Repair & Maintenance

DATA SHEET **E-11**

METRODE PRODUCTS LTD
HANWORTH LANE, CHERTSEY
SURREY, KT16 9LL
Tel: +44(0)1932 566721
Fax: +44(0)1932 565168 Sales
Fax: +44(0)1932 569449 Technical
Fax: +44(0)1932 566199 Export
Email: info@metrode.com
Internet: http//www.metrode.com

NICKEL-IRON FOR CAST IRON

Alloy type

Nominally Fe-55% Ni alloy for the repair and joining of cast iron.

Materials to be welded

ASTM	BS
A602, A47, A338, A220	2789 – SG irons
	6681 – Ductile irons

Applications

The NiFe alloy is suitable for welding all grades of cast iron but particularly for **spheroidal graphite** (**SG**), **nodular** or **ductile irons** and some **alloy cast irons**. It provides compatible strength, ductility and toughness, coupled with good machinability.

The NiFe consumables can also be used on some of the high alloy **austenitic irons** (**Ni-Resist**). The flake graphite grades are welded with a preheat of 300-350°C but the SG grades are best buttered using low heat input, and low temperature techniques to avoid HAZ hot cracking.

Note the martensitic **Ni-Hard** cast irons and **white irons** are generally considered to be unweldable because they are too crack-sensitive.

The NiFe consumables are also suitable for welding **transition joints** between cast iron and cast steels, and cast iron and mild/low alloy steels.

Typical components are **machine bases**, **pump bodies**, **engine blocks**, **gears** and **transmission housings**.

Welding guidelines

Welding is often carried out without preheat but heavy multipass deposits or highly restrained joints may require preheat 150-250°C.

Prior to welding surfaces should be prepared by careful gouging and/or grinding using limited amounts of heat to avoid propagating cracks. The area to be welded should be cleaned as far as practicable from sand, oil, grease, paint or rust. Preheating can help to remove impregnated oil on used castings which are being repaired.

If welding is carried out without preheat it is desirable to minimise the width of the HAZ by using a low heat input and low interpass temperature. A skip welding technique can be beneficial in helping to achieve this.

For thicker section welds and highly restrained welds preheat in the range 150-250°C may be necessary. Light peening to reduce contraction stresses can also be beneficial but care should be taken not to exhaust the ductility of the weld metal.

Buttering the joint faces, or sides of the repair cavity, prior to filling can also be desirable whether a preheat is used or not.

On completion of welding the workpiece should be allowed to cool slowly, using insulation if necessary.

Additional information

The NiFe weld metals produce higher strength than the pure nickel cast iron types and are therefore preferable for dissimilar joints, nodular irons and higher strength cast irons. The NiFe types are also less sensitive to hot cracking caused by pick-up of impurities such as phosphorus which are often present in castings. The low matrix contraction coefficient of NiFe is also enhanced in the higher carbon electrode deposits by expansion accompanying graphite precipitation and results in lower stresses in heavy repairs; the possibility of cold cracking is therefore reduced.

Related alloy groups

The pure nickel types (data sheet E-10) are also used for welding cast iron.

Products available

Process	Product	Specification
MMA	**CI Special Cast NiFe**	AWS ENiFe-CI
	CI-Met NiFe	AWS ENiFe-CI
MIG	**55NiFe**	BS NA47

General Data for all MMA Electrodes

Storage	**3 hermetically sealed ring-pull metal tins** per carton, with unlimited shelf life. Direct use from tin is satisfactory. For electrodes that have been exposed: **Redry** 100 – 150°C/1-2h to restore to as-packed condition. Maximum 150° C, 3 cycles, 10h total. **Storage**: 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	Ba	OES (mg/m^3)
3.5	1	2	<0.2	<0.5	12	<0.5	5

CI SPECIAL CAST NiFe

NiFe MMA electrode for most grades of cast iron

Product description	MMA electrode with special basic-graphite flux (no barium compounds) on a 55%Ni alloy core wire. Good refining action provides maximum resistance to cracking and freedom from porosity. Recovery is about 95% with respect to core wire, 70% with respect to whole electrode.
Specifications	**AWS A5.15** ENiFe-CI **BS EN 1071** E C NiFe-CI 1 **DIN 8573** (E NiFe-1 BG)
ASME IX Qualification	**QW432** F-No --

Composition (weld metal wt %)

	C	Mn	Si	S	P	Fe	Ni	Al	Cu
min	--	--	--	--	--	bal	45.0	--	--
max	2.0	2.5	2.0	0.03	0.03	bal	60.0	1.0	2.5
typ	0.5	1.5	0.5	0.010	0.005	42	55	<0.1	<0.1

All-weld mechanical properties

As welded		typical
Tensile strength	MPa	400
0.2% Proof stress	MPa	230
Elongation	%	10-12
Hardness	HV	170-200

Operating parameters

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

ø mm	2.5	3.2	4.0
min A	60	70	90
max A	80	110	150

Packaging data

ø mm	2.5	3.2	4.0
length mm	305	355	355
kg/carton	13.5	15.0	15.0
pieces/carton	618	450	297

CI-MET NiFe

NiFe MMA electrode on bi-metallic core wire

Product description	MMA electrode with special basic-graphite flux (no barium compounds) on bi-metallic Fe clad Ni core wire. Good refining action provides maximum resistance to cracking and freedom from porosity. The bi-metallic core wire minimises the risks of over-heating normally associated with NiFe MMA electrodes and produces excellent operability. Recovery is about 95% with respect to core wire, 70% with respect to whole electrode.
Specifications	**AWS A5.15** ENiFe-CI **BS EN 1071** E C NiFe-CI 1 **DIN 8573** (E NiFe-1 BG)
ASME IX Qualification	**QW432** F-No --

CI-MET NiFe (continued)

Composition (weld metal wt %)

	C	Mn	Si	S	P	Fe	Ni	Al	Cu
min	--	--	--	--	--	bal	45.0	--	--
max	2.0	2.5	2.0	0.03	0.03	bal	60.0	1.0	2.5
typ	0.5	1.5	0.5	0.010	<0.01	42	55	<0.1	<0.1

All-weld mechanical properties

As welded		typical
Tensile strength	MPa	400
0.2% Proof stress	MPa	230
Elongation	%	10-12
Hardness	HV	170-200

Operating parameters

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

ø mm	2.5	3.2	4.0
min A	60	75	100
max A	80	120	155

Packaging data

ø mm	2.5	3.2	4.0
length mm	300	350	350
kg/carton	13.5	15.0	15.0
pieces/carton	789	468	300

55NiFe

Solid MIG wire for welding cast irons

Product description

Solid wire for MIG.

Specifications

BS 2901 pt 5 NA47
BS EN 1071 S C NiFe-1
DIN 8573 (MSG NiFe-1)

ASME IX Qualification

QW432 F-No --

Composition (wire wt %)

	C	Mn	Si	S	P	Ni	Fe	Cu	Co
min	--	--	--	--	--	52.0	bal	--	--
max	0.15	1.0	0.5	0.02	0.03	60.0	bal	0.5	2.0
typ	0.05	0.7	0.2	<0.01	<0.01	58	40	0.01	0.05

All-weld mechanical properties

Typical values as welded		MIG (Ar-5%CO_2)
Tensile strength	MPa	400
0.2% Proof stress	MPa	230
Elongation	%	24
Hardness	HV	150

Typical operating parameters

	MIG
Shielding	Ar / Ar + 1-2%O_2 / Ar + 2-25%CO_2 / 100%CO_2
Current	DC+
Diameter	1.2mm
Parameters	200A, 28V

Packaging data

ø mm	MIG
1.2	15kg spool
1.6	15kg spool

Fume data

MIG fume composition, wt %:

Fe	Mn	Cr^3	Ni	Cu	OES (mg/m^3)
35	2	<0.1	30	<0.5	1.7