diameter: 415 mm
Inside diameter: 300 mm
Width: 105 mm
Wire capacity: 15 - 27 kg
Coiling: 2.00 - 5.00 mm

SPOOL K415

SPOOL SPECIFICATION:
Outside diameter: 415 mm
Inside diameter: 300 mm
Width: 105 mm
Wire capacity: 15 - 27 kg
Coiling: 2.00 - 5.00 mm

COIL

COIL SPECIFICATION:
Outside diam.: 600-700 mm
Inside diam.: 400-500 mm
Width: 10-20 mm
Wire capacity: 25-40 kg
Coiling: 1.60 - 5.00 mm

TIG BOX

TIG ROD SPECIFICATION:
Diameter: 1.00-5.00 mm
Length: 300-1000 mm
Package type: tube/box
Material: carton / plastic
Weight: 2.5-10.00 kg

WIRE DRUM

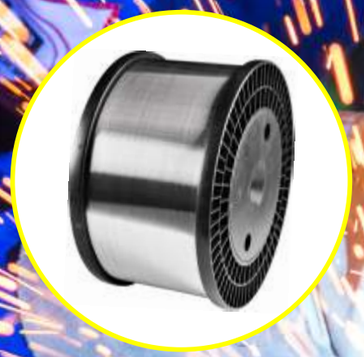
DRUM SPECIFICATION:
Height: 800 mm
Width: 500 mm
Material: cardboard / timber
Wire capacity: 100-300 kg
Coiling: 0.6-2.00 mm

SPOOL BS300

SPOOL SPECIFICATION:
Outside diameter: 300 mm
Inside diameter: 52 mm
Width: 98 mm
Wire capacity: 15-18 kg
Coiling: 0.60 - 2.40 mm

SPOOL K300

SPOOL SPECIFICATION:
Outside diameter: 300 mm
Inside diameter: 190 mm
Width: 98 mm
Wire capacity: 15-18 kg
Coiling: 0.60 - 2.40 mm



SPOOL K350

SPOOL SPECIFICATION:
Outside diameter: 350 mm
Inside diameter: 52 mm
Width: 185 mm
Wire capacity: 15-18 kg
Coiling: 1.20 - 5.00 mm

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