IS : 1261 - 1959
(Reaffirmed 1998)

Indian Standard

CODE OF PRACTICE FOR SEAM WELDING IN MILD STEEL

(Sixth Reprint NOVEMBER 1995)

UDC 621·791·056 : 669·141·24

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

Gr 3

October 1959

Indian **Standard**

CODE OF PRACTICE FOR SEAM WELDING IN MILD STEEL

Structural Welding Sectional Committee, SMDC 15

Chairman

SHRI D. S. DESAI	M. N. Dastur & Co. Private Ltd., Calcutta

Members

SHRI R. J. KUMBHANI (*Alternate* to Shri D. S. Daai)	
SHRI N. C. BAGCHI	Government Teat House, Calcutta
DR. D. R. DHANBHOORA	The Tata Iron & Steel Co. Ltd., Jamrhedpur
SHRI S. VISWANATHAN (*Alternate*)	
SHRI MARTIN EICHLER	The Tata Locomotive & Engineering Co. Ltd., Jamshedpur
SHRI M. K. MOOKERJEE (*Alternate*)	
SHRI KAPOOR CHAND GANGWAL	The Asiatic Oxygen & Acetylene Co. Ltd., Calcutta
SHRI M. MITRA (*Alternate*)	
SHRI S. B. KAPADIA	Hindustan Shipyard Ltd., Visakbapamam
SHRI B. V. KULKARNI	Central Public Works Department, New Delhi
SHRI A. M MADDOX	Stewarts & Lloyd, of India Private Ltd., Calcutta
SHRI C. P. MALIK	National Buildings Organization, New Delhi
SHRI SHRI KRISHNA (*Alternate*)	
SHRI B. N. MOJUMDAR	Directorate General of Supplies & Disposals (Inspection Wing) (Ministry of Works, Housing & Supply)
SHRI S. V. NADKARNI	J. B. Advani-Oerlikon Electrodes Private Ltd., Bombay
SHRI P. S. VISVANATHAN (*Alternate*)	
SHRI S. NANDI	Braithwaitc Burn & Jeuop Construction Co. Ltd., Calcutta
SHRI R. N. PATEL	Structural Engineering Works Ltd., Bombay
SHRI C. H. SHAH	Institution of Engineers (India), Calcutta
SHRI T. R. SHIELDS	Indian Oxygen Ltd., Calcutta
SHRI A. P. FORSYTH (*Alternate*)	
BRIG SHIV DIAL SINGH	Engineer-in-Chief's Branch, Army Headquarters
LT-COL R. N. BHARGAVA (*Alternate*)	
SHRI V. R. SUBRAMANIAN	Ministry of Railways
SHRI A. K. BHATTACHARYA (*Alternate*)	
DR. LAL C. VERMAN (*Ex-officio*)	Director, IS1

Secretaries

SHRI B. S. KRISHNAMACHAR	Assistant Director (S & M), ISI
SHRI A.P. SIVARAMAKRISHNAN	Extra Assistant Director (S & M), ISI

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

Indian Standard

CODE OF PRACTICE FOR SEAM WELDING IN MILD STEEL

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 10 March 1959, after the draft finalized by the Structural Welding Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 This standard specifies the requirements for seam welding in mild steel where the total added thickness of the components to be welded does not exceed 8·0 mm.

0.3 For a particular weld design to be efficient, safe and satisfactory, the designers should be conversant with the possibilities and limitations of the welding processes which are available for use. It is only in recent years that sufficient information and data regarding resistance welding processes have become available to give designers the necessary confidence to use resistance seam welding in assemblies where strength and safety are of importance. It is possible now to indicate procedures and suggest formulæ for the design of such assemblies.

0.4 In the preparation of this standard, the Sectional Committee kept in view the manufacturing and trade practices followed in the country in this field. Furthermore, due consideration was also given to the need for international co-ordination among standards being followed in various countries of the world in this field. These considerations led the Sectional Committee to derive assistance from B.S. 2937 : 1957 General Requirements for Seam Welding in Mild Steel, issued by the British Standards Institution.

0.5 This standard requires reference to IS : 812-1957 Glossary of Terms Relating to Welding and Cutting of Metals.

0.5.1 Wherever a reference to IS : 812-1957 appears in this code, it shall be taken as a reference to the latest version of the standard.

0.6 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, shall be rounded off in accordance with *IS : 2-1949 Rules for Rounding Off Numerical Values. The number of

*Since revised.

significant places retained in the rounded off value should be the same as that of the specified value in this standard.

0.7 In view of the Government of India's decision to introduce in the country a uniform system of weights and measures based on the metric system, all values appearing in this standard are given in metric units.

0.8 This standard is intended chiefly to cover the technical provisions relating to use of seam welding in mild steel, and it does not include all the provisions of a contract.

1. SCOPE

1.1 This standard relates to seam welding in mild steel where the total added thickness of the components to be welded does not exceed 8·0 mm.

1.2 When it is necessary or desirable to seam weld sheets of widely dissimilar thicknesses, there may be limitations on the ratio of the thickness of the material being welded. Further, special techniques for welding may have to be employed.

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions given in IS': 8 12-1957 shall apply.

3. MATERIALS

3.1 Parent Metal

3.1.1 Steel sheets, strips and plates to be seam welded in accordance with this code shall be free from laminations and other defects and shall have a chemical composition with the following limits for carbon, manganese, sulphur and phosphorus:

	Percent
	Max
Carbon	0·15
Manganese	0·50
Sulphur	o-050
Phosphorus	0·050

3.1.1.1 Residual elements, such as chromium, nickel, copper and molybdenum may, if excessive, result in hard or brittle welds which may

be dangerous if the welds are subjected to tensile loading or impact loading, Specimens of such material should be welded by the procedure by which it is intended to weld the component, and the weld shall satisfy the requirements of the tests specified under 7.

NOTE — The purchaser by agreement with the supplier may set a limit to the amount of one or more residual elements and/or may require the amount of such elements to be stated on the certificate of analysis.

3.1.2 This clause does not purport to specify the material to be used in the manufacture of the components. For this purpose, reference should be made to the appropriate Indian Standard.

4. WELDING PLANT

4.1 Welding machines used for seam welding should conform to the requirements specified in Appendix A.

5. ELECTRODES

5.1 The electrodes used for seam welding should conform to the requirements specified in Appendix B.

6. WELDING PROCEDURE

6.1 **Preparation of Parent Metal** — Prior to welding, all the relevant portions of surfaces of components to be seam welded shall be freed from grease, scale, rust, paint., dirt or excessive pitting. Certain surface treatments, such as paint primers, rust prevention treatment, light oiling or plating may be applied before welding provided that the coating is uniform in thickness and it has been proved that consistent welds which comply with this standard can be obtained.

6.1.1 *Edge Conditions and Forms of Components* -The shape of the component and the condition of the edges and surfaces to be welded shall be such that there is proper interface contact at the areas where the welds are to be made.

6.1.2 The electrode wheels and mandrels shall be maintained in such a condition that welds of the required quality are produced.

6.2 **Machine Setting** — The machine shall be capable of exerting a pressure between the electrode wheels in accordance with the following formula:

$$P = 425 W \sqrt{d}$$

where

P = total pressure in kg,

W = width of the tread of the wheel in mm, and

d = mean wheel diameter in mm.

NOTE - **Mean wheel diameter is the mean diameter of the top and the bottom rollers.**

6.2.1 With air-operated machines, an adequate supply of clean and dry air shall be provided to ensure that the required welding pressure is always maintained.

6.2.2 Recommended welding pressures are given *in* Appendix C.

6.2.3 The setting of the machine to exert the required pressure shall be decided upon by tests at the commencement of welding to ensure correct size and strength of the weld and such setting shall become part of the welding procedure for that job.

6.2.3.1 Where the parts to be welded are to be pressure tested, the setting of the machine should be verified by means of a pillow test (see Appendix D).

6.2.4 To enable'a satisfactory setting to be obtained, the correct pressure, the correct welding current, the correct heat time and cool time, the initial width of electrode wheel tread and the number of welds per millimetre shall be ascertained before welding on the actual job is started..

6.2.5 When the work pieces involve introducing into the throat of the machine a varying amount of magnetic material, this will cause an alteration in the welding current and the machine setting shall be adjusted accordingly.

Jigs and. fixtures inserted in the throat of the machine should be constructed of non-magnetic material.

NOTE — **Fluctuations in mains voltage will cause variation in the values of the welding current which will affect the welds.**

6.3 Material Indentation

6.3.1 The indentation caused by the wheel shall 'be not greater than 10 percent of the thickness of the sheet with which the wheel is in contact.

6.3.2 If a pad or mandrel, type electrode is used, the indentation on the wheel side of the work shall be not greater than 15 percent of the thickness of the sheet with which the wheel is in contact.

6.3.3 In the case of 'series welding, the maximum' indentation permitted shall be the subject of agreement between, the purchaser and the manufacturer..

7. ROUTINE TESTS

7.1 To ensure consistent seam welds, test pieces shall be made on the following occasions:

a) As soon as practicable at the beginning of each shift or daily work period,

b) When the tread width has grown to $W + \frac{W}{3}$ (see Appendix B),

c) Immediately after new or re-conditioned electrodes are fitted to the machine,

d) When any of the machine settings is varied, and

e) Immediately prior to the end of the shift or daily work period.

7.2 Conditions, **Under Which Test Pieces are to be Made**

7.2.1 When practicable, actual components shall be used.

7.2.2 When it is not practicable to use actual components, test pieces from the same material may be used, provided sufficient steel is in the throat of the machine to give approximately the same magnetic effect as the work piece under production conditions and provided the test piece is welded using the same setting as was used for the actual components.

7.2.3 The test piece shall always be made with the same thickness of material as on the work. piece.

7.2.4 Test pieces shall be taken from each machine in use on the occasions specified under 7.1.

7.3 **Methods of Testing** — One or more of the tests specified under 7.3.1 to 73.4 shall be selected by agreement between the purchaser and the manufacturer, and shall be carried out on the occasions and under the conditions specified under 7.1 and 7.2.

7.3.1 *Pressure Test* — Where a pressure test is required, this shall be carried out on the actual component and the form and the pressure shall be as agreed to between the purchaser and the manufacturer on the occasions. The test shall be carried out on the occasions and under the conditions stated under 7.1 and 7.2. For the purpose of setting the machine, the pillow test described in Appendix D shall be used.

7.3.2 Slug or *Peel Test -The* test specimen for a slug or peel test shall be 75 mm long. There shall be sufficient metal on either side to enable the specimen to be held in a vice. The test piece shall be peeled apart and one part shall be peeled off the other so that the slugs of metal tend to be pulled from one or other of the sheets. Where an actual component is used as the test sample, the test piece shall be taken from a position as

agreed to between the purchaser and the manufacturer to be the worst condition for welding. The length and width of **the slug** pulled from one or other of the sheets shall approximate to the width of the wheel and the design length of the weld.

7.3.3 *Shear Test* -The shear test specimen shall be made from the same material as'the actual component and shall be a parallel specimen 25 mm wide. The weld shall be considered as satisfactory provided the joint does not shear at a load less than 70 percent of the tensile strength of the material (*see* Fig. 1).

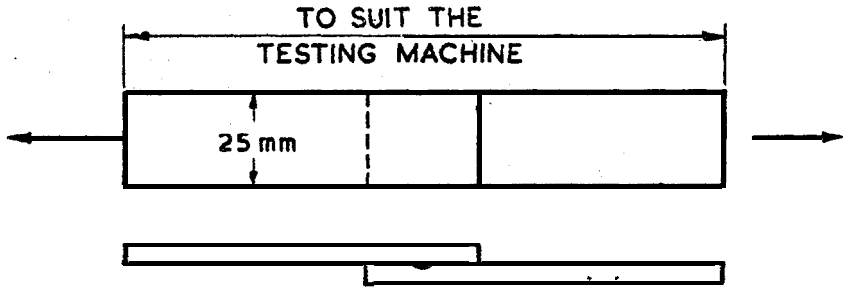

FIG. 1 SHEAR TEST SPECIMEN

7.3.4 *Microscopic Examination* — The test specimen for microscopic examination shall be **of** the same dimension as that for the slug or peel test, and shall be sectioned, polished and etched. The weld shall be examined under a microscope having a magnification of not less than × 10, and shall show no cavities or cracks extending beyond the edge of the weld. Small isolated cracks in the weld may be permitted, provided they do not run across **the interface** of the weld.

8. DESIGN

8.1 Weld Width — The weld width shall conform to the following formula:

$$W = 5\sqrt{e}$$

where

W = width of the wheel in mm, and

e = the thickness of the material in mm.

8.1.1 The weld width shall approximate to the tread width, and may be determined by measurement after exposure of the weld by either sectioning or the slug test specified under **7.3.2.**

8.2 Minimum Edge Distance — The minimum distance from the edge of a component to the major (longitudinal) axis of the weld shall be not less than 1) W, where W is the width of the wheel tread.

9. INSPECTION AND TESTING

9.1 Manufacture shall not start until a satisfactory test specimen has been obtained at the beginning of each period specified under 7.1.

9.2 No dressing, painting or other operation interfering with the examination of the weld zone shall be carried out on the assemblies until the welding has been inspected.

9.3 Visual inspection shall show that the surfaces of the work pieces are of at least the same standard as the. test specimens conforming to the requirements given, under 7.3.

9.4 In the event of the test specimen at the end of the shift or work period failing, the following procedure shall be adopted:

Two percent or ten pieces, whichever is'greater, shall be selected from the production during the period following the previous test on that machine and tested in accordance with 7.3. In the event of more than 20 percent of the selected components failing, the whole of the production during that period shall be deemed not to comply with this Indian Standard.

9.5 The purchaser or his representative shall have access at all reasonable times to those parts of the works engaged on the production and testing of the part which he has ordered and shall be free to inspect the manufacture at any stage.

9.6 The manufacturer shall supply the labour and appliances for such testing as may be carried out on his premises in accordance with this code. Failing facilities at his own works for making the prescribed tests, the manufacturer shall bear the cost of carrying out the tests elsewhere.

APPENDIX A

(*Clause* 4.1)

REQUIREMENTS OF WELDING PLANT

A-l. The machine should be equipped with an automatic controlgear which on the initial actuation of a foot- or hand-operated auxiliary switch, takes the control of the machine out of the hands of the operator

and performs at least the following cycle of operations in the sequence given:

a) Brings the electrodes into contact with the components and applies welding pressure to the work piece.

b) Causes the welding current to flow after the pre-set welding pressure (the pressure between the electrodes) has been'attaincd.

c) Maintains the pre-set heat and cool *sequence,* whilst the pressure is maintained.

d) The actuation of a hand-. or foot-operated switch for stopping welding will cause the automatic control to stop the flow of current before the pressure is automatically released.

NOTE-The electrode wheel or wheels may be rotated continuously or may be started or stopped by the action of a pressure switch.

A-2. The welding pressure, heat time and cool time should be variable over a range sufficient to ensure that optimum welding conditions can be obtained. The machine should be provided with methods of indicating the current setting, pressure and time.

APPENDIX B

[*Clauses* 5.1 *and* 7.1 (b)]

REQUIREMENT OF ELECTKODES

B-1. ELECTRODE MATERIAL

B-l.1 The wilding electrodes shall be of copper alloy of sufficient cross-sectional area and strength to carry the welding current and the electrode pressure without overheating, deformation or cxccssivc deflection.

The electrode shall have an electrical conductivity of not less than 75 percent of that of a standard annealed copper and a hardness of not less than 110 *HV.*

NOTE -The following reristivity specified in pub 28 (1925) International Standard of Resistance of Copper (*Revised* ed.) issued by the International Electrotechnical Commission is taken as the normal value of annealed copper:

' At a temperature of 20°C, the volume resistivity of standard annealed copper is 0·0 17 241 ohms square millimetre per metre.

Copper which has thii resistivity is said to have a conductivity of 100 percent."

B-2. ELECTRODE TREAD WIDTH

B-2.1 The tread width of one of the wheels shall conform to the following formula:

$$W = 5\sqrt{e}$$

where

W = **the tread** width in mm, and

e = the thickness **of** the **component in contact with the wheel in mm.**

B-2.2 The width of the wheel should be at least twice the tread width (*see* Fig. 2 and 3).

NOTE --If an offset tread is necessitated by the shape of the components to be welded, the limit of offset should bc as indicated in Fig. 3, and the bevel width should not be reduced below $\frac{W}{3}$ and the wheel width should not bc reduced below $2W$, where W = the tread width.

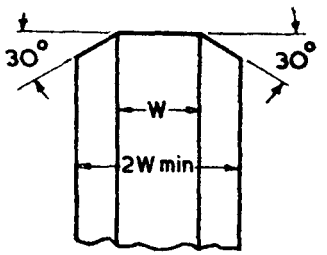

FIG. 2 CONCENTRIC ELECTRODE

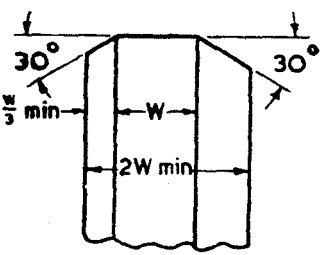

FIG. 3 OFFSET ELECTBODE

B-2.3 It is recommended that, where possible, the minimum overall width of the wheel should be not less than 3 W.

B-2.4 Where a pad or mandrel type electrode is used, the requirement specified under B-23 applies only to the wheel.

B-3. WHEEL BEVEL ANGLE

B-3.1 Unless otherwise specified, the angle of bevel shall be not less than 30" (see Fig. 2 and 3).

B-4. PERMISSIBLE INCREASE OF TREAD WIDTH

B-4.1 The width of the tread of the electrode wheels, or of one wheel in cases where mandrel electrode is used, shall not be allowed to increase by more than 30 percent above the initial width given by the formula under B-2.1.

In the case. of pad or mandrel type electrode, the surface shall be kept clean and free from grooves which would be detrimental to the work.

The size and 'condition of the electrodes shall be checked periodically. When the permissible increase in tread width has been reached, the electrode shall be replaced *or* redressed to its initial size by a competent person.

A greater increase in tread width is permissible, provided tests prove that the strength of the weld is not decreased below the design requirements.

NOTE -Attention is drawn to the fact that tht initial pressure and current setting should be sufficiently above the minimum requirements for obtaining satisfactory welds to allow a 30 percent increase in wheel width to take place, and still obtain acceptable results. Provided the current settings are adjusted accordingly, the pressures given in Appendix C will allow satisfactory welds to be obtained until the. wheel width has increascd to 30 percent above the initial width at which the pressure was set.

APPENDIX C

(*Clauses* 6.2.2 *and* B-4.1 Note)

RECOMMENDED **WELDING** PRESSURES

Sheet Thickness		*Tread Width*	*Mean Wheel Diameter*	*Pressure*
over	Up to and Including			
(1)	(2)	(3)	(4)	(5)
mm	mm	mm	mm	kg
—	0·55	3	100 150 200	130 155 180
0·55	0·70	4	100 150 200	170 210 240
0·70	1·20	5	100 150 200 250	210 260 300 335
1·20	1·60	6	100 150 200 250 300	255 315 360 400 440

(Continued)

RECOMMENDED WELDING PRESSURES — *Contd*

Sheet Thickness		*Tread Width*	*Mean Wheel Diameter*	*Pressure*
Over	Up to and Including			
(1)	(2)	(3)	(4)	(5)
mm	mm	m m	mm	kg
1·60	2·0	7	100 150 200 250	300 365 *420* 470
2·0	2·50	8	100 150 200 250	340 415 *480* 535
2.50	3·20	9	100 150 200 250	*380* *470* *540* 605
3·20	4·0	10	100 150 *200* 250	*425* *520* 600 670

APPENDIX D

(*Clauses* 6.2.3.1 *and* 7.3.1)

PILLOW TEST

D-1. Sheets 100 mm square, should be cut from the same material for which the machine is being set. Suitable means should be providdd in one of the sheets for applying pressure to the inside of the assembly.

D-2. The two sheets should then be placed directly on top of one another and they should be seam welded all round the periphery.

D-3. A pressure equal to that which will be applied to the assembly in test for which the machine is being set, should then be applied and provided no leaks occur, the setting can be assumed to be satisfactory.

BUREAU OF INDIAN STANDARDS

Headquarters :

Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002

Telephones : 331 01 31
331 13 75

Telegrams : Manaksanstha
(Common to all Offices)

Regional Offices :		*Telephone*
Central	: Manak Bhavan, 9. Bahadur Shah Zafar Marg, NEW DELHI 110002	*331 01 31* *331 13 75*
* Eastern	: 1/14 C.I.T. Scheme VII M, V.I.P. Road, Maniktola, CALCUTTA 700054	*37 86 62*
Northern	: SCO 445-446, Sector 35-C, CHANDIGARH 160036	*531640*
Southern	: C.I.T. Campus, IV Cross Road, MADRAS 600113	*2352315*
† Western	: Manakalaya, E9 MIDC. Marol, Andheri (East). BOMBAY 400093	*632 92 95*

Brunch Offices :

'Pushpak', Nurmohamed Shaikh Marg, Khanpur, AHMADABAD 380001	*2 63 48*
‡ Peenya Industrial Area, 1 st Stage, Bangalore-Tumkur Road, BANGALORE 560058	*39 49 55*
Gangotri Complex, 5th Floor, Bhadbhada Road. T.T. Nagar. BHOPAL 462003	*65 40 21*
Plot No. 21. Satyanagar. BHUBANESHWAR 751007	*40 36 27*
Kalai Kathir Building, 6/48-A Avanasi Road, COIMBATORE 641037	*21 01 41*
Plot No 43, Sector 16A, Mathura Road, FARIDABAD 121001	*8-28 88* 01
Savitri Complex, 116 G. T. Road, GHAZIABAD 201001	*8-71* 19 98
53/5 Ward No. 29. R.G. Barua Road. 5th Bv-lane. GUWAHATI 781003	41137
S-8-56C L. N. Gupta Marg, (Nampally Station Road) HYDERABAD 500001	201083
R14 Yudhister Marg, C Scheme, JAIPUR 302005	521374
117/418 B Sarvodaya Nagar, KANPUR 208005	21 68 76
Plot No, A-9, House No. 561/63, Sindhu Nagar, Kanpur Road, LUCKNOW 226005	5 5507
Patliputra Industrial Estate, PATNA 800013	26 23 05
C/o Smt. Sunita Mirakhar. 66 D/C **Annexe, Gandhi Nagar, JAMMU(TAWI) 180004**	
T. C. No. 14/1421, University P. O., Palayam. THIRUVANANTHAPURAM 695034	6 21 04

Inspection Offices (with Sale Point) :

Pushpanjali. First Floor, 205-A West High Court Road. Shankar Nagar Square, NAGPUR 440010	62 61 71
Institution of Engineers (India) Building, 1332 Shivaji Nagar. PUNE 411005	5 24 35

● *SSleS* Office Calcutta is at 5 Chowringhee Approach. P. O. Princep Street, CALCUTTA — 27 99 65

† Sales Office is at Novelty Chambers, Grant Road, BOMBAY — 309 66 28

‡ Sales Office is at Unity Building, Narasimharaja Square, BANGALORE — 22 39 71

Printed at Dee Kay Printers. New Delhi. India