

**PROVISIONAL**

**RESTRICTED**  
**SPECIFICATION NO CIL/406**  
**FOR**  
**CARBON TAPE**

This SPECIFICATION, or any other Patterns, Drawings or other information issued in connection therewith MAY ONLY BE USED for a specific order placed by a COMPETENT AUTHORITY and is NOT TO BE USED for any other purpose whatsoever WITHOUT THE EXPRESS WRITTEN SANCTION OF THE DIRECTOR GENERAL OF INSPECTION (Ministry of Defence) or any other person authorized by him.

**GENERAL**

- (a) All clauses of this specification shall be complied with in every respect irrespective of the source of supply of the materials and/or components.
- (b) Should any discrepancy exist between this specification and any sample or pattern loaned for any purpose, the specification and/or other connected specifications or drawings shall be taken as correct.
- (c) The contractor shall afford the AHSP or his authorized representative, free of cost, all reasonable facilities (including test equipments) for satisfying himself that the stores are being manufactured in accordance with the specification and for this purpose the AHSP or his authorized representative must have free access to the Contractor's/Sub-contractors works at all reasonable times during the run of the contract. The Contractor is required to notify the AHSP of all Sub-contracts placed by him.

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*M. J. L.*  
*(M. C. REDDY)*  
*FLY(S)*  
*18/11/2002*  
*18/11/2002*

### 1.0 SCOPE

This Standard specifies the requirements and tests for Carbon Tapes using staple fibre or any other suitable fibre coated with carbon. The carbon tape is used as an electro static shielding in Cable Telephone Carrier Quad 1A (Y3/6145-001036) and Cable Telephone 20 conductor Polythene Insulated PVC Sheathed 2A(Y3/6145-004680).

### 2.0 RELATED SPECIFICATIONS

IS:2500, Pt I - Specification for inspection by attributes and by count of defects.

### 3.0 GENERAL REQUIREMENTS

The Carbon Tape shall consist of evenly and firmly woven staple fibre and well and evenly coated with carbon on each side and subsequently cut into rolls of specified widths. The tape shall be capable of being unwound without the end threads unravelling or getting entangled when adjacent layers of tape are separated and the compound shall not pull away from the fabric and leave bare spots during unwinding.

### 4.0 TERMINOLOGY

4.1 Unit of product - A Unit of product shall be a roll of 500 metres length for 19 mm width and 300-330 m for 30 mm width. A maximum of two joints per roll may be allowed.

4.2 Group 'A' tests - These comprise of all essential tests which are required to be carried out on all rolls of tapes of a tendered lot.

4.3 Group 'B' tests - These comprise of those acceptance tests which are more comprehensive than Group 'A' tests. These tests shall be carried out on sampling basis.

4.4 Group 'C' tests - These comprise of those acceptance tests which are more comprehensive than Group 'A' and Group 'B' tests. These tests shall be carried out on sampling basis.

### 5.0 DIMENSIONAL REQUIREMENTS

5.1 Length - Rolls of tape shall be supplied in lengths of 500 metres for 19 mm width and 300-330 m for 30 mm width unless otherwise agreed to between the purchaser and the supplier.

5.2 Width - Tapes shall be supplied in the following widths as demanded:-

(a) 19 mm.

(b) 30 mm. The width of the tape shall not vary from the nominal specified value by more than  $\pm 0.9$  mm.

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5.3 Thickness - The thickness of Carbon Tape with nominal width of 19 mm shall be  $0.13 \pm 0.01$  mm. The thickness of carbon tape of nominal width of 30 mm shall be  $0.20 \pm 0.02$  mm.

6.0 MECHANICAL REQUIREMENTS

6.1 Breaking Load

6.1.1 Breaking load (Longitudinal direction). The breaking load of carbon tape shall be not less than 7 N/mm width when tested as per Cl 10.4.

6.1.2 Breaking load (Transverse direction) : Breaking load of Carbon cloths in transverse direction when tested as per Cl 10.5 shall not be less than 3.5 N/mm width. For this test the manufacturer shall supply a cloth of 25 cm x 25 cm of same thickness of that of the tape marking longitudinal and transverse direction.

6.2 Elongation

6.2.1 Elongation (longitudinal direction) - The elongation of carbon tape when tested as per Cl 10.4 shall not be less than 3 percent.

6.2.2 Elongation (transverse direction) - The elongation of carbon cloth in transverse direction when tested as per Cl 10.5 shall not be less than 13 percent. For this test the manufacturer shall submit a cloth of size 25 cm x 25 cm and of same thickness as that of tape marking longitudinal and transverse directions.

7.0 ELECTRICAL REQUIREMENTS

7.1 dc resistance - The dc resistance of carbon tape when tested as per Cl 10.6 shall be between the values given below:-

For 19 mm width carbon tape - 5 k $\Omega$  to 15 k $\Omega$

For 30 mm width carbon tape - 3 k $\Omega$  to 10 k $\Omega$

8.0 ENVIRONMENTAL REQUIREMENTS

8.1 The Breaking Load and elongation after heat ageing

The Breaking Load and elongation of the carbon tape after being subjected to heat ageing test as per Cl 10.7 shall not be less than as specified in Cl 6.1.1 and 6.1.2 respectively.

8.2 dc resistance after heat ageing - The dc resistance of carbon tape after being subjected to heat ageing as per Cl 10.7 shall be as specified at Cl 7.1.

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## 9.0 CLASSIFICATION OF TESTS

## 9.1 Group 'A' tests

These tests shall be conducted on all tendered lots.

Srl.No.	Name of test	Test method
1	Visual examination	10.1
2	Width	10.2
3	Thickness	10.3
4	Packing	11.1

## Group 'B' tests

These tests shall be carried out on sampling basis as per IS:2500 Pt 1 for acceptance quality level as shown against each:-

Srl.No.	Name of test	Test Cl ref.	Sampling method
1	Breaking Load and Elongation (Longitudinal)	10.4	AQL 4 percent Inspection Level II
2	dc resistance	10.6	

## Group 'C' tests

1	Heat ageing test	10.7	* ref note below
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\* Note:- 5 rolls from each tendered lot shall be tested.

## 10 TEST PROCEDURE

- 10.1 Visual examination - The tape shall be examined for good workmanship and finish. The tape shall generally meet all the requirements as specified in clause 3.0
- 10.2 Width - The width shall be measured at five places at random in a length of not less than one metre of tape from each roll. A length of 5 metres shall be discarded from the starting end of each roll before measurements are taken.
- 10.3 Thickness - The thickness shall be measured with a micrometer capable of measuring to an accuracy of 0.001 mm. Five measurements shall be made at random in a length of not less than one metre of tape from each sample roll. A length of 5 metres shall be discarded from the starting end of each roll before measurements are taken.
- 10.4 Breaking Load and Elongation (Longitudinal)  
The breaking load of the tape shall be determined on a suitable tensile strength testing machine. The initial distance between the grips as well as initial length of tape between them shall be adjusted to 200 mm. The rate of fall of lower jaw shall be 250-300 mm per minute. Two marks separated by a distance of 100 mm shall be made on the tape before start of the test.

## 10.4 (Contd.....)

Three tests shall be made on each sample roll. The mean ~~tensile strength~~ <sup>breaking load</sup> is calculated. Elongation shall be calculated from the difference in length between the marks at the time of break and the initial separation. Elongation shall be expressed as percentage of original length. Alternatively, if the moving jaw has a pointer fixed to it which travels along a scale, lengths at break can be read directly from this scale and elongation in percent computed from the original lengths. If the tape breaks unevenly or at the jaws of testing machine the test shall be void.

10.5 Breaking Load and Elongation (Transverse direction)

A sample of 15 mm width and 250 mm length is cut from the carbon cloth in such a way that the fibres are transversely oriented. The Breaking Load and elongation shall be determined as described at Cl 10.5. Three Specimens shall be tested.

10.6 dc resistance - The dc resistance of carbon tape shall be determined by using bar electrodes (also known as strip electrodes). Fig.1 gives a schematic representation of the electrode system. The tape shall be inserted between two conducting electrodes (made of brass and copper) at one end and the other end of the tape shall be similarly clamped between another pair of two conducting electrodes. The distance between the two electrode pairs shall be 20 cm. The dc resistance of the tape shall then be measured by a Kelvin bridge <sup>or</sup> milliohmmeter having an accuracy of 1 percent or better <sup>or</sup> any other <sup>precision</sup> equipment. Three measurements shall be made on samples from each roll.

10.7 Heat Aging - A specimen of length 500 mm shall be exposed to dry air at a temperature of  $150 \pm 1^\circ\text{C}$  for a period of 30 minutes. The specimen shall be supported in a suitable oven in such a way that the test lengths hang freely and is not in contact with or in the too close proximity to other parts of the oven or to other tape specimens. After a recovery of two hours (during which period the aged specimens shall be protected from contact with free matter), the specimens shall be tested for ~~tensile strength~~ <sup>breaking load</sup> and elongation as per Cl 10.4 and dc resistance as per Cl 10.6. The values shall be not less than those specified at Clause 6.1.1, 6.2.1 and Cl 7.1 respectively.

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11.0 PACKAGING AND MARKING

11.1 Carbon Tape should be coiled on paper core which is 52 mm  $\pm$  1 mm inner diameter and 65  $\pm$  1 mm outer diameter for tape of 19.0 mm width. Carbon tape of 30 mm width should be coiled over paper core which is 58.0  $\begin{matrix} -0.00 \\ +2.00 \end{matrix}$  mm inner dia and 72  $\pm$  2 mm outer dia. The standard outer dia of Carbon tape coiled core should be 280 mm to 300 mm.

11.2 Marking

The packages must be marked with lengths, A/T No, date of delivery and manufacturer's identification.

12.0 WORKMANSHIP

The tape shall be inspected for workmanship at any stage of production. Any faulty workmanship pointed out by the Inspector shall be corrected to his satisfaction.

13.0 INSPECTION

Inspection will be by the Controller, Controllerate of Inspection Electronics, Bangalore-560 006, or by his authorised representative.

*R.R. DUTTA*

APPROVED

(Dr. R.K. DUTTA GUPTA)

DCSO

Dt: 7J-80

for DIRECTOR GENERAL OF INSPECTION

NOT

This SPECIFICATION should be returned to the ISSUING AUTHORITY on completion of TENDER/CONTRACT.

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(AHK/11/11/11)  
19 Oct 59  
68 Ppt  
CQAP

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Specn.No.CIL/405

### 1.0 SCOPE

This standard specifies the requirements and tests for Carbon Tapes using staple fibre or any other suitable fibre coated with carbon. The carbon tape is used as an electrostatic shielding in cable Telephone Carrier Quad 1A (Y3/6145-001036) and Cable Telephone 20 conductor Polythene Insulated PVC Sheathed 2A (Y3/6145-004680).

### 2.0 RELATED SPECIFICATIONS

IS: 2500, Pt I - Specification for inspection by attributes and by count of defects.

### 3.0 GENERAL REQUIREMENTS

The Carbon Tape shall consist of evenly and firmly woven staple fibre and well and evenly coated with carbon on each side and subsequently cut into rolls of specified widths. The tape shall be capable of being unwound without the end threads unravelling or getting entangled when adjacent layers of tape are separated and the ~~residual~~ compound shall not pull away from the fabric and leave bare spots during unwinding.

### 4.0 TERMINOLOGY

4.1 Unit of product: A unit of product shall be a roll of 500 metres length for 19 mm width and 300-330 m for 30 mm width. A maximum of two joints per roll may be allowed.

4.2 Group 'A' tests: These comprise of all essential tests which are required to be carried out on all rolls of tapes of tendered lot.

4.3 Group 'B' tests: These comprise of those acceptance tests which are comprehensive than Group 'A' tests. These tests shall be carried out on sampling basis.

4.4 Group 'C' tests: These comprise of those acceptance tests which are more comprehensive than group 'A' and Group 'B' tests. These tests shall be carried out on sampling basis.

### 5.0 DIMENSIONAL REQUIREMENTS

5.1 Length: Rolls of tape shall be supplied in lengths of 500 metres for 19 mm width and 300-330 m for 30 mm width unless otherwise agreed to between the purchaser and the supplier.

5.2 Width: Tapes shall be supplied in the following width as demanded:

- a) 19 mm
- b) 30 mm The width of the tape shall not vary from the nominal specified value by more than  $\pm 0.5$  mm.

5.3 Thickness: - The thickness of Carbon Tape with nominal width of 19 mm shall be  $0.13 \pm 0.01$  mm. The thickness of carbon tape of nominal width of 30 mm shall be  $0.20 \pm 0.02$  mm.

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<u>Srl.No</u>	<u>Name of test</u>	<u>Test Cl ref.</u>	<u>Sampling method</u>
1	Breaking Load and Elongation (Longitudinal)	10.4	AQL 4 percent Inspection Level II
2	dc resistance	10.6	
<u>Group 'C' tests</u>			
1	Heat ageing test	10.7	* ref.Note below.

\* Note:- 5 rolls from each tendered lot shall be tested.

10 TEST PROCEDURE

10.1 Visual examination: The tape shall be examined for good workmanship and finish. The tape shall generally meet all the requirements as specified in clause 3.0

10.2 Width: The width shall be measured at five places at random in a length of not less than one metre of tape from each roll. A length of 5 metres shall be discarded from the starting end of each roll before measurements are taken.

10.3 Thickness: The thickness shall be measured with a micro meter capable of measuring to an accuracy of 0.001 mm. Five measurements shall be made at random in a length of not less than one metre of tape from each sample roll. A length of 5 metres shall be discarded from the starting end of each roll before measurements are taken.

10.4 Breaking Load and Elongation (Longitudinal)

The Breaking Load of the tape shall be determined on a suitable tensile strength testing machine. The initial distance between the grips as well as initial length of tape between them shall be adjusted to 200 mm. The rate of traverse of lower jaw shall be 250-300 mm per minute. Two marks separated by a distance of 100 mm shall be made of the tape before start of the test. Three tests shall be made on each sample roll. The mean breaking load is calculated. Elongation shall be calculated from the difference in length between the marks at the time of break and the initial separation. Elongation shall be expressed as percentage of original length. Alternatively, if the moving jaw has a pointer fixed to it which travels along a scale, lengths at break can be read directly from this scale and elongation in percent computed from the original length. If the tape breaks unevenly or at the Jaws of testing machine the test shall be void.

10.5 Breaking Load and Elongation (Transverse direction)

A sample of 15 mm width and 250 mm length is cut from the carbon cloth in such a way that the fibres are transversely oriented. The Breaking Load and elongation shall be determined as described at Cl 10.5. Three Specimens shall be tested.

10.6 dc resistance: The dc resistance of carbon tape shall be determined by using bar electrodes (also known as stripelectrodes). Fig. 1 gives a schematic representation of the electrode system.

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10.6 (Contd...)

The tape shall be inserted between two conducting electrodes. (made of brass and copper) at one end and the other end of the tape shall be a similarly clamped between another pair of two conducting electrodes. The distance between the two electrode pairs shall be 20 cm. The dc resistance of the tape shall then be measured by a Kelvin bridge/Millichrometer having an accuracy of 1 percent or better or any other similar equipment. Three measurements shall be made on samples from each roll.

10.7 Heat Ageing : A specimen of length 500 mm shall be exposed to dry air at a temperature of  $150 \pm 1^\circ\text{C}$  for a period of 30 minutes. The specimen shall be supported in a suitable oven in such a way that the test length hangs freely and is not in contact with or in the too close proximity to other parts of the oven or to other tape specimens. After a recovery of two hours (during which period the aged specimens shall be protected from <sup>1</sup> /with free matter), the specimens shall be tested for breaking load and elongation as per Cl.10.4 and dc resistance as per Cl.10.6. The values shall be not less than those specified at Clause 6.1.1, 6.2.1 and Cl7, respectively. contact

11.0 PACKAGING AND MARKING

11.1 Carbon Tape should be coiled on paper core which is 52 mm  $\pm$  1 mm inner diameter and  $65 \pm 1$  mm outer diameter for tape of 19.0 mm width. Carbon tape of 30 mm width should be coiled over paper core which is 58.0  $\pm$  0.00 mm inner dia and  $72 \pm 2$  mm outer dia. The standard outer dia of Carbon Tape coiled core should be 280 mm to 300 mm.

11.2 Marking The packages must be marked with lengths A/1 No. date of delivery and manufacturer's identification.

12.0 WORKMANSHIP

The tape shall be inspected for workmanship at any stage of production. Any faulty workmanship pointed out by the Inspector shall be corrected to his satisfaction.

13.0 INSPECTION

Inspection will be by the Controller, Controllerate of Inspection Electronics, Bangalore-560 006, or by his authorised representative.

Approved  
Dt : 7 Jun 80

Sd/-  
DR. RA. GUPTA (GUPTA)  
DCSO

for DIRECTOR GENERAL OF INSPECTION

This SPECIFICATION should be returned to the ISSUING AUTHORITY on completion of TENDER/CONTRACT.

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MATERIAL STANDARD  
 REVISED MSO-8 R  
 COMPOUNDED POLYETHYLENE (BLACK)

COMPOUNDED POLYETHYLENE is used for insulating the stranded conductor.

2. Quality

2.1 Appearance.

The compound shall be black granule and of even quality free from any impure or alien substances. The granule shall be of one size free from any chips.

2.2 Performance.

No.	Item	Requirements.
1.	Melt index	Not more than 2.8
2.	Tensile strength	Not less than 1.2 Kg/mm <sup>2</sup>
3.	Elongation	Not less than 400%
4.	Power factor	Not more than $5 \times 10^{-4}$ at 1 KVP <sub>av</sub> MHz
5.	Dielectric constant	Not more than 2.35 at 1 KV <sub>av</sub> MHz 2.40
6.	Heating ageing test at 90°C for 96 hours	
	Depreciation of tensile strength	Not more than 25%
	Depreciation of elongation	Not more than 25%
7.	Brittle temperature	Not higher than -60°C
8.	Density	0.910-0.925 g/cm <sup>3</sup>
9.	Carbon Content	0.08-0.15%

Note: Material upto dielectric constant 2.40 at 1 MHz will be acceptable  
 Velled vide our letter no 0905 dt 9 Nov '77



(M.K. KHAN)  
 Jso  
 for Controller.



MATERIAL STANDARD  
MSUQ-8  
STAINLESS STEEL WIRE

This is stainless steel wire to be used as braided wire on Carbon Tape.

3.1. Quality

Chemical Composition:

Item	Composition
1. Carbon (C)	Not more than 0.10%
2. Silicon (Si)	Not more than 1.00%
3. Manganese (Mn)	Not more than 2.00%
4. Phosphorus (P)	Not more than 0.04%
5. Sulphur (S)	Not more than 0.03%
6. Nickel (Ni)	8.00 - 11.00%
7. Chromium (Cr)	17.00 - 20.00%

3.2. Physical and Mechanical Properties:

Item	Requirements
1. Diameter	0.381 ± 0.010 mm
2. Tensile Strength	Not less than 210.9 kg/mm <sup>2</sup>
3. Torsion test	Not less than 5 turns at 38 mm
4. Conductivity	Not less than 1.5%
5. Permeability	Not more than 20

3.3. Packing

4.1. Stainless steel wire is coiled on reel which is 300 mm in flange dia, 130 mm in barrel dia, 130 mm in traverse, 15 mm in flange thickness and 30 mm bore dia.

4.2. Net weight of each reel is not less than 2 Kg.

4.3. The supplier shall supply  $B-H$  curve (viz a plot of permeability against intensity of magnetization) for values of  $H$  upto 300 oersteds in respect of each consignment. Measurements may be carried out at 10, 20, 30, 40, 50, 75, 100, 200 & 300 oersteds. The intention is to find out Max. value of permeability. The Inspecting Officer may waive off tests at intensities higher than one point five times of the intensity which maximum permeability is observed.

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C O N T E N T S

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### 1.0 SCOPE

This Standard specifies the requirements and tests for Carbon Tapes using staple fibre or any other suitable fibre coated with carbon. The carbon tape is used as an electro static shield in Cable Telephone Carrier Quad 1A (Y3/6145-001036) and Cable Telephone 20 conductor Polythene Insulated PVC Sheathed 2A(Y3/6145-004680).

### 2.0 RELATED SPECIFICATIONS

IS:2500, Pt I - Specification for inspection by attributes and by count of defects

### 3.0 GENERAL REQUIREMENTS

The Carbon Tape shall consist of evenly and finely woven staple fibre and well and evenly coated with carbon on each side and subsequently cut into rolls of specified widths. The tape shall be capable of being unwound without the end threads unraveling or getting entangled when adjacent layers of tape are separated and the compound shall not pull away from the fabric and leave bare spots during unwinding.

### 4.0 TERMINOLOGY

4.1 Unit of product - A Unit of product shall be a roll of 500 metres length for 19 mm width and 300-330 m for 30 mm width. A maximum of two joints per roll may be allowed.

4.2 Group 'A' tests - These comprise of all essential tests which are required to be carried out on all rolls of tapes of a tendered lot.

4.3 Group 'B' tests - These comprise of those acceptance tests which are more comprehensive than Group 'A' tests. These tests shall be carried out on sampling basis.

4.4 Group 'C' tests - These comprise of those acceptance tests which are more comprehensive than Group 'A' and Group 'B' tests. These tests shall be carried out on sampling basis.

### 5.0 DIMENSIONAL REQUIREMENTS

5.1 Length - Rolls of tape shall be supplied in lengths of 500 metres for 19 mm width and 300-330 m for 30 mm width unless otherwise agreed to between the purchaser and the supplier.

5.2 Width - Tapes shall be supplied in the following widths as demanded:-

(a) 19 mm

(b) 30 mm

The width of the tape shall not vary from the nominal specified value by more than  $\pm 0.5$  mm.

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6.0 MECHANICAL REQUIREMENTS6.1 Breaking load

6.1.1 Breaking load (Longitudinal direction). The breaking load of Carbon tape shall be not less than 7 N/mm width when tested as per Cl 10.4.

6.1.2 Breaking load (Transverse direction) : Breaking load of Carbon cloths in transverse direction when tested as per Cl 10.5 shall not be less than 3.5 N/mm width. For this test the manufacturer shall supply a cloth of 245 25 cm x 25 cm of same thickness of that of the tape marking longitudinal and transverse direction.

6.2 Elongation

6.2.1 Elongation (longitudinal direction) : The elongation of carbon tape when tested as per Cl 10.4 shall not be less than 3 percent.

6.2.2 Elongation (Transverse direction) : The elongation of carbon cloth in transverse direction when tested as per Cl 10.5 shall not be less than 13 percent. For this test the manufacturer shall submit a cloth of size 25 cm x 25 cm end of same thickness as that of tape marking longitudinal and transverse directions.

7.0 ELECTRICAL REQUIREMENTS

7.1 dc resistance : The dc resistance of carbon tape when tested as per Cl 10.6 shall be between the values given below:-

For 19 mm width carbon tape : 5 k $\Omega$  to 15 k $\Omega$

For 30 mm width carbon tape: 3 k $\Omega$  to 10 k $\Omega$

8.0 ENVIRONMENTAL REQUIREMENTS8.1 Breaking Load and Elongation after heat ageing

The Breaking Load and elongation of the carbon tape after being subjected to heat ageing test as per Cl 10.7 shall not be less than as specified in Cl 6.1.1 and 6.1.2 respectively.

8.2 dc resistance after heat ageing

The dc resistance of carbon tape after being subjected to heat ageing as per Cl 10.7 shall be as specified at Cl 7.1.

9.0 CLASSIFICATION OF TESTS9.1 Group 'A' tests

These tests shall be conducted on all tendered lots.

<u>Srl No.</u>	<u>Name of test</u>	<u>Test method</u>
1	Visual examination	10.1
2	Width	10.2
3	Thickness	10.3
4	Packing	11.1

Group 'B' tests

These tests shall be carried out on sampling basis as per IS: 2500, Pt I for acceptance quality level as shown against each:-

5.3 Thickness - The thickness of Carbon Tape with nominal width of 19 mm shall be  $0.13 \pm 0.01$  mm. The thickness of carbon tape of nominal width of 30 mm shall be  $0.20 \pm 0.02$  mm.

#### 6.0 MECHANICAL REQUIREMENTS

##### 6.1 Breaking Load

6.1.1 Breaking load (Longitudinal direction). The breaking load of carbon tape shall be not less than 7 N/mm width when tested as per Cl 10.4.

6.1.2 Breaking load (Transverse direction) : Breaking load of Carbon cloths in transverse direction when tested as per Cl 10.5 shall not be less than 3.5 N/mm width. For this test the manufacturer shall supply a cloth of 25 cm x 25 cm of same thickness of that of the tape marking longitudinal and transverse direction.

##### 6.2 Elongation

6.2.1 Elongation (longitudinal direction) - The elongation of carbon tape when tested as per Cl 10.4 shall not be less than 3 percent.

6.2.2 Elongation (transverse direction) - The elongation of carbon cloth in transverse direction when tested as per Cl 10.5 shall not be less than 13 percent. For this test the manufacturer shall submit a cloth of size 25 cm x 25 cm and of same thickness as that of tape marking longitudinal and transverse directions.

#### 7.0 ELECTRICAL REQUIREMENTS

7.1 dc resistance - The dc resistance of carbon tape when tested as per Cl 10.6 shall be between the values given below:-

For 19 mm width carbon tape - 5 k $\Omega$  to 15 k $\Omega$

For 30 mm width carbon tape - 3 k $\Omega$  to 10 k $\Omega$

#### 8.0 ENVIRONMENTAL REQUIREMENTS

##### 8.1 The Breaking Load and elongation after heat ageing

The Breaking Load and elongation of the carbon tape after being subjected to heat ageing test as per Cl 10.7 shall not be less than as specified in Cl 6.1.1 and 6.1.2 respectively.

8.2 dc resistance after heat ageing - The dc resistance of carbon tape after being subjected to heat ageing as per Cl 10.7 shall be as specified at Cl 7.1.

## 9.0 CLASSIFICATION OF TESTS

## 9.1 Group 'A' tests

These tests shall be conducted on all tendered lots:

Srl.No.	Name of test	Test method
1	Visual examination	10.1
2	Width	10.2
3	Thickness	10.3
4	Packing	11.1

## Group 'B' tests

These tests shall be carried out on sampling basis as per IS:2500 Pt I for acceptance quality level as shown against each:-

Srl.No.	Name of test	Test Cl ref.	Sampling method
1	Breaking Load and Elongation (Longitudinal)	10.4	AQL 4 percent Inspection Level II
2	dc resistance	10.6	

## Group 'C' tests

1 Heat ageing test 10.7 \* ref note below

\* Note:- 5 rolls from each tendered lot shall be tested.

## 10 TEST PROCEDURE

10.1 Visual examination - The tape shall be examined for good workmanship and finish. The tape shall generally meet all the requirements as specified in clause 3.0

10.2 Width - The width shall be measured at five places at random in a length of not less than one metre of tape from each roll. A length of 5 metres shall be discarded from the starting end of each roll before measurements are taken.

10.3 Thickness - The thickness shall be measured with a micrometer capable of measuring to an accuracy of 0.001 mm. Five measurements shall be made at random in a length of not less than one metre of tape from each sample roll. A length of 5 metres shall be discarded from the starting end of each roll before measurements are taken.

10.4 Breaking Load and Elongation (Longitudinal)

The Breaking Load of the tape shall be determined on a suitable tensile strength testing machine. The initial distance between the grips as well as initial length of tape between them shall be adjusted to 200 mm. The rate of travel of lower jaw shall be 250-300 mm per minute. Two marks separated by a distance of 100 mm shall be made on the tape before start of the test.



10.4 (Contd.....)

Three tests shall be made on each sample roll. The mean ~~breaking load~~ <sup>breaking load</sup> tensile strength is calculated. Elongation shall be calculated from the difference in length between the marks at the time of break and the initial separation. Elongation shall be expressed as percentage of original length. Alternatively, if the moving jaw has a pointer fixed to it which travels along a scale, lengths at break can be read directly from this scale and elongation in percent computed from the original lengths. If the tape breaks unevenly or at the jaws of testing machine the test shall be void.

10.5 Breaking Load and Elongation (Transverse direction)

A sample of 15 mm width and 250 mm length is cut from the carbon cloth in such a way that the fibres are transversely oriented. The Breaking Load and elongation shall be determined as described at Cl 10.5. Three Specimens shall be tested.

10.6

dc resistance - The dc resistance of carbon tape shall be determined by using bar electrodes (also known as strip electrodes). Fig.1 gives a schematic representation of the electrode system. The tape shall be inserted between two conducting electrodes (made of brass and copper) at one end and the other end of the tape shall be similarly clamped between another pair of two conducting electrodes. The distance between the two electrode pairs shall be 20 cm. The dc resistance of the tape shall then be measured by a Kelvin bridge/milliohmmeter having an accuracy of 1 percent or better/<sup>or</sup> any other equipment. Three measurements shall be made on samples from each roll.

10.7

Heat Aging - A specimen of length 500 mm shall be exposed to dry air at a temperature of  $150 \pm 1^\circ\text{C}$  for a period of 30 minutes. The specimen shall be supported in a suitable oven in such a way that the test lengths hang freely and is not in contact with or in the too close proximity to other parts of the oven or to other tape specimens. After a recovery of two hours (during which period the aged specimen shall be protected from contact with free matter), the specimens shall be tested for <sup>breaking load</sup> tensile strength and elongation as per Cl 10.4 and dc resistance as per Cl 10.6. The values shall be not less than those specified at Clause 5.1.1, 5.1.2 and Cl 7.1 respectively.

RESTRICTED

11.0 PACKAGING AND MARKING

11.1 Carbon Tape should be coiled on paper core which is 52 mm  $\pm$  1 mm inner diameter and 65  $\pm$  1 mm outer diameter for tape of 19.0 mm width. Carbon tape of 30 mm width should be coiled over paper core which is 58.0  $\pm$  0.00 mm inner dia and 72  $\pm$  2 mm outer dia. The standard outer dia of Carbon tape coiled core should be 280 mm to 300 mm.

11.2 Marking

The packages must be marked with lengths, A/T No, date of delivery and manufacturer's identification.

12.0 WORKMANSHIP

The tape shall be inspected for workmanship at any stage of production. Any faulty workmanship pointed out by the Inspector shall be corrected to his satisfaction.

13.0 INSPECTION

Inspection will be by the Controller, Controllerate of Inspection Electronics, Bangalore-560 006, or by his authorised representative.

APPROVED

Dt: 7 Jun 60

ZnP

*R.R. DUTTA*

(Dr. R.R. DUTTA GUPTA)  
DCSO

for DIRECTOR GENERAL OF INSPECTION

This SPECIFICATION should be returned to the ISSUING AUTHORITY on completion of TENDER/CONTRACT.