



**PRODUCT STANDARD**  
TME DIVISION, BHOPAL

**TM 20591**

REV 00

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TME 2011

**Material Specification of Corona Resistant Winding Wire**  
**Flat (Square or Rectangular)**

**1 GENERAL:**

**1.1 Scope**

This specification lays down all the requirements of the corona resistant polyimide film/ corona resistant polyamide-imide enameled square or rectangular winding wire.

**1.2 Dimensions**

See order

**1.3 Delivery Documents, Destination for Delivery**

See order

**2 REQUIREMENTS:**

**2.1 Bare Conductor Material:** The conductor material must be Cu-ETP according to EN 13602.

**2.2 Insulation:**

Presently corona resistant polyimide film grade (150FCR019) of M/s DuPont is approved for conductor insulation. Any other equivalent grade film/insulation can be offered against this specification subject to winding wire properties confirms to the routine (clause no. 2.4) and type test (clause no. 2.5) requirement of this specification. BHEL approval is must before offer/supply of non-approved grade.

**2.3 Inline high voltage test:**

The conductor insulation must meet the requirements of sub clause 2.4 & 2.5 in respect of the entire length of the wire.

Quality of insulation throughout the whole length of the wire shall be demonstrated by a continuous high voltage test (e.g. Inline test during production) at 4.0 kV, DC, based on the procedure given in IEC 60851-5 section 5.4. Carbon fiber brushes have to be used as electrode for contacting the wire surface. It shall be ensured that the passing wire is contacted by the brushes over the entire perimeter. The usage of bend chain electrodes is not permitted.

Defects shall be identified within self-adhesive labels in a signal colour. A total of 5 defects per km wire length is permitted for the acceptance of a delivery.

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**2.4 Properties (For Routine test)**

Sl No	Property	Unit	Required Values	Test Method
1	Bare Conductor dimension and tolerance	mm	According to IEC60317-0-2	IEC-60851 Part-2, Clause 3.2.1
2	Overall dimensions	mm	--	IEC-60851 Part-2, Clause 3.2.5
3	Overlap "p" of corona resistant polyimide film ( in case of film insulated)	%	$53 \leq p \leq 60$	Proposed by supplier
4	Increase in dimensions Due to insulation <sup>1</sup>	mm	$0.23 \pm 0.03$	IEC-60851 Part-2, Clause 3.2.4
5	Elongation at fracture up to 2.5 mm wire thickness	%	> 30	IEC-60851 Part-3, Clause 3.1
	over 2.5 mm wire thickness		> 32	
6	Springiness angle For thickness (s) of bare wire	Degree	max. 6.0	IEC-60851 Part-3, Clause 4.2
	$0.56 < s \leq 0.80$ mm		max. 5.5	
	$0.80 < s \leq 1.50$ mm		max. 5.0	
	$1.50 < s \leq 3.00$ mm		max. 4.5	
7	Flexibility in <sup>2)</sup> mandrel winding test	-	no cracks	IEC-60851 Part-3, Clause 5.1
	Edgewise $\varnothing = 2$ width (b) Flatwise $\varnothing = 2$ thickness(s)		no cracks	
8	Adherence test: Elongation without loss of adhesion	%	> 20	IEC-60851 Part-3, Clause 5.5
9	Heat shock test <sup>2)</sup> on bent test pieces at 220 °C	-	no cracks	IEC-60851 Part-6, Clause 3
	Edgewise $\varnothing = 2$ width (b) Flatwise $\varnothing = 2$ thickness(s)		no cracks	
10	Dielectric breakdown voltage <sup>3)</sup> straight	kV (AC)	> 7	IEC-60851 Part-5, Clause 4.7
	after mandrel winding test		> 4	
	after heat shock test		> 4	
11	Electrical resistance	$\Omega$	According to IEC60317-0-2	IEC-60851 Part-5, Clause 3

**Denotation:**

- 1) Increase in dimension: Overall dimension (insulated wire) minus conductor dimension (bare wire). The tolerances for insulation coating may be exceeded if the overall of the insulated wire are not exceeded the sum of permissible tolerances for the bare wire and for the insulation coating.
- 2)  $\varnothing$  = diameter of bending mandrel, expressed as a multiple of the bare wire width (b) or bare wire thickness(s).
- 3) At least 4 out of 5 straight samples or 7 out of 8 bent specimens shall pass the break down voltage test.

**Note:** The above requirement shall be tested for every batch delivered. Compliance with this requirement shall be confirmed by an inspection certificate according to EN 1204 sub clause 3.1.

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**2.5 Properties (For Type test)**

For technical approval of new film/insulation grade, the following type testes have to be passed successfully.

S No	Property	Unit	Required Values	Test Method
1.	Temperature Index	-	$\geq 220$	IEC-60851 Part-6, Section-5
2.	Corona resistance (Inverter Endurance test) (First failure of 5 wire specimens)	Hrs	> 10	--
	At 1.4 KV, 1050 Hz AC			
	At 1.2 KV, 1050 Hz AC		> 200	
3.	Solubility	--	No exposed bare conductor	Immersed in 60 °C solvent for 0.5 Hrs. Needle scrape
4.	Twisting test	--	No cracks	A piece of wire, of 150 mm length shall be twisted 5 x 360°. One end of sample shall be mounted on holder and other end shall be twisted. One sample shall be twisted CW and one CCW.

**2.3 Consignment**

**2.5.1 From of the Consignment**

Dimension of the conductor in mm		Reels acc. to IEC-60264-2-1
over	up to + with	
b x s	2.00 x 0.80	250 Ø mm
2.00 x 0.80	4.00 x 1.00	355 Ø mm
4.00 x 1.00	7.10 x 2.00	500 Ø mm
7.10 x 2.00	--	710 Ø mm

Reels made up in accordance with IEC 60264-2-1 are recommended as delivery units. Other reels for delivery in accordance with IEC 60264-2-1 are permitted, depending on the facilities available for winding off from the reels.

Each delivery unit may contain one length of wire. If, in exceptional cases, two or more lengths of wire are permitted on the same reel, this must be clearly marked on the outside of the unit.

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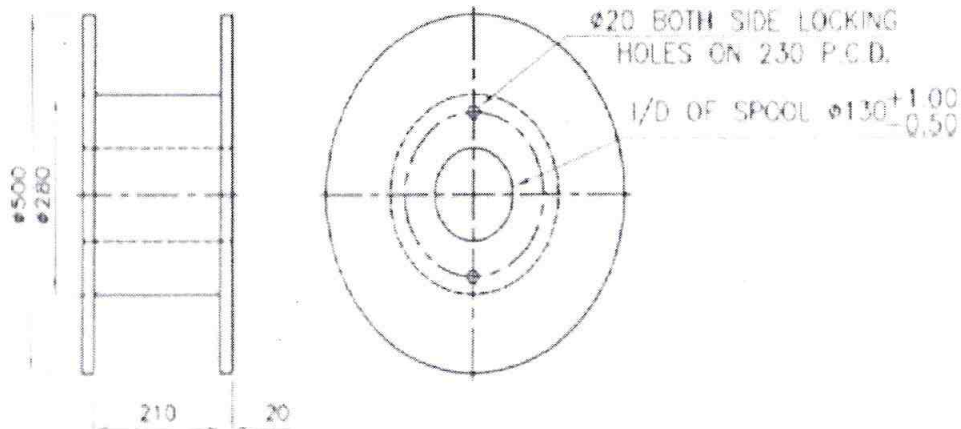
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**2.5.2 Packing**

The winding wire shall be wound evenly and compactly on spools. The separators shall be inserted in between each layer of winding wire and a layer of thick paper shall be given over the last layer of wire to protect the winding wire from external damages. The net weight of the winding wire per spool shall be max. 50 to 65 Kgs. The construction of the spool shall be as per the sketch shown.



**2.5.3 Transport**

The shipment is to be made by rail or road transport in such a way that it can be unloaded easily. Full reels must only be transported with their axes horizontal.

**2.5.4 Identification**

Container or palettes and reels must be labelled securely and indelibly (e.g. with an adhesive label or an appendage) with the following details.

Specification of product, size, quantity (weight) and date of manufacture.

**2.5.5 Test Certificate**

Each consignment must be accompanied by a manufacturer's test certificate in accordance with EN 10201 sub clause 3.1, which confirms that the delivery complies with requirement specified in Clause 2.4.

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