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Jawaharlal Nehru
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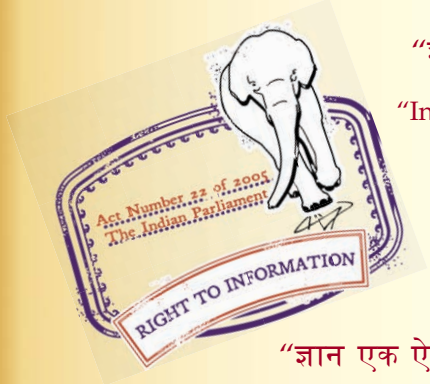
IS 5511 (1991): Covered electrodes for manual metal arc welding of cast iron_ [MTD 11: Welding General]



"ज्ञान से एक नये भारत का निर्माण"
Satyanarayan Gangaram Pitroda
"Invent a New India Using Knowledge"

"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

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IS 5511 : 1991
(Reaffirmed 2003)

भारतीय मानक

ढलवां लोहे की हस्त धातु आर्क वेल्डिंग के लिये ढके इलैक्ट्रोडों की विशिष्टि

(पहला पुनरीक्षण)

Indian Standard

COVERED ELECTRODES FOR MANUAL METAL ARC WELDING OF CAST IRON — SPECIFICATION

(First Revision)

UDC 621·791·753·042·4 : 003·62

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

September 1991

Price Group 4

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Welding General Sectional Committee had been approved by the Metallurgical Engineering Division Council.

This standard was first published in 1969. In this revision the following modifications have been effected:

a) Classification system for the electrode has been aligned with ISO 1071 : 1983 'Covered electrodes for manual arc welding of cast iron — Symbolisation'; and
b) Usability test has been included.

In the formulation of this standard assistance has been derived from the following International Standards apart from keeping in view the practices prevailing in the country:

a) ISO 1071 : 1983 'Covered electrodes for manual arc welding of cast iron — Symbolisation', issued by the International Organization for Standardization.
b) AWS A 5.15 : 1982 'Specification for welding rods and covered electrodes for cast iron', issued by the American Welding Society, inc, U.S.A.; and
c) JIS Z 3252 : 1976 Japanese Industrial Standard 'Covered electrodes for cast iron', issued by the Japanese Standards Association, Japan.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off values should be the same as that of the specified value in this standard.

Indian Standard

COVERED ELECTRODES FOR MANUAL METAL ARC WELDING OF CAST IRON — SPECIFICATION

(First Revision)

1 SCOPE

1.1 This standard specifies a system of classification and coding and covers requirements for covered electrodes for manual metal arc welding of cast iron.

2 REFERENCES

The following Indian Standards are necessary adjuncts to this standard :

IS No.	*Title*
210 : 1978	Specification for grey iron casting
812 : 1957	Glossary of terms relating to welding and cutting of metals
12308	Methods of chemical analysis of cast iron and pig iron

3 TERMINOLOGY

For the purpose of this standard the definitions given in IS 812 : 1957 shall apply.

4 BASIS FOR CODING

4.1 General

The coding for cast iron electrodes is based upon the chemical composition of the core wire for iron base and copper base electrodes and of the weld metal for nickel base electrodes (*see* Table 1).

4.2 Method of Coding

The method of coding for an electrode consists of symbols for the following elements:

a) Prefix symbol E (*see* **4.2.1**),

b) Symbol for chemical composition of the electrode core wire or weld metal, using a group of letters and possibly a number (*see* **4.2.2**),

c) Symbol characterising using one or two letters (*see* **4.2.3**) type of coating; and

d) Symbol relating to conditions of use:

i) Welding positions — using a number (*see* **4.2.4**).

ii) Power supply — using a number (*see* **4.2.5**).

4.2.1 *Prefix Symbol*

The letter E at the head of the symbol code distinguishes the covered electrodes for arc welding from any other filler product.

4.2.2 *Symbol for Chemical Composition*

The group of symbol indicate the main constituents of the core wire for iron based and copper based electrodes and of the weld metal for nickel base electrodes. Where more than one classification is included in a basic group individual classification for the group are identified by digits 1, 2. etc. Table 1 gives symbols according to types of alloys.

Table 1 Symbols for Some Alloy Types

(*Clause* 4.1)

Basic Group	Symbol	Type of Alloy
Iron Base	FeC 1	Grey cast iron
	FeC 2	Grey cast iron with steel core
	Fe	Steel
Nickel Base	Ni Fe	Nickel — iron
	Ni Cu 1	Nickel — copper
	Ni Cu 2	Nickel — copper
	Ni	Nickel
Copper Base	Cu Al	Copper — aluminium
	Cu Sn 1	Copper — tin
	Cu Sn 2	Copper — tin
	Z	Other types

NOTE — Annex B gives detailed description of these electrodes and examples of their.

4.2.3 *Symbol for Type of Coating*

Type of coating is indicated by the following letters:

B — Basic
G — Graphite
BG — Basic with Graphite
S — Organic Salt
V — Other types

Description for the type of coatings pertaining the above symbol has been explained in Annex A.

4.2.4 *Symbol for Welding Positions*

4 2.4.1 The symbol used to denote the basic welding positions for which an electrode is suitable are given in Table 2.

Table 2 Welding Positions
(*Clause* 4.2.4.1)

Symbol	Basic Welding Position
1	All
2	All, except vertical downwards
3	Flat (butt and fillet welds) and horizontal vertical (fillet weld)
4	Flat (butt and fillet)
5	As for 3 and recommended for vertical downwards.

4.2.5 *Symbols for Welding Currents*

4.2.5.1 The symbols used to denote welding current indicate the power supply required to obtain operating conditions free from such occurrences as instability or interruption of the arc.

4.2.5.2 The open circuit voltage necessary for striking the arc varies according to the diameter of the electrode. A reference diameter in digit is, therefore, given for symbolisation.

4.2.5.3 Welding current for electrodes of diameter equal to or greater than 2·5 mm is given in Table 3. The frequency of the alternating current is assumed to be 50 to 60Hz. The open circuit voltage required when the electrodes are used with a direct current depends essentially on the dynamic characteristics of the welding plant.

Table 3 Welding Currents

Symbol	Direct Current Recommended Polarity**	Alternative Current Minimum Open Circuit Voltage, V
0*	+	
1	+ or —	50
2	—	50
3	+	50
4	+ or —	70
5	—	70
6	+	70
7	+ or —	90
8	—	90
9	+	90

* Symbol reserved for electrodes used exclusively with direct current.
** Positive polarity: +
Negative polarity: —

5 EXAMPLES OF CODING AND APPLICATION

5.1 An electrode for manual arc welding of cast iron has the following characteristic:

a) Chemical composition of weld metal: nickel 55 percent, from 42 percent (approx. relative proportion);

b) Coating with high contents of graphite, arc stabilizing elements and flux;

c) Welding in the flat position only (butt and fillet weld); and

d) For direct current electrode of positive polarity is preferred and for welding with alternating current, the open circuit voltage is 90 volt minimum.

The above characteristic of the electrode are symbolised as ENiFeG49.

5.2 A detailed description of various types of electrodes, their characteristics and examples of application has been given in Annex B so as to assist the users in specifying and selecting the appropriate electrode.

6 DIMENSIONS

6.1 Size

The size of the electrode shall be designated by the diameter of the core wire expressed in mm. The designation and size of the electrodes shall be as given in Table 4.

Table 4 Size of Electrodes

Size Designation	Diameter of Core Wire, mm
2·5	2·50
3·15	3·15
4	4·00
5	5·00
6·3	6·30

6.2 Tolerance on the Size

Tolerance on the specified diameter of the core wire shall be + 0·00 mm and — 0·15 mm.

6.3 Length

The nominal length of the various size of electrodes shall be 350 mm and 450 mm.

6.4 Tolerances on Length

The tolerance on length of individual electrodes over nominal length shall be ± 3 mm.

7 QUALITY REQUIREMENTS

7.1 General

7.1.1 The core wire and covering shall be free from defects which may interfere in the uniform performance of the electrode.

7.1.2 The contact end of the electrode shall be bare and clean to a length of 20 to 30 mm.

7.1.3 The arc striking end of the electrode shall be sufficiently bare to permit easy striking of the arc. The distance from the arc and to the first point where the full cross-section of the covering prevails shall not exceed the diameter of the core wire subject to a maximum of 2·5 mm.

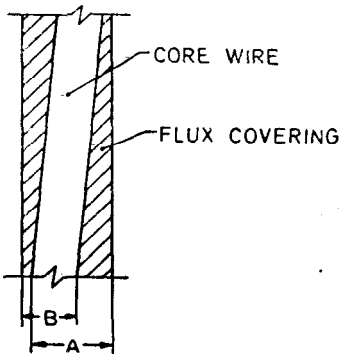
7.2 Covering

7.2.1 The covering shall be free from harmful defects and shall be sufficiently robust to

withstand normal handling storage and use, without damage.

7.2.2 The covering shall not easily give rise to chemical changes nor absorb moisture during storage effecting performance of the electrode and properties of the weld metal.

7.2.3 The covering shall be uniform in outside diameter and in thickness. The tolerance permitted for uniformity of covering shall be such that the maximum core plus one covering dimensions shall not exceed the minimum core-plus one covering dimension by more than five percent of the mean of the two dimensions (*see* Fig. 1).



A = core plus one maximum covering; and
B = core plus one minimum covering.

FIG. 1 PERMISSIBLE TOLERANCES FOR FLUX COVERING

7.3 Chemical Composition

The chemical composition of the core wire for iron based and copper based electrodes and of the weld metal for nickel based electrodes when tested as per **8.2** shall conform to Table 5.

7.4 Usability

Usability test when conducted according to **8.3** the welding arc shall be stable and without spattering and the bead surface and polished weld shall show no harmful visual defects.

8 TESTING

8.1 Each batch of the electrodes manufactured shall be tested for chemical composition and usability test as per **8.2** and **8.3.**

NOTE – For the purpose of this standard, a batch is defined as being of the same dry mix and the same cast number.

8.2 Chemical Analysis

The chemical composition of the core wire or the weld metal shall be analysed according to relevant part of IS 12308 or by any suitable method as agreed to between the supplier and the purchaser.

8.2.1 For the chemical analysis of the core wire for iron based or copper based electrodes, adequate number of bare welding rods, sufficient for retest, if necessary, shall be obtained.

8.2.2 For the chemical analysis of the nickel based covered electrodes, the sample of weld

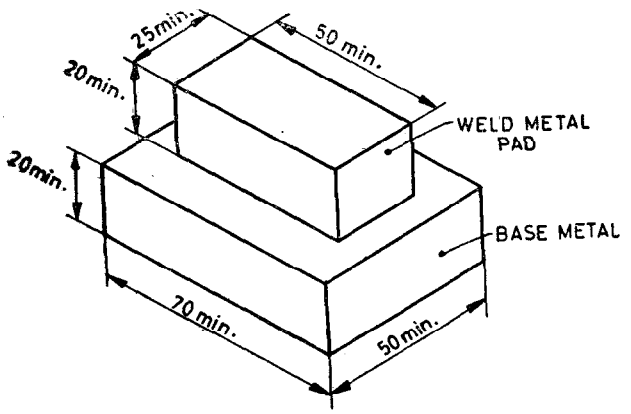
Table 5 Chemical Composition
(*Clause* 7.3)

Symbol	FeC 1	FeC 2:Fe	NiFe	NiCu 1	NiCu 2	Ni	CuAl	CuSn 1	CuSn 2
Element	Composition of Core Wire %[1]								
C	3·25 to 3·50	0·15	2 00	0·35 to 0·55	0·35 to 0·55	2·00	—	—	—
Si	2·75 to 3·00	0·03	4·00	0·75	0·75	4·00	0·10	[4]	[4]
Mn	0·60 to 0·75	0·30 to 0·60	1·00	2·25	2·25	1·00	—	[4]	[4]
P	0·50 to 0·75	0·04	—	—	—	—	—	0·10 to 0·35	0·05 to 0·35
S	0·10	0·04	0·03	0·025	0·025	0·025	—	—	—
Fe	remainder	remainder	remainder	3·0 to 6·0	3·0 to 6·0	8·00	1·5	[4]	[4]
M	trace	—	—	—	—	—			
Ni[2]	trace	—	45·0 to 60·0	50·0 to 60·0	60·0 to 70·0	85 *Min*	—	[4]	[4]
Cu[3]	—	—	2·50	35·0 to 45·0	25·0 to 35·0	2·50	remainder	remainder	remainder
Zn	—	—	—	—	—	0·02	[4]		[4]
Sn	—	—	—	—	—	—	4·0 to 6·0		7·0 to 9·0
Al	—	—	—	—	—	9·0 to 11·0	0·01[4]		0·01[4]
Pb	—	—	—	—	—	0·02	0 02[4]		0·02[4]
Total or other elements	—	—	1·00	1·00	1·00	1·00	0·50	0·50	0·50

1) Unless otherwise stated, single values represent maximum percentages.
2) Nickel plus incidental cobalt.
3) Copper plus incidental silver.
4) Total of other elements including those (footnote 4), shall not exceed the specified value.

metal prepared in accordance with the following shall be used.

The deposited weld metal pad shall be laid in the flat position to the dimensions shown in Fig. 2 on a base metal of convenient size of cast iron or carbon steel, as agreed. The weld metal pad shall be built up of multiple passes and layers. Slag shall be removed following each pass. The minimum temperature of the test pad shall be 16°C prior to welding. The maximum interpass temperature shall be 120°C.



All dimensions in millimetres.

FIG. 2 DIMENSION OF WELD PAD FOR CHEMICAL ANALYSIS

The top surface of the weld metal pad shall be removed prior to obtaining a sample for chemical analysis. The analysis sample of about 60 gms shall be obtained from the pad by machining, drilling, milling or chipping. The sample shall be free of slag and shall be taken not closer than 7 mm from the metal. Cutting oil shall not be used when taking the sample. Post heat treatment, if required, to make the weld metal soft may be done while taking the sample.

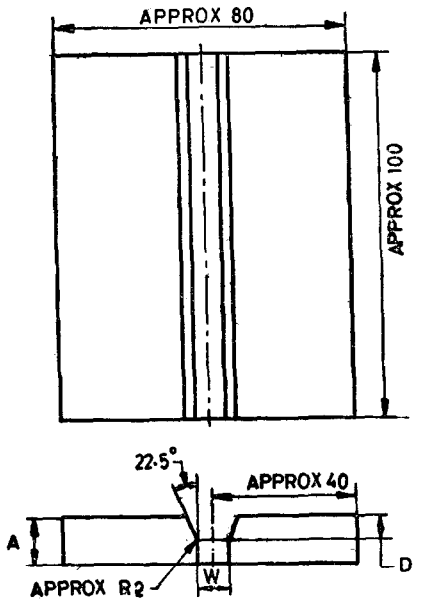
8.3 Usability Test

8.3.1 *Preparation of Test Sample*

The test plate on which the weld metal is to be deposited shall be of grey iron casting conforming to grade FG 200 of IS 210 : 1978 and shall be reasonably free from porosity. The surface of the groove in the test plate shall be machined prior to welding. Dimensions of the test plate shall be as given in Fig. 3.

The weld metal shall then be completely deposited in flat down hand position in the groove of the test plate by suitable welding conditions (*see* **4.2.4** and **4.2.5**) provided that the weld of each pass shall be started with the temperature of the test plate at a maximum of 100°C with FeC 1 electrodes the welding may be started at a maximum of 200°C.

8.3.1.1 The test plate with the deposited weld metal shall be machined or ground 1 to 2 mm below the surface of the casting for physical examination.



All dimensions in millimetres.

Size Designation	*A* mm	*W* mm	*D* mm	*Number of Layers*
2.5	13	4	3·5	2 or 3
3.15	13	5	4	2 or 3
4	13	6	5	2 or 3
5	25	8	6	2 or 3
6.3	25	10	8	2 or 3

FIG. 3 DIMENSIONS FOR TEST PLATE FOR USABILITY TEST

8.3.2 *Inspection*

The test plate shall be visually inspected. Weld area shall be reasonably free from cracks and porosity, not exceeding 6 pores per 10 square centimetre area, with no pores greater than 1·5 mm in diameter.

8.4 Retesting

If either chemical analysis or usability test does not conform to the requirements specified in this standard, that test may be repeated only once, and the results of retest shall conform to the specified requirements.

9 PACKING AND STORAGE

9.1 The net mass of an individual bundle or box of electrodes shall not exceed 5 kg.

9.2 Electrodes shall be suitably packed to guard against damage during transportation. The packing shall be suitable to ensure that under normal store-room conditions the electrode shall, for a period of at least six months after the despatch from the manufacturer's stores, be capable of giving results in accordance with the provisions of the specifications and that if the

flux covering is of a type requiring special protection during storage, the details of such special protection shall be furnished by the manufacturer and reference to this shall be included in the marking of the bundle or box of electrodes. The electrodes shall be stored in dry room.

9.3 Each bundle or package shall contain the manufacturer's certificate to guarantee that the electrodes therein comply with the physical and chemical requirements specified in this standard.

9.3.1 The batch of electrodes represented by the electrodes tested shall not be certified as complying with this specification, unless the test results obtained satisfy the requirements specified and the manufacturer has performed tests at intervals in accordance with the requirements of this specification.

9.3.2 If the marking on the bundle includes the IS Standard Mark (*see* **10.2**), the manufacturer's certificate need not be included.

10 MARKING

10.1 Each bundle or package of electrodes shall be clearly marked with the following informations:

a) Code marking;

b) Name of manufacturer;

c) Designation of electrodes;

d) Size;

e) Batch number (*see* note);

f) Recommended current range;

g) Recommendations for special storage conditions, if required (*see* **9.2**); and

h) Date of manufacture.

NOTE – Method of marking coding and other major characteristics of the electrode is given in Annex C.

10.2 Standard Marking

The bundle or package of electrodes may also be marked with the Standard Mark.

ANNEX A
(*Clause* 4.2.3)

TYPE OF COATINGS

A-1 TYPE B (BASIC)

Electrodes of the basic type usually have a covering containing considerable quantities of calcium carbonate and other fluorides, so that they are basic from a metallurgical point of view.

Only a small amount of dense slag is produced which is typical brown black and of glossy appearance. The slag gets easily detached and rises to the surface quickly. There is little possibility of inclusion in this type of electrode. These electrodes have a moderately penetrating arc which is suitable for welding in all positions. Direct current and positive polarity are generally preferred, but there are some electrodes of this type which can be used with an alternating current at fairly high open circuit voltage.

A-2 TYPE G (GRAPHITE)

The typical coating ingredients and their proportions are indicated below for information:

— graphite	> 20 %
— iron ore	10 to 30 %
— CaF_2	≤ 7 %
— alkaline earth carbonates	< 20 %
— ferro-alloys	< 20 %

With a few exceptions, electrodes of this type can be used for welding in all positions. They have the advantage, especially for iron-based alloys and for welding at high working temperatures of containing a relatively law amount of slag, which is easily removed at high temperatures.

They can be used with direct current (positive or negative polarity) or with alternating current.

A-3 TYPE BG (BASIC WITH GRAPHITE)

The typical coating ingredients and their proportions are indicated below for information:

— alkaline earth carbonates	> 40 %
— graphite	7 to 20 %
— CaF_2	7 to 30 %
— iron ore	< 10 %
— ferro-alloys	< 15 %

Direct current (positive or negative polarity) or alternating current may be used. The elecrodes are suitable for welding in all positions. The welding properties depend to a certain extent on the choice of current and polarity. It is therefore important that the recommendations of electrode manufacturers be taken into account.

A-4 TYPES (ORGANIC SALT)

The typical coating ingredients and their proportion are given below for information:

— sodium components	> 40 %
— cellulose	10 to 20 %
— other slag-forming component	< 20 %
— ferro-alloys	< 20 %

Direct current (with positive or negative polarity) or alternating current may be used. These electrodes are suitable for welding in all positions.

A-5 TYPE V (OTHER TYPE)

The symbol V covers all coatings not specified in **A-1** to **A-4.**

ANNEX B
(*Clause* 5.2)

DESCRIPTION AND EXAMPLES OF USE OF ELECTRODES

B-1 FeC 1 ELECTRODES

B-1.1 This electrodes has a cast iron core wire to which a heavy covering is applied in order to make it suitable for metal arc welding. The weld metal is very fluid and flows readily with a light slag over it. The slag can be easily removed. The weld is machinable, with a hardness of about 170 to 220 Brinell. Castings to be welded should first be grooved to an angle of 60 to 90°. The V-groove should have a root face to prevent difficulties with alignment and melting through.

Preheating is recommended within the range 250 to 760°C, depending on the size of the workpiece and the machinability desired. Subsequent runs should be welded without delay to prevent cooling.

Example of use: Manufacture and repair of pieces of grey cast iron.

B-2 FeC 2 ELECTRODES

B-2.1 This electrodes has a steel core wire, but the weld deposit becomes alloyed with carbon silicon from the covering. In general the carbon content of the deposit is lower and the silicon content higher than for the deposit of an FeC 1 electrode, so that the weld metal has a high tendency to solidify with a structure similar to that of grey cast iron. It is important to follow the manufacturer's instructions as there is an upper limit for the solidification rate which should not be exceeded. The molten metal is less fluid and the strength of the weld metal is higher than with an FeC 1 electrode. The problems of weld stresses and their control are the same as for other cast iron welding methods. The weld deposit is machinable.

Example of use: Manufacture and repair of grey iron castings.

B-3 Fe ELECTRODES

B-3.1 This is a covered electrode for use in all positions. Weld deposits of this electrode are not readily machinable. The formation of a hard fusion zone and the possibility of cracking, due to the difference in shrinkage between steel and cast iron, makes it generally advisable to employ studs which key the weld to the parent metal below the fusion zone.

Preheating is employed where necessary to prevent excessive stresses in other parts of the casting.

This electrode is generally used at low current intensities in order to minimize the dilution effect and cracking of the parent metal. Short runs and slight peening of the runs is recomended.

Example of use: Due to the unfavourable mechanical properties of the weld metal, the use of these electrodes is largely confined to the repair to small pits and cracks with some application in the repair of casting that require no machining.

B-4 Ni: NiFe: NiCu — NICKEL BASE ELECTRODES

B-4.1 General

Weld made with these electrodes can usually be machined. The hardness of the weld metal depends to a great extent upon the extent of dilution by the parent metal. High level of dilution may rise to a hardness of 350 Brinell. Moderately heavy runs, where the dilution is reduced by using a low current and directing the arc on the weld metal, or multiple layer welds, may give a hardness within the range of 175 to 200 Brinell. These electrodes have a soft stable arc with globular metal transfer. Penetration is low. The weld metal wets the cast iron well, resulting in good metal 'wash up'. The liquid slag is fluid and small in amount.

The solidification slag is generally easy to remove. Deposits from NiFe and NiCu electrodes differ less in colour from the cast iron then do Ni deposits. The choice between these electrodes is to be made on the basis of the colour of the deposit and the mechanical properties.

Example of use: (i) Joining or repair of ordinary grey iron castings in light and medium sizes, joining of cast irons to other ferrous and non-ferrous metals.

ii) Welding of nodular graphite cast irons.

B-4.2 Ni Electrodes

Statisfactory welds can be produced on light and medium-size castings and where the welding stresses set up are not severe or where the

phosphorus content of the cast iron is not too high.

B-4.3 NiFe Electrodes

Castings containing higher than normal phosphorus (approximately 0·20%) are more readily welded using the electrodes. Due to the higher tensile strength and ductility of the nickel iron deposits, satisfactory welds can be made on heavy or highly stressess sections. These same characteristics also enable satisfactory welds to be made on high strength and engineering grades of cast iron.

B-4.4 NiCu Electrodes

These electrodes are used in many of the same applications as Ni and NiFe electrodes. Advantages can be found in the colour matching, a slightly lower heat input, and a lower sensitivity to impurities in the cast iron. However, regarding ductility and resistance to cracking, these electrodes are generally somewhat inferior to the other nickel base types. It is difficult to obtain crack-free multi-run welds.

B-5 CuSn — COPPER TIN TYPE ELECTRODES

This group contains electrodes depositing tin bronzes. The weld metal has reasonable mechanical properties with an elongation of about 25 percent and hardness of 70 to 140 Brinell. The weld deposit retains its toughness at sub-zero temperatures and is non-magnetic. The material is not creep-resistant. The metal melts at a temperature of 900 to 1 050 °C. The lower heat input minimizes fusion zone cracking due to the fact that less hard, brittle, white cast iron is formed in this critical area.

The difference between the CuSn 1 and CuSn 2 types is in tin content only. The higher tin content of the CuSn 1 type results in a weld metal of greater hardness and a higher tensile strength and yield stress.

In welding with these electrodes it is advisable to use wide grooves, to clean the edges for joining of all traces of moisture, grease, oil and dirt, to preheat the castings to between 150 to 200°C, to use the lowest possible current for good fusion, and to weld at high speed without waving to minimize dilution from the parent metal.

After welding, the part should be cooled slowly to obtain the best properties in the weld metal. A large part of the contraction strain takes place before the cooling weld metal yielding properties, thus resulting in low residual stresses and thereby greatly reducing the chances of cracking. The weld metal has a bronze colour.

Example of use: Joining and repair of grey cast iron where the danger of stresses and cracking due to heat input is great. Surfacing of heat-resistant and corrosion-resistant surfaces.

B-6 CuAl — COPPER ALUMINIUM TYPE ELECTRODES

In general the same can be said for the CuAl electrodes as for the CuSn types. The tensile strength and yield stress of the deposits are almost double those of the copper in deposits and the ductility is relatively high. The deposit also retains its toughness at sub-zero temperatures but, unlike the previous type, the weld metal is creep-resistant up to a temperature of 250°C. The deposit is non-magnetic.

The weld metal has a golden yellow colour.

Example of use: Same as the CuSn types but these electrodes are more suitable for joining higher strength cast irons, as well as for the surfacing of wear resistant surface.

ANNEX C
(*Clause* 10.1)

METHODS OF MARKING THE CODING OF ELECTRODES

C-1 Each packet of electrodes shall bear a marking which indicates the coding and the major characteristics of the electrodes. The marking shall be in one of the two forms shown below:

Coding	*Current/Voltage*	*Coding*
Position	*Condition*	*Position*
		Current/Voltage
		Condition

C-1.1 Against the heading 'Coding' shall be inserted the coding as specified under **4** and **5.**

C-1.2 Against the heading 'Position' shall be inserted the appropriate symbols for the welding positions for which the electrodes satisfies the test requirement (*see* **4.2.4**).

C-1.3 Against the heading Current/Voltage conditions, shall be inserted the appropriate symbols to indicate the welding current conditions (*see* **4.2.5**).

C-2 Any electrode classified under one coding shall not be classified under any other coding of this specification.

C-3 Examples of completed coding labels are shown below:

Coding	*ENiFeG49*	*Coding*	*ENiFeG49*
Position	*Current/Voltage*	*Position*	*F*
F	*Condition*	*Current/*	*D ± A 90*
	D ± A 90	*Voltage*	
		Condition	

C-3.1 The explanation of the coding illustrated in **C-3** is as follows:

a) The electrode is suitable for manual metal arc welding of cast iron;

b) The core wire is of the nickel-iron alloy;

c) The electrode is suitable for welding in the flat position only;

d) The electrode is suitable for welding in the flat position only; and

e) The electrode is suitable for welding on direct current with electrode positive and it is also suitable for welding with alternative currents with no load voltage not less than 90 volts.

Standard Mark

The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act, 1986* to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Revision of Indian Standards

Indian Standards are reviewed periodically and revised, when necessary and amendments, if any, are issued from time to time. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition. Comments on this Indian Standard may be sent to BIS giving the following reference :

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TO
IS 5511 : 1991 COVERD ELECTRODES FOR MANUAL METAL ARC WELDING OF CAST IRON — SPECIFICATION

(First Revision)

(*Page* 3, *Table* 5)—Substitute the following for the existing table:

'Table 5 Chemical Composition

(*Clause* 7.3)

Symbol	FeC 1	FeC 2	NiFe	NiCu 1	NiCu 2	Ni	CuAl	CuSn 1	CuSn 2
Element	**Composition of Core Wire, Percent[1)]**								
C	3·25 to 3·50	0·15	2·0	0·35 to 0·55	0·35 to 0·55	2·0	—	—	—
Si	2·75 to 3·00	0·03	4·0	0·75	0·75	4·0	0·10	4)	4)
Mn	0·60 to 0·75	0·30 to 0·60	1·0	2·25	2·25	1·0	—	4)	4)
P	0·50 to 0·75	0·04	—	—	—	—	—	0·10 to 0·35	0·05 to 0·35
S	0·10	0·04	0·03	0·025	0·025	0·025	—	—	—
Fe	remainder	remainder	remainder	3·0 to 6·0	3·0 to 6·0	8·0	1·5	4)	4)
M	trace	—	—	—	—	—	—	—	—
Ni[2)]	trace	—	45·0 to 60·0	50·0 to 60·0	60·0 to 70·0	85·0 *Min*	—	4)	4)
Cu[3)]	—	—	2·50	35·0 to 45·0	25·0 to 35·0	2·50	remainder	remainder	remainder
Zn	—	—	—	—	—	—	0·02	4)	4)
Sn	—	—	—	—	—	—	—	4·0 to 6·0	7·0 to 9·0
Al	—	—	—	—	—	—	9·0 to 11·0	0·01[4)]	0·01[4)]
Pb	—	—	—	—	—	—	0·02	0·02[4)]	0·02[4)]
Total of other elements	—	—	1·00	1·00	1·00	1·00	0·50	0·50	0·50

1) Unless otherwise stated, single values represent maximum percentages.
2) Nickel plus incidental cobalt.
3) Copper plus incidental silver.
4) Total of other elements including those (foot-note 4), shall not exceed the specified value.'

(MTD 11)

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