Repair & Maintenance

DATA SHEET **E-22**

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29.9 DISSIMILAR WELD METALS

Alloy type

Austenite-ferrite weld metal composition of nominally 29%Cr-9%Ni for dissimilar joints and difficult to weld steels.

Materials to be welded

Medium and high carbon hardenable steels, tool steels and free-cutting steels.

Eg. BS970 part 21: 080M40 (En8), 070M55 (En9), 709M40 (En19) etc.

Applications

Use for welding medium and high carbon hardenable steels, of known or unknown specifications, for example **tool steels, shafts, gear teeth, free-cutting steels, dissimilar alloy combinations, buffer layers, overlays** etc.

Combination of high alloy and high ferrite content (40-50FN) gives extreme tolerance to dilution on a wide range of hardenable and alloy steels with minimum or no preheat. It has also been found useful for welding **free-cutting steels** or those with a low Mn:S ratio (especially < 20 or so), where other weld metals may fail to prevent hot cracking due to liquation at the fusion boundary.

Weld deposit work-hardens and gives good wear and friction resistance.

Useful for resistance to corrosion and to high temperature scaling up to about 1000°C, but not recommended for structural applications above 300°C or for welds to be post-weld heat treated, owing to embrittlement.

Not recommended for filling up heavy joints nor for sub-zero applications or where high notch toughness is required. In these cases, it is generally best to use the electrode for buttering only (preheat if appropriate), then fill with a more ductile austenitic type (no preheat needed) according to required properties.

Microstructure

Duplex austenite-ferrite microstructure with about 40% ferrite.

Welding guidelines

Procedure will depend on base material. Preheat not normally required for small components and buffer layers, although desirable for thicker high carbon steels to avoid possible HAZ quench cracking and to control peak hardness, 100-250°C.

Additional information

Although 29.9 alloys have good resistance to high temperature oxidation, duplex high ferrite weld metal is subject to 475°C embrittlement above about 300°C and sigma embrittlement at higher temperatures. This alloy is therefore not used where high temperature structural service or PWHT is involved.

Related alloy groups

For dissimilar joints etc. the 309L (data sheet B-50), 309Mo (data sheet B-51), armour welding consumables (data sheet E-20) and 307 types (data sheet E-21) may also be suitable.

Products available

Process	Product	Specification
MMA	**29.9 Super R**	(AWS E312-17)
TIG/MIG/SAW	**312S94**	AWS ER312
Flux	**SS300**	BS EN SA AF2 AC
	SSB	BS EN SA AF2 DC
	LA491	BS EN SA FB255 AC

29.9 SUPER R

Acid rutile MMA electrode

Product description

MMA electrode with acid rutile flux on matching 312 stainless steel core wire.

Recovery is about 100% with respect to core wire, 65% with respect to whole electrode.

Specifications

AWS A5.4	(E312-17)
BS EN 1600	E 29 9 R 32
BS 2926	29.9.AR
DIN 8556	E 29 9 R 21

ASME IX Qualification

QW432 F-No 5

Composition (weld metal wt %)

	C	Mn	Si	S	P	Cr	Ni	Mo	Cu
min	--	--	--	--	--	28.0	8.0	--	--
max	0.15	1.5	1.2	0.025	0.035	31.0	10.5	0.5	0.75
typ	0.1	0.8	1	0.01	0.02	29	9.5	0.1	0.1

All-weld mechanical properties

As welded		min	typical
Tensile strength	MPa	660	830
0.2% Proof stress	MPa	450	700
Elongation on 4d	%	22 *	26
Elongation on 5d	%	15	25
Reduction of area	%	--	30
Hardness	HV	--	280

* Minimum elongation required by AWS not always obtained.

A high tensile strength with moderate ductility is typical for multipass all-weld test specimens but these properties may be altered under conditions of high dilution from base material for which this electrode is intended. Dilution typically raises ductility.

Operating parameters

DC +ve or AC (OCV: 50V min)

ø mm	1.6	2.0	2.5	3.2	4.0	5.0
min A	25	40	60	75	100	130
max A	45	60	90	120	155	210

Packaging data

ø mm	1.6	2.0	2.5	3.2	4.0	5.0
length mm	250	250	300	350	350	350
kg/carton	9.0	9.3	12.0	13.8	14.1	13.5
pieces/carton	1389	948	642	435	276	168

Storage

3 hermetically sealed ring-pull metal tins per carton, with unlimited shelf life. Direct use from tin is satisfactory for longer than a working shift of 8h. Excessive exposure of electrodes to humid conditions will cause some moisture pick-up and increase the risk of porosity.
For electrodes that have been exposed:
Redry 200 – 250°C/1-2h to restore to as-packed condition. Maximum 400° C, 3 cycles, 10h total.
Storage of redried electrodes at 50 – 200°C in holding oven or heated quiver: no limit, but maximum 6 weeks recommended. Recommended ambient storage conditions for opened tins (using plastic lid): < 60% RH, > 18°C.

Fume data

Fume composition, wt % typical:

Fe	Mn	Ni	Cr	Cu	F	OES (mg/m^3)
8	4	1	8	0.2	17	0.6

312S94

Solid wire for TIG, MIG and SAW

Product description

Solid wire for TIG, MIG and SAW.

Specifications

AWS A5.9	ER312
BS EN ISO 14343-A	29 9
BS EN ISO 14343-B	SS312
BS 2901: Pt2	312S94
DIN 8556	(SG X10CrNi 30 9 (1.4337))

ASME IX Qualification

QW432 F-No 6

Composition (wire wt %)

	C	Mn	Si	S	P	Cr	Ni	Mo	Cu
min	--	1.0	0.30	--	--	28.0	8.0	--	--
max	0.15	2.5	0.65	0.02	0.030	32.0	10.5	0.3	0.3
typ	0.1	1.8	0.4	0.005	0.02	30	9.3	0.1	0.1

All-weld mechanical properties

Typical values as welded			TIG	MIG	
				$Ar + 5\%CO_2$	$Ar + 2\%O_2$
Tensile strength		MPa	790	813	789
0.2% Proof stress		MPa	640	628	638
Elongation on 4d		%	21	25	10
Elongation on 5d		%	19	24	10
Reduction of area		%	35	31	10
Impact energy	+ 20°C	J	50	--	27
Hardness		HV	275	270	300

Typical operating parameters

	TIG	MIG	SAW
Shielding	Ar *	$Ar + 2\text{-}5\%CO_2$ **	SS300 ***
Current	DC-	DC+	DC+
Diameter	2.4mm	1.2mm	2.4
Voltage	120A, 14V	220A, 26V	350A, 30V

* Also required as a purge for root runs.

** $Ar – CO_2$ gases were found to produce better ductility than $Ar – 2\%O_2$ (see properties above).

*** **SSB** and **LA491** also suitable.

Packaging data

ø mm	TIG	MIG	SAW
1.2	--	15kg spool	--
1.6	2.5kg tube	--	25kg coil
2.4	2.5kg tube	--	25kg coil
3.2	To order	--	--

Fume data

MIG fume composition (wt %) (TIG and SAW fume negligible)

Fe	Mn	Cr^3	Ni	Mo	Cu	OES (mg/m^3)
30	12	22	9	<1	<1	2.3