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Draft Indian Standard
Specification for Cotton Covered Copper Conductors
Part 1 Round Conductors

(First Revision of IS 7391 Part 1)

Winding Wire Sectional
Committee, ETD 33

Last date for comments- 10/02/2025

FOREWORD

(Formal clauses of the draft will be added later)

This Draft standard (Part 1) covers cotton covered round copper conductors. Cotton covered rectangular copper conductors are covered in IS 7391 (Part 2).

Revision of this standard has been taken up to update and align it with the present practices followed in the industry.

In the preparation of this standard, considerable assistance has been derived from the following publications:

IEC 60317-0-1: 2013 'Specifications for particular types of winding wires - Part 0-1: General requirements - Enamelled round copper wire'.

This standard specifies the requirements of paper covered high conductivity annealed copper flexible/stranded conductors to be used as transformer connecting leads.

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
SPECIFICATION FOR COTTON COVERED COPPER CONDUCTORS
PART 1 ROUND CONDUCTORS
(First Revision)

1 SCOPE

1.1 This draft standard (Part 1) covers the requirements and dimensions for round copper conductors covered with one or two layers of cotton yarn.

1.1.1 It does not apply to other types of cotton covering, such as braiding.

1.2 The requirements of this standard are applicable to conductors having diameters 0.140 to 6.000 mm.

2 REFERENCES

The standards listed in Annex A 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.

3 TERMINOLOGY

For the purpose of this standard, the following definitions shall apply.

3.1 Conductor

The bare metal after removal of the cotton covering.

3.2 Increase in Diameter Due to Covering

The difference between the diameter over the cotton covering and the diameter of the conductor.

3.3 Tolerance

The permissible divergence of an actual magnitude from that prescribed.

3.4 Wire

The insulated material as received.

4 GRADES

3.1 The wire shall be classified into two grades as follows:

- a) Single, Ordinary or Fine; and
- b) Double, Ordinary or Fine.

5 GENERAL TEST CONDITIONS

5.1 Unless otherwise specified, all tests shall be carried out within a temperature range of 15 to 35 °C, and a relative humidity range of 45 to 75 percent. Before measurements are made, the specimens shall be preconditioned under these atmospheric conditions for a time sufficient to allow specimens to reach stability.

5.2 The wire to be tested shall be removed from the packaging in such a way that the wire is not subjected to tension or unnecessary bends.

5.3 Before each test sufficient length of wire shall be discarded to ensure that any damaged wire is not included in the test specimens.

5.4 When no specific range of sizes is given for a test, the test is applicable to all sizes.

6 CONDUCTOR

6.1 The conductor shall be of high conductivity annealed copper having the properties given in 6.2.

6.2 Physical Constants

6.2.1 *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 0.000 017 per degree Celsius.

6.2.2 *Density*

The density of annealed copper at room temperature shall be taken as 8.89 g/cm³.

6.2.3 *Resistance*

The resistance at 20 °C of a conductor of copper of one metre in length and of a uniform cross-sectional area of one square millimetre shall be taken as 0.017 241 ohm.

6.2.4 *'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 0.003 93 per degree Celsius.

NOTE — For any temperature t_0 above 0 °C the temperature coefficient of resistance is

$$\frac{1}{234.45 + t_0} \cdot$$

6.3 Diameter

The diameters and tolerance on conductor diameters shall be as given in Table 1.

NOTE — The conductor shall be checked for diameter and/or resistance in the manner:

<i>Diameter</i> mm	<i>Measurement</i>
Up to and including 1.00 0	By resistance and diameter
Over 1.00 0	Only by diameter

6.4 Out-of-Roundness of Conductor (Nominal Conductor Diameter Over and Including 0.071 mm)

The out-of-roundness shall be than 50 percent of the total value for tolerance given in Table 1.

6.5 Resistance

See Note under 6.3.

6.5.1 The resistance of the conductors at 20 °C shall be as given in Table 1.

6.5.2 The resistance of the conductor shall be expressed as the dc resistance at 20 °C. The method used shall provide an accuracy of 0.5 percent. One measurement shall be made.

If the resistance R_t is measured at a temperature t other than 20 °C, the resistance, R_{20} at 20 °C, shall be calculated by means of the formula:

$$R_{20} = \frac{R_t}{1 + 0.00393(t - 20)}$$

where

t is the actual temperature in °C during the measurement.

6.5.3 Tolerance on Resistance

The maximum and minimum permissible values of resistance shall be as given in Table 1 and are calculated by the method described in Appendix A.

6.6 Elongation

A sample of conductor 250 mm long between grips shall be steadily stretched at a rate not more than 300 mm/min until the conductor fractures. The elongation at fracture shall comply with the requirements of Table 1.

Table 1 Dimensions, Resistance and Elongation of Cotton Covered Conductors

(Clauses, 6.3, 6.4, 6.5.1, 6.5.3. 6.6 and 8.1)

SI No	NOMINAL CONDUCTOR DIAMETER	TOLERANCE $\pm t$	SINGLE COTTON COVERING				DOUBLE COTTON COVERING				RESISTANCE AT 20 °C			ELONGATION
			Ordinary		Fine		Ordinary		Fine		Nem	Max	Min	
			Overall Diameter	Increase in Diameter	Overall Diameter	Increase in Diameter	Overall Diameter	Increase in Diameter	Overall Diameter	Increase in Diameter				
			Max	Min	Max	Min	Max	Min	Max	Min				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	Ω/m	Ω/m	Ω/m	percent
i)	0.140	0.003	0.253	0.090	0.233	0.075	0.343	0.160	0.293	0.125	1.11030	1.1695	1.0552	21
ii)	0.160	0.003	0.273	0.090	0.253	0.075	0.363	0.160	0.313	0.125	0.8500	0.8905	0.8122	22
iii)	0.180	0.003	0.293	0.090	0.273	0.075	0.383	0.160	0.333	0.125	0.6717	0.7006	0.6443	23
iv)	0.200	0.003	0.313	0.090	0.293	0.075	0.403	0.160	0.353	0.125	0.5441	0.5656	0.5236	24
v)	0.224	0.003	0.337	0.090	0.317	0.075	0.427	0.160	0.377	0.125	0.4337	0.4494	0.4188	24
vi)	0.250	0.004	0.364	0.100	0.354	0.083	0.474	0.180	0.424	0.140	0.3482	0.3628	0.3345	25
vii)	0.280	0.004	0.404	0.100	0.384	0.083	0.504	0.180	0.454	0.140	0.2776	0.2882	0.2676	26
viii)	0.315	0.004	0.439	0.100	0.419	0.083	0.539	0.180	0.489	0.140	0.2193	0.227	0.2121	26
ix)	0.355	0.004	0.479	0.100	0.459	0.083	0.579	0.180	0.529	0.140	0.1727	0.1782	0.1674	27
x)	0.400	0.005	0.525	0.100	0.505	0.083	0.625	0.180	0.575	0.140	0.1360	0.1407	0.1316	27
xi)	0.450	0.005	0.585	0.110	0.565	0.090	0.695	0.200	0.635	0.150	0.1075	0.1109	0.1042	28
xii)	0.500	0.005	0.635	0.110	0.615	0.090	0.745	0.200	0.685	0.150	0.08706	0.08959	0.08462	28
xiii)	0.560	0.006	0.696	0.110	0.676	0.090	0.806	0.200	0.746	0.150	0.06940	0.07153	0.06736	29
xiv)	0.630	0.006	0.766	0.110	0.746	0.090	0.876	0.200	0.816	0.150	0.05484	0.05638	0.05335	29
xv)	0.710	0.007	0.867	0.125	0.842	0.100	0.987	0.220	0.917	0.160	0.04318	0.04442	0.04198	30
xvi)	0.750	0.008	0.908	0.125	0.883	0.100	1.028	0.220	0.958	0.160	0.03869	0.03987	0.03756	30
xvii)	0.800	0.008	0.958	0.125	0.933	0.100	1.078	0.220	0.988	0.160	0.03401	0.03500	0.03305	30
xviii)	0.850	0.009	1.009	0.125	0.984	0.100	1.129	0.220	1.039	0.160	0.030121	0.031034	0.029243	31
xix)	0.900	0.009	1.059	0.125	1.034	0.100	1.179	0.220	1.109	0.160	0.02687	0.02765	0.02612	31
xx)	0.950	0.010	1.110	0.125	1.085	0.100	1.230	0.220	1.160	0.160	0.024113	0.024841	0.023413	32
xxi)	1.000	0.010	1.160	0.125	1.135	0.100	1.280	0.220	1.210	0.160	0.02176	0.02240	0.02116	32
xxii)	1.060	0.011	1.221	0.125	1.196	0.100	1.341	0.220	1.271	0.160	0.019368	—	—	32

Table 1 Continued

SI No	NOMINAL CONDUCTOR DIAMETER	TOLERANCE $\pm t$	SINGLE COTTON COVERING				DOUBLE COTTON COVERING				RESISTANCE AT 20 °C			ELONGATION
			Ordinary		Fine		Ordinary		Fine		Nem	Max	Min	
			Overall Diameter	Increase in Diameter	Overall Diameter	Increase in Diameter	Overall Diameter	Increase in Diameter	Overall Diameter	Increase in Diameter				
			Max	Min	Max	Min	Max	Min	Max	Min	Min			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	Ω/m	Ω/m	Ω/m	percent
xxiii)	1.120	0.011	1.291	0.135	1.266	0.110	1.421	0.240	1.351	0.180	0.01735	—	—	32
xxiv)	1.180	0.012	1.352	0.135	1.327	0.110	1.482	0.240	1.412	0.180	0.015629	—	—	33
xxv)	1.250	0.013	1.423	0.135	1.398	0.110	1.553	0.240	1.483	0.180	0.01393	—	—	33
xxvi)	1.320	0.013	1.493	0.135	1.468	0.110	1.623	0.240	1.553	0.180	0.013928	—	—	33
xxvii)	1.400	0.014	1.574	0.135	1.549	0.110	1.704	0.240	1.634	0.180	0.01110	—	—	33
xxviii)	1.500	0.015	1.675	0.135	1.650	0.110	1.805	0.240	1.735	0.180	0.012490	—	—	33
xxix)	1.600	0.016	1.791	0.145	1.761	0.120	1.926	0.260	1.856	0.200	0.008502	—	—	33
xxx)	1.626	0.016	—	—	—	—	1.953	0.260	1.883	0.200	0.0082311	—	—	34
xxxi)	1.700	0.017	1.892	0.145	1.892	0.120	2.027	0.260	1.957	0.200	0.007530	—	—	34
xxxii)	1.727	0.017	—	—	—	—	2.055	0.260	1.985	0.200	0.0072965	—	—	34
xxxiii)	1.800	0.018	1.993	0.145	1.993	0.120	2.128	0.260	2.058	0.200	0.006718	—	—	34
xxxiv)	1.829	0.018	—	—	—	—	2.158	0.260	2.088	0.200	0.0065054	—	—	34
xxxv)	1.900	0.019	2.094	0.145	2.064	0.120	2.229	0.260	2.159	0.200	0.0067167	—	—	34
xxxvi)	1.927	0.019	—	—	—	—	2.260	0.260	2.187	0.200	0.0058605	—	—	34
xxxvii)	2.000	0.020	2.195	0.145	2.165	0.120	2.330	0.260	2.260	0.200	0.005441	—	—	34
xxxviii)	2.032	0.020	—	—	—	—	2.363	0.260	2.293	0.200	0.0052705	—	—	35
xxxix)	2.120	0.021	2.316	0.145	2.286	0.120	2.451	0.260	2.381	0.200	0.0048420	—	—	35
xl)	2.185	0.022	—	—	—	—	2.536	0.280	2.467	0.200	0.0045582	—	—	35
xli)	2.337	0.023	—	—	—	—	2.691	0.280	2.621	0.200	0.0039846	—	—	35
xlii)	2.240	0.022	2.452	0.160	2.422	0.130	2.592	0.280	2.522	0.220	0.004338	—	—	35
xliiii)	2.360	0.024	2.574	0.160	2.544	0.130	2.714	0.280	2.644	0.220	0.0039073	—	—	35
xliv)	2.490	0.025	—	—	—	—	2.844	0.280	2.775	0.220	0.0035100	—	—	35
xlv)	2.500	0.025	2.715	0.160	2.685	0.130	2.855	0.280	2.785	0.220	0.003482	—	—	35

Table 1 Continued

SI No	NOMINAL CONDUCTOR DIAMETER	TOLERANCE $\pm t$	SINGLE COTTON COVERING				DOUBLE COTTON COVERING				RESISTANCE AT 20 °C			ELON G-ATION
			Ordinary		Fine		Ordinary		Fine		Nem	Max	Min	
			Overall Diameter	Increase in Diameter	Overall Diameter	Increase in Diameter	Overall Diameter	Increase in Diameter	Overall Diameter	Increase in Diameter				
			Max	Min	Max	Min	Max	Min	Max	Min				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	Ω/m	Ω/m	Ω/m	percent
xlvi)	2.642	0.026	—	—	—	—	2.999	0.280	2.929	0.220	0.0031177	—	—	36
xlvii)	2.650	0.027	2.867	0.160	2.837	0.130	3.007	0.280	2.937	0.220	0.0030989	—	—	36
xlviii)	2.794	0.028	—	—	—	—	3.152	0.280	3.082	0.220	0.0027877	—	—	36
xliv)	2.800	0.028	3.018	0.160	2.988	0.130	3.158	0.280	3.088	0.220	0.002776	—	—	36
l)	2.946	0.029	—	—	—	—	3.306	0.280	3.236	0.220	0.0025075	—	—	36
li)	3.000	0.030	3.220	0.160	3.190	0.130	3.360	0.280	3.290	0.220	0.0024180	—	—	36
lii)	3.098	0.031	—	—	—	—	3.460	0.280	3.391	0.220	0.0022675	—	—	36
liii)	3.150	0.032	3.372	0.160	3.542	0.130	3.512	0.280	3.442	0.220	0.002193	—	—	36
liv)	3.251	0.033	—	—	—	—	3.635	0.300	3.555	0.230	0.0020591	—	—	36
lv)	3.350	0.034	3.584	0.170	3.554	0.0140	3.734	0.300	3.654	0.230	0.0019392	—	—	36
lvi)	3.454	0.035	—	—	—	—	3.840	0.300	3.761	0.230		—	—	36
lvii)	3.550	0.036	3.786	0.170	3.756	0.140	3.936	0.300	3.856	0.230	0.001727	—	—	36
lviii)	3.658	0.037	—	—	—	—	4.046	0.300	3.966	0.230		—	—	37
lix)	3.750	0.038	3.988	0.170	3.958	0.140	4.138	0.300	4.058	0.230	0.0015475	—	—	37
lx)	4.000	0.040	4.240	0.170	4.210	0.140	4.390	0.300	4.310	0.230	0.001360	—	—	37
lxi)	4.064	0.041	—	—	—	—	4.457	0.300	4.377	0.230	0.0013176	—	—	37
lxii)	4.250	0.043	4.493	0.170	4.463	0.140	4.643	0.300	4.563	0.230	0.0012048	—	—	37
lxiii)	4.470	0.045	—	—	—	—	4.865	0.300	4.785	0.230	0.0010892	—	—	37
lxiv)	4.500	0.045	4.745	0.170	4.715	0.140	4.895	0.300	4.815	0.230	0.001075	—	—	37
lxv)	4.750	0.048	4.998	0.170	4.968	0.140	5.148	0.300	4.168	0.230	0.00096452	—	—	38
lxvi)	4.877	0.049	—	—	—	—	5.277	0.300	5.197	0.230	0.00091494	—	—	38
lxvii)	5.000	0.050	5.250	0.170	5.220	0.140	5.400	0.300	5.320	0.230	0.0008706	—	—	38
lxviii)	5.385	0.054	—	—	—	—	5.790	0.305	5.710	0.235	0.00075046	—	—	38
lxix)	5.893	0.059	—	—	—	—	6.298	0.305	6.223	0.235	0.00062665	—	—	38

7 APPLICATION OF COTTON COVERING

7.1 General

The conductor shall be completely and uniformly covered with one or two layers of cotton, as may be required.

7.2 Arrangement of Layers

The cotton covering shall be lapped firmly, evenly, closely and continuously round the conductor. Where there are two layers, they shall be applied in opposite directions.

8 OVERALL DIAMETER AND INCREASE IN DIAMETER

8.1 The maximum overall diameter and the minimum increase in diameter shall be in accordance with Table 1.

8.2 Measuring Equipment

The measurement shall be made with an accuracy better than 0.002 mm. If a micrometer is used it shall be ensured that the measuring force is in the range of 0.75 to 1.25 N. The spindle and the anvil of the micrometer shall have a diameter of 5 to 8 mm.

For wires greater than 0.500 mm, a force of 1 to 3 N may be used.

8.3 Measuring Method

8.3.1 Overall Diameter of the Wire

Approximately 1.5 m length of the wire from the reel shall be discarded and the diameter determined over the covering. Three measurements at 60° angular displacement shall be made around the circumference of the wire at each of the two places one metre apart.

The average of the six results shall be reported as 'overall diameter'.

8.3.2 Conductor Diameter

The covering shall be removed at two places one metre apart.

Three measurements at 60° angular displacement shall be made around the circumference of the conductor at these places.

The average of the six results for the bare diameter shall be reported as 'conductor diameter'.

8.3.3 Increase in Diameter

The difference between the overall diameter and the conductor diameter is the 'increase in diameter due to covering'.

9 MANDREL WINDING TEST

9.1 A sample of the covered wire shall be wound on a polished metal mandrel having a diameter as follows:

<i>Nominal Conductor Diameter (d)</i>		<i>Mandrel Diameter</i>
Over mm	Up to and Including mm	mm
—	1.000	$6 d$
1.000	6.000	$8 d$

9.2 Only sufficient tension shall be used to give an even and compact layer. The cotton covering shall not open sufficiently to expose the conductor or the inner layer, if any, to view, when examined under diffused light by normal eyesight.

10 PACKING AND MARKING

10.1 The wire shall be tightly and evenly wound on reels complying with IS 2069 and IS 14841/ IEC 60264 Series.

10.1.1 The wire on each reel shall be in one continuous length.

10.2 The label which is to be securely attached to the reel shall have the following information:

- a) Manufacturer's name or trade-mark,
- b) Grade of covering,
- c) Nominal conductor diameter,
- d) Increase in diameter due to covering, and
- e) Weight of wire (gross and net).

10.3 BIS Certification Marking

The product may also be marked with Standard Mark.

10.3.1 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 details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

11 SAMPLING

11.1 A recommendatory sampling plan and criteria for acceptance of lot are given in Appendix B.

APPENDIX A

(Clause 6.5.3)

METHOD OF CALCULATION OF LINEAR RESISTANCE

A-1 LIMITS OF ELECTRICAL RESISTANCE

A-1.1 The limits of electrical resistance are calculated on the following basis.

A-1.1.1 The maximum and minimum values of resistance for conductors of diameter up to and including 1.000 mm are calculated from the maximum and minimum dimensional tolerance.

The linear resistance is:

$$\begin{aligned} R_{\max} &= \rho \max q^{-1} \min \text{ (ohm/m)} \\ R_{\min} &= \rho \min q^{-1} \max \text{ (ohm/m)} \end{aligned}$$

Where q_{\max} and q_{\min} are respectively the maximum and minimum conductor cross-section in mm^2 calculated by taking into account the relevant dimensional tolerance for the diameter.

A-1.1.2 The maximum and minimum values of resistivity are given below:

$$\rho_{\max} = 1/58 \text{ (ohm.mm}^2\text{/m)}$$

$$\rho_{\min} = 1/59 \text{ (ohm.mm}^2\text{/m)}$$

APPENDIX B

(Clause 11.1)

RECOMMENDED SAMPLING PLAN AND CRITERIA FOR ACCEPTANCE OF LOT

B-1 LOT

B-1.1 In any consignment all the reels of the same type, and manufactured from the same material under essentially similar conditions of production shall be grouped together to constitute a lot.

B-2 SCALE OF SAMPLING

B-2.1 For judging the conformity of a lot to the requirements of the specification, the tests shall be done for each lot separately. For this purpose the number of reels to be selected at random from lot shall be in accordance with Table 2.

Table 2 Scale of Sampling and Permissible Number of Defectives

(Clauses B-2.1, B-3.1, B-3.2)

Sl No.	Lot size	For Physical Constants and Diameter		For Resistance, Elongation and Freedom from Defects	
		Sample Size	Permissible No. of Defectives	Sample Size	Permissible No. of Defectives
(1)	(2)	(3)	(4)	(5)	(6)
i)	Up to 300	20	0	13	0
ii)	301 to 500	32	1	20	0
iii)	501 to 1 000	50	2	32	1
iv)	1 001 to 3 000	80	3	50	2
v)	3 001 and above	125	5	80	3

B-3 NUMBER OF TESTS AND CRITERIA FOR ACCEPTANCE

B-3.1 From each of the reels selected according to col 3 of Table 2, suitable lengths of test samples shall be taken after discarding approximately 1.5 m of the wire from both ends. Each of these test samples shall be subjected to the measurements of dimensions and physical constants (see 6.2 and 6.3). The number of test samples not fulfilling the requirements of any of these tests shall be less than or equal to the corresponding permissible number given in col 4 of Table 2.

B-3.2 For the test for resistance, elongation and freedom from defects, the number of samples to be tested and the permissible number of defects for each of these characteristics shall be in accordance with col 5 and 6 of Table 2.

NOTE — The test samples for the purpose of **B-3.2** may be chosen from the reels already selected for the purpose of **B-3.1**.

B-3.3 If the requirements of **B-3.1** and **B-3.2** are met with, the lot shall be accepted.

Annex A

(Clause 2)

LIST OF REFERRED STANDARDS

<i>IS NO.</i>	<i>Title</i>
IS 2069 : 1991	Drums for covered winding wires and strips for electrical purposes — Specification (<i>second revision</i>)
IS 7391 (Part 2) : 1974	Specification for cotton covered copper conductors Part 2 Rectangular conductors
IS 14841 (Part 2/Sec 1) : 2000	Packaging of winding wires Part 2 Cylindrical barrelled delivery spools Section 1 Basic dimensions
IS 14841 (Part 2/Sec 2) : 2000	Packaging of winding wires Part 2 Cylindrical barrelled delivery spools Section 2 Specification for returnable spools made from thermoplastic materials
IS 14841 (Part 3/Sec 1) : 2000	Packaging of winding wires Part 3 Taper barrelled delivery spools Section 1 Basic dimensions
IS 14841 (Part 3/Sec 2) : 2000	Packaging of winding wires Part 3 Taper barrelled delivery spools Section 2 Specification for returnable spools made from thermoplastic materials
IS 14841 (Part 3/Sec 3) : 2000	Packaging of winding wires Part 3 Taper barrelled delivery spools Section 3 Specification for non - Returnable spools made from thermoplastic material
IS 14841 (Part 3/Sec 4) : 2000	Packaging of winding wires Part 3 Taper barrelled delivery spools Section 4 Basic dimensions of containers for taper barrelled delivery spools
IS 14841 (Part 4/Sec 1) : 2013	Packaging of winding wires Part 4 Methods of test Section 1 Delivery spools made from thermoplastic materials (<i>first revision</i>)