BUREAU OF INDIAN STANDARDS
DRAFT FOR COMMENTS ONLY

Draft Indian Standard

Winding Wires for Submersible Motors — Specification

Part 1 Conductor Data

(Second Revision of IS 8783 Part 1)

Winding Wire Sectional Committee, ETD 33

Last date for comments- 30-10-2025

FOREWORD

(Formal clauses of the draft will be added later)

This standard was initially published in 1978, covering PVC insulated winding wires for submersible motors designed for 85 °C operation. Subsequently, two related standards—IS 10051 : 1981, Specification for PVC insulated winding wires for submersible motors for 105 °C operation, and IS 12788 : 1989, Specification for PVC insulated winding wires overcoated with nylon for submersible motors — were introduced but later withdrawn.

This part of the series covers the specification of conductors used in winding wires for submersible motors.

In view of the prolonged absence of revision in the IS 8783 series, the associated winding wire standards for submersible motors are now being revised and circulated for public comments.

Although the committee did not observe significant technical changes in the construction or application of submersible winding wires, it approved wide circulation of the revised drafts with updated normative references to facilitate broader stakeholder consultation for following standards:

IS 8783	Winding wires for submersible motors — Specification
Part 1 : 1995	Part 1 Conductor data
Part 2 : 1995	Part 2 Materials for dielectric and jacket
Part 3 : 1995	Part 3 Methods of tests
Part 4/Sec 1 : 1995	Part 4 Specification for individual wires, Section 1 HR PVC insulated winding wires
Part 4/Sec 2 : 1995	Part 4 Specification for individual wires, Section 2 Cross linked polyethylene insulated and polyamide jacketed wires
Part 4/Sec 3 : 1995	Part 4 Specification for individual wires, Section 3 Polyester and polypropylene insulated winding wires

This revision includes the incorporation of amendments.

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 : 2022 ‘Rules for rounding off numerical values (*second revision*)'.The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Draft Indian Standard

WINDING WIRES FOR SUBMERSIBLE MOTORS — SPECIFICATION

PART 1 CONDUCTOR DATA

(Second Revision of IS 8783 Part 1)

1 SCOPE

This draft standard (Part 1) covers the requirements of high conductivity annealed round and stranded copper conductors used for winding wires for submersible motors irrespective of types of insulation. The range of size include solid round conductor dia 0.4 mm to 5.0 mm and stranded conductor area 3.58 mm^2 to 25.65 mm^2.

2 REFERENCES

The standards listed below contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed.

IS No.	*Title*
IS 14841 Series	Packaging of winding wires
IS 1885 (Part 32) : 2019	Electrotechnical vocabulary Part 32 Electric cables (*second revision*)
IS 8783 (Part 3) : 1995	Winding wires for submersible motors — Specification Part 3 methods of tests

3 TERMINOLOGY

3.1 For the purpose of this standard, the definitions given in IS 1885 (Part 32) and the following shall apply.

3.2 Tolerance

The permissible deviation (magnitude) of an actual reading from that prescribed.

4 MATERIAL

4.1 Conductor

The conductor shall be made from high conductivity annealed copper having the properties given in **4.1.1**.

4.1.1 *Physical Constants for Annealed Copper*

4.1.1.1 *Coefficient of linear expansion*

The coefficient of linear expansion of annealed copper over a temperature range of 0 to 150 °C shall be taken as 17 × 10-6/ °C.

4.1.1.2 *Density*

The density of annealed copper at a temperature of 20 °C shall be taken as 8.89 g/cm 3.

4.1.1.3 *Resistance*

The resistance at 20 °C of a conductor of annealed copper of one metre in length and of a uniform cross-sectional area of one square millimetre shall be taken as 0.017241 ohm. The method of calculation of conductor resistance is given in Annex A. The temperature correction factors are given in Table 3.

4.1.1.4 *Constant mass temperature coefficient of resistance*

At a temperature of 20 °C the constant mass temperature coefficient of resistance of annealed copper measured between two potential points rigidly fixed to the conductor, the metal being allowed to expand freely, shall be taken as 0.00393/ °C.

NOTE — For any temperature to above 0 °C the temperature coefficient of resistance is 1/234.45 + t_0.

4.1.2 *Form of Conductor*

The conductors shall be circular solid or stranded as per the specific requirement. The conductor shall be clean bright reasonably uniform in size and shape, smooth and free from slivers, spills, cracks and other harmful defects.

4.1.3 *Joints in Conductor*

4.1.3.1 *Solid conductors*

No joints shall be made in finished solid conductor.

4.1.3.2 *Stranded conductors*

Joints shall be permitted in the individual strands of which the conductor is formed, but no joint shall be within 300 mm of any other joint within the same layer. The joints shall be made by resistance butt welding, fusion welding, cold pressure welding, electric welding, gas welding, brazing or silver soldering. The joints in individual strand shall be such that no deformity is observed in finished stranded conductor.

5 CONDUCTOR COMPOSITION

5.1 Round Conductor

5.1.1 The conductor shall consist of single strand of bright annealed plain copper in accordance with Table 1.

5.1.2 The conductor shall be of solid circular cross-section.

5.2 Stranded Conductor

5.2.1 The conductor shall consist of bright annealed plain copper strands in accordance with Table 2.

5.2.2 The strands in the conductor shall have the same nominal diameter before stranding.

5.2.3 The number of strands in the conductor shall be in accordance with Table 2.

5.3 Tolerance on the Nominal Wire Diameter

The tolerance on the nominal wire diameter shall be ± 1 percent of basic size.

6 DETAILS OF TESTS

Tests	**For Requirements, Ref to**	**For test Method, ref to**
Dimensions	Tables 1 and 2	IS 8783 (Part 3)
Annealing test (elongation)	Tables 1 and 2	IS 8783 (Part 3)
Resistance test	Tables 1 and 2	IS 8783 (Part 3)
Visual examination	**4.1.2** of this specification	

7 IDENTIFICATIONS

The manufacturer’s identification shall be provided on labels. The label shall contain the name of the manufacturer and trade name, if any.

8 PACKING

The conductor shall be wound on spools/reels/coils as per IS 14841 Series, packed and labelled.

9 MARKING

9.1 The conductor shall carry following information labelled on spool/reel/coil:

a) Reference to Indian Standard, for example, IS 8783 (Part 1);
b) Manufacturer's name, brand name or trademark;
c) Size of conductor/nominal cross-sectional area
d) Number of lengths on spool/reel/coil (if more than one);
e) Approximate gross mass;
f) Year of manufacture; and
g) Direction of rotation of spool/reel/coil.

NOTE — The requirements of packing and marking are not applicable when the processing of the conductor forms part of the manufacturing of complete winding wire.

9.2 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the Bureau of Indian Standards Act, 2016 and the Rules and Regulations framed thereunder, and the products may be marked with the Standard Mark.

Table 1 Conductor Data — Round Solid Conductor

(*Clause* 5.1.1)

Sl No.	Cross-Sectional Area (Nominal)	Diameter of Conductor (Nominal)	Elongation *(Min)*	Conductor Resistance at 20 °C *(Max)*
	mm²	**mm**	**Percent**	**Ohm/km**
(1)	(2)	(3)	(4)	(5)
i)	0.126	0.40	24	141.32
ii)	0.159	0.45	25	111.66
iii)	0.196	0.50	25	90.44
iv)	0.238	0.55	26	74.75
v)	0.283	0.60	26	62.81
vi)	0.332	0.65	28	53.52
vii)	0.385	0.70	28	46.14
viii)	0.442	0.75	28	40.20
ix)	0.502	0.80	28	35.33
x)	0.568	0.85	29	31.29
xi)	0.636	0.90	29	27.91
xii)	0.709	0.95	30	25.05
xiii)	0.785	1.0	30	22.61
xiv)	0.950	1.1	30	18.69
xv)	1.130	1.2	31	15.70
xvi)	1.330	1.3	32	13.38
xvii)	1.540	1.4	32	11.54
xviii)	1.770	1.5	32	10.05
xix)	2.010	1.6	32	8.83
xx)	2.270	1.7	32	7.82
xxi)	2.540	1.8	32	6.98
xxii)	2.840	1.9	32	6.26
xxiii)	3.140	2.0	33	5.65
xxiv)	3.460	2.1	33	5.13
xxv)	3.800	2.2	33	4.67
xxvi)	4.150	2.3	33	4.27
xxvii)	4.520	2.4	33	3.93
xxviii)	4.910	2.5	33	3.62
xxix)	5.310	2.6	34	3.34
xxx)	5.730	2.7	34	3.10
xxxi)	6.160	2.8	34	2.88
xxxii)	6.610	2.9	34	2.69
xxxiii)	7.070	3.0	34	2.51
xxxiv)	7.550	3.1	35	2.35
xxxv)	8.040	3.2	35	2.21
xxxvi)	8.550	3.3	35	2.08
xxxvii)	9.080	3.4	35	1.96
xxxviii	9.620	3.5	35	1.85
xxxix)	10.180	3.6	36	1.74

Sl No.	Cross-Sectional Area (Nominal)	Diameter of Conductor (Nominal)	Elongation *(Min)*	Conductor Resistance at 20 °C *(Max)*
	mm^2	mm	Percent	Ohm/km
(1)	(2)	(3)	(4)	(5)
xl)	10.750	3.7	36	1.65
xli)	11.340	3.8	36	1.57
xlii)	11.950	3.9	36	1.49
xliii)	12.570	4.0	37	1.41
xliv)	13.200	4.1	37	1.35
xlv)	13.850	4.2	38	1.28
xlvi)	15.210	4.4	38	1.17
xlvii)	16.620	4.6	38	1.07
xlviii)	18.100	4.8	39	0.98
xlix)	19.640	5.0	40	0.90

NOTE — The finished copper wire sample shall exhibit 95 percent value of the elongation given in col 3 above.

Table 2 Conductor Data — Stranded Conductor

(*Clauses* 5.2.1 *and* 5.2.3)

Sl No.	Conductor Cross-Sectional Area (Nominal)	Number of Strands	Diameter of Strands Nominal	Elongation Before Stranding	Conductor Diameter (Nominal)	Conductor Resistance at 20 °C *Max*
	mm^2		mm	Percent	mm	Ohm/Km
(1)	(2)	(4)	(5)	(6)	(7)	(8)
i)	3.58	19	0.49	25	2.45	5.10
ii)	4.03	19	0.52	25	2.60	4.53
iii)	4.50	19	0.55	26	2.75	4.05
iv)	5.00	19	0.58	26	2.90	3.64
v)	5.55	19	0.61	26	3.05	3.23
vi)	6.11	19	0.64	26	3.20	2.93
vii)	6.90	19	0.68	28	3.40	2.60
viii)	7.95	19	0.73	28	3.65	2.26
ix)	9 08	19	0.78	28	3.90	1.98
x)	10.00	19	0.82	28	4.10	1.79
xi)	12.09	19	0.90	29	4.50	1.48
xii)	13.18	19	0.94	29	4.70	1.36
xiii)	14.04	19	0.97	30	4.85	1.28
xiv)	14.92	19	1.00	30	5.00	1.20
xv)	16.00	19	1.04	30	5.20	1.11
xvi)	18.06	19	1 10	30	5.50	0.993
xvii)	20.08	19	1 16	31	5.80	0.893
xviii)	21.30	27	1.00	30	6.15	0.846
xix)	25.65	27	1.10	30	6.80	0.699

NOTE — The copper wire samples taken from finished insulated winding wire shall exhibit 95 percent of the elongation given in col 4 above.

The test, however, shall be conducted on the central wire.

Table 3 Temperature Correction Factors for Conductor Resistance to Correct the Measured Resistance at t °C to 20 °C

(*Clause* 4.1.1 3)

Sl No.	Tempe-rature t °C	Multiplier Constant	Reciprocal Constant		Sl No.	Tempe-rature t °C	Multiplier Constant	Reciprocal Constant
i)	(1)	(2)	(3)		xxxix)	(1)	(2)	(3)
ii)	10	1.0409	0.9607		xl)	29	0.9658	1.0354
iii)	10.5	1.0388	0.9627		xli)	29.5	0.9640	1.0373
iv)	11	1.0367	0.9646		xlii)	30	0.9622	1.0393
v)	11.5	1.0346	0.9666		xliii)	30.5	0.9604	1.0413
vi)	12	1.0325	0.9686		xliv)	31	0.9585	1.0432
vii)	12.5	1.0304	0.9705		xlv)	31.5	0.9568	1.0452
viii)	13	1.0283	0.9725		xlvi)	32	0.9550	1.0472
ix)	13.5	1.0262	0.9745		xlvii)	32.5	0.9532	1.0491
x)	14	1.0241	0.9784		xlviii)	33	0.9514	1.0511
xi)	14.5	1.0221	0.9784		xlix)	33.5	0.9496	1.0531
xii)	15	1.0200	0.9804		l)	34	0.9478	1.0550
xiii)	15.5	1.0180	0.9823		li)	34.5	0.9461	1.0570
xiv)	16	1.0160	0.9843		lii)	35	0.9443	1.0590
xv)	16.5	1.0139	0.9862		liii)	35.5	0.9426	1.0609
xvi)	17	1.0119	0.9882		liv)	36	0.9408	1.0629
xvii)	17.5	1.0099	0.9902		lv)	36.5	0.9391	1.0648
xviii)	18	1.0079	0.9921		lvi)	37	0.9374	1.0668
xix)	18.5	1.0059	0.9941		lvii)	37.5	0.9357	1.0687
xx)	19	1.0039	0.9961		lviii)	38	0.9339	1.0708
xxi)	19.5	1.0020	0.9980		lix)	38.5	0.9322	1.0727
xxii)	20	1.0000	1.0000		lx)	39	0.9305	1.0747
xxiii)	20.5	0.9980	1.0020		lxi)	39.5	0.9288	1.0766
xxiv)	21	0.9961	1.0039		lxii)	40	0.9271	1.0786
xxv)	21.5	0.9941	1.0059		lxiii)	40.5	0.9254	1.0806
xxvi)	22	0.9922	1.0079		lxiv)	41	0.9238	1.0825
xxvii)	22.5	0.9903	1.0098		lxv)	41.5	0.9221	1.0845
xxviii)	23	0.9883	1.0118		lxvi)	42	0.9204	1.0865
xxix)	23.5	0.9864	1.0138		lxvii)	42.5	0.9188	1.0884
xxx)	24	0.9845	1.0157		lxviii)	43	0.9171	1.0904
xxxi)	24.5	0.9826	1.0177		lxix)	43.5	0.9155	1.0923
xxxii)	25	0.9807	1.0197		lxx)	44	0.9133	1.0949
xxxiii)	25.5	0.9788	1.0216		lxxi)	44.5	0.9122	1.0963
xxxiv)	26	0.9770	1.0236		lxxii)	45	0.9105	1.0983
xxxv)	26.5	0.9751	1.0255		lxxiii)	45.5	0.9089	1.1002
xxxvi)	27	0.9732	1.0275		lxxiv)	46	0.9073	1.1022
xxxvii)	27.5	0.9714	1.0295		lxxv)	46.5	0.9057	1.1041
xxxviii)	28	0.9695	1.0314		lxxvi)	47	0.9011	1.1061
xxxix)	28.5	0.9677	1.0334		lxxvii)	47.5	0.9025	1.1080

NOTE — Given the resistance of a wire t°C, the resistance at 20 °C, is calculated by multiplying the resistance at t°C by the multiplier constant given in the above table. Conversely given the resistance at 20 °C the corresponding resistance at t°C is calculated by multiplying the resistance at 20°C by the reciprocal constant for t°C also given in the table above.

ANNEX A

(*Clause* 4.1.1.3)

FORMULA FROM WHICH RESISTANCE IS CALCULATED

A-1 The resistance value specified have been calculated from the formula

$$R = \frac{4\rho}{n\pi d^2} k_1 k_2$$

where

R = resistance at 20 °C, in ohms/km;

ρ = standard resistivity of the metal at 20 °C in absolute ohm, mm²/km, that is, 17.241 for annealed copper;

n = number of wires in the conductor;

d = nominal diameter of the wires in the conductor, in millimetres;

π= 3.1415927 in accordance with SP 8;

k_1 = factor depending on the diameter of the wire in the conductor, the value of this factor is given in Table 4; and

k_2 = factor depending on the way in which the conductor is formed the value of this factor is as given below:

Factor k_2

a) For solid conductor :1.00
b) For stranded conductor where nominal strand diameter;
   i) Exceeds 0.6 mm :1.02
   ii) Does not exceed 0.6 mm :1.04

Table 4 Factor k_1

(*Clause* A-1)

Sl No.	**Maximum Diameter of Wires in Conductor**		**Solid Conductor**	**Stranded Conductor**
	Over mm	Up to and Including mm		
(1)	(2)	(3)	(4)	(5)
i)	0.31	4.5	1.03	1.02
ii)	4.50	—	—	—