

Saudi Electricity Company



الشركة السعودية للكهرباء

SEC DISTRIBUTION MATERIALS SPECIFICATION

11-SDMS-03, Rev. 02

DATE: 01-12-2013

11-SDMS-03

REV. 02

SPECIFICATIONS

FOR

**XLPE INSULATED POWER CABLES
FOR RATED VOLTAGES FROM 15 KV UP TO 36 KV (U_m)**

**This specification is property of SEC and
subject to change or modification without notice**



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1.0 SCOPE

This SEC Distribution Materials Specification specifies the minimum technical requirements for design, engineering, manufacturing, testing, inspection and performance of XLPE insulated, single/three core aluminum or copper power cables for rated voltages from 15 kV up to 36 kV (U_m) suitable for direct burial or installation in ducts or in air within cable guard on poles intended to be used in the medium voltage system of Saudi Electricity Company (SEC).

Cables included in this specification are itemized in Table-1 and Table-2.

Table-1
15 kV Cables

S. No.	Cable Size, mm ²	Description
1	3x185/35	Three core, unarmored, copper
2	3x300/35	Three core, armored, copper
3	3x300/35	Three core, armored, aluminum
4	3x500/35	Three core, armored, aluminum
5	3x70/16	Three core, armored, aluminum
6	1x50/16	Single core, unarmored, copper

Table-2
36 kV Cables

S. No.	Cable Size, mm ²	Description
1	1x500/35	Single core, unarmored, copper
2	3x240/35	Three core, armored, copper
3	3x185/35	Three core, armored, copper
4	1x50/16	Single core, unarmored, copper

2.0 CROSS REFERENCES

This specification shall always be read in conjunction with SEC General Specification No. 01-SDMS-01 (latest revision) titled "General Requirements for all Equipments /Materials", which shall be considered as an integral part of this SDMS.

This SDMS shall also be read in conjunction with SEC Purchase Order or Contract Schedules and the Scope of Work and Technical Specifications for Project, as applicable.



3.0 APPLICABLE CODES & STANDARDS

The latest revision of the following codes and standards shall be applicable for cables covered in this SDMS. In case of any conflict, the manufacturer/vendor may propose cables conforming to one group of codes and standards quoted hereunder without jeopardizing the requirements of this SDMS.

IEC INTERNATIONAL ELECTROTECHNICAL COMMISSION:

IEC 60228	Conductors of Insulated Cables.
IEC 60502-2	Power Cables with Extruded Insulation and Their Accessories for Rated Voltages from 1 kV up to 30 kV ($U_m = 36$ kV).
IEC 60811	Common Test Methods for Insulating and Sheathing Materials of Electric Cables.
IEC 60229	Electric Cables – Tests on Extruded Oversheaths with a Special Protective Function.

AEIC ASSOCIATION OF EDISON ILLUMINATING COMPANIES:

AEIC CS8	Specifications for Extruded Dielectric, Shielded Power Cables Rated 5 through 46 kV.
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4.0 DESIGN & CONSTRUCTION REQUIREMENTS

4.1 General

- 4.1.1 The power cable shall meet or exceed the requirements of this specification in all respects.
- 4.1.2 Manufacturer's drawings, as required by 01-SDMS-01, shall show the outline of the power cable, together with all pertinent dimensions. Any variations in these dimensions due to manufacturing tolerances shall be indicated.

4.2 Design Criteria

- 4.2.1 Unless otherwise specified, the cable shall conform to IEC 60502-2.
- 4.2.2 The power cable shall be designed for service conditions specified in 01-SDMS-01.
- 4.2.3 Cable design shall facilitate heat shrink, cold shrink or pre-molded joints and



terminations. This requirement shall include the use of an extruded inner covering under armor where applicable.

4.2.4 The conductor semi-conducting layer, insulation and insulation semi-conducting layer shall be a triple extrusion process.

4.2.5 The construction of the cables shall be essentially as shown in Figure 1 and Figure 2. The ratings and dimensions shall be as indicated in Technical Data Schedule.

4.3 Materials

4.3.1 Conductor

The conductor shall be uncoated annealed copper or aluminum Class 2 as per IEC 60228, and shall be round, compacted and stranded. The conductor size, shape and material shall be as specified in Technical Data Schedule.

4.3.2 Conductor Semi-conducting Screening

Conductors of the cables shall be screened. The conductor screen shall consist of an extruded black semi-conducting material compatible with the insulation of the conductor and shall have an allowable operating temperature equal to or higher than the insulation. The outer surface of the conductor shield shall be cylindrical and shall be firmly bonded to the insulation. The extruded shield shall be easily removable from the conductor. The conductor screen shall meet all the requirements of AEIC CS8.

4.3.3 Insulation

The insulation shall be extruded solid dielectric cross-linked polyethylene (XLPE) complying with the appropriate requirements specified in Section 6.1 of IEC 60502-2.

The nominal insulation thickness shall be as specified in IEC 60502-2, Table 6. The cross linking process shall not expose the material to water or steam.

The average insulation thickness shall not be less than the specified nominal value.

The minimum thickness at any point shall not fall below the nominal value by more than 0.1 mm + 10 % of nominal value.



4.3.4 Insulation Semi conducting Screening

Core insulation of the cables shall be screened. The insulation semi-conducting screen shall consist of an extruded black semi-conducting material applied directly over the insulation and shall comply with the requirements of AEIC CS8.

The extruded insulation semi conducting screen shall be easily strippable without damaging the insulation, leaving no conducting material that cannot readily be removed. An insulation screen that requires heat for removal shall not be supplied. The insulation shield shall comply with the stripping test requirements of AEIC CS8.

4.3.5 Metallic Screening

All cores with semi-conducting insulation screening shall have a supplementary copper wire screen helically applied in intimate contact with the non-metallic semi-conducting screening.

A copper tape counter-helix shall be applied over the copper wires.

The screen size shall be as given below excluding copper tape.

- 16 mm² for up to and including 70 mm² core.
- 35 mm² for sizes in excess of 70 mm² core.

The minimum size of copper tape binder shall be 0.1 x 15 mm.

4.3.6 Inner Coverings and Assembly of Cores

For three core cables, an extruded inner covering shall be provided over the cores assembly. The metallic screens of the cores shall be in contact with each other.

4.3.7 Inner Covering and Fillers Requirements

The inner coverings and fillers shall be of materials suitable for the operating temperature of the cable and compatible with the insulation. The fillers shall be non-hygroscopic. The inner covering material shall be PE compound.



4.3.8 Armor Tapes

For armored cables, double steel tape of galvanized steel shall be applied helically over the inner covering. Nominal thickness shall conform to IEC 60502-2, Table 10, and minimum thickness shall not be less than 90 % of nominal value.

4.3.9 Outer Sheath

The outer sheath material shall be red PVC type ST2, as per IEC 60502-2. The nominal thickness of outer sheath shall be as per IEC 60502-2. Minimum thickness at any point shall not be less than 80% of nominal value.

4.4 Core Identification

For three core cables, Red, Yellow and Blue identifying tapes shall be used, and insulation shall not be colored.

4.5 Fabrication

4.5.1 The conductor shield, the cross-linked polyethylene insulation and the outer semi conductor shall be extruded by the triple extrusion method as given in Clause 4.2.4.

4.5.2 The power cable shall be free of material and manufacturing defects, which would prevent it from meeting the requirements of this specification.

4.6 Marking

4.6.1 The jacket for all cables shall be marked by embossing at intervals not exceeding one meter with the following minimum information:

- a) The manufacturer's name or trademark (in Arabic).
- b) Voltage designation (in English).
- c) Type of insulation, XLPE (in English).
- d) Conductor size and material (in Arabic and English).
- e) Year of manufacture (in Arabic and English).
- f) Cumulative length at every one meter with the highest length marked on the outer end of the cable.

4.6.2 All cables shall be marked with "Property of Saudi Electricity Company" in both Arabic and English.

4.6.3 Marking by matrix print is not acceptable.



5.0 TESTS

5.1 General

5.1.1 All cables shall be tested in accordance with the latest standards and as specified herein.

The supplier shall provide all test results for review and acceptance by SEC.

5.1.2 The full range of routine, special and type tests specified in IEC 60502-2 shall be carried out as applicable.

5.1.3 Routine and/or special tests shall be carried out in the factory. Type test reports and certificates from an independent testing laboratory shall be submitted to SEC at Inquiry stage.

5.1.4 Sheath of all cables shall be spark tested as per IEC 60229.

5.1.5 Cables shall be tested for strippability requirements for insulation shield as given in AEIC CS8.

5.2 Routine Tests

The following routine tests shall be carried out on each manufactured length of cable.

5.2.1 **Electrical Resistance of Conductors**

Resistance measurement shall be made on all conductors of each cable length submitted to routine tests. Resistance values shall be in accordance with IEC 60228.

5.2.2 **Partial Discharge Test**

The partial discharge test shall be carried out in accordance with IEC 60885-3. The magnitude of the discharge at $1.73 U_0$ shall not exceed 10 pC.

5.2.3 **Voltage Test**

The power frequency test voltage shall be $3.5 U_0$. Values for single phase test voltage are given below:

Rated Voltage	15 (17.5) kV	30 (36) kV
Test Voltage	30.5 kV	63 kV



If, for three-core cables, the voltage test is carried out with a three phase transformer, the test voltage between the phases shall be 1.73 times the values given above.

5.3 Special Tests

- 5.3.1 Conductor examination shall be in accordance with IEC 60228.
- 5.3.2 Dimensional check shall be in accordance with IEC 60502-2.
- 5.3.3 Hot set test for XLPE insulation, as per IEC 60502-2.

6.0 PACKING AND SHIPPING

In addition to the applicable items per 01-SDMS-01, packing and shipping of the cable shall conform to the following:

- 6.1 The cable ends shall be sealed with a waterproof, heat shrinkable end cap with adhesive-type sealing compound. Cable ends shall be properly secured to the reel.
- 6.2 The cable shall be delivered without splices, properly packed on a standard size non-returnable reel of sturdy construction, and protected by means of wood lagging (or any other suitable material) to prevent possible physical damage to the cable during transit and customary storage/handling operations. Lagging shall be secured with steel straps.
- 6.3 The minimum diameter of the drum of the shipping reel shall not be less than the minimum bending diameter of the power cable.
- 6.4 Cables shall be supplied in lengths as specified in the Inquiry. The allowable tolerance on the specified length shall be $\pm 5\%$.

6.5 Reel Markings

6.5.1 Cable reels/drums shall be marked in legible and indelible letters giving the following particulars:

- a) Cable voltage and conductor material and size and number of cores.
- b) Type of insulation.
- c) Length and weight of cable on reel.
- d) Gross weight.
- e) Dimensions of reel.



- f) Manufacturer's name and country of origin.
- g) SEC address, purchase order number, Inquiry number and year of manufacture.
- h) Serial number of reel.
- i) SEC stock number in 10 cm high bold numerals.
- j) Direction of rolling the reel.
- k) 11-SDMS-03 (the latest revision).

6.5.2 All markings shall appear on both sides of the reel, as per Figure 3.

6.5.3 Cable reel identification shall include any additional information as required by SEC shipping instructions.

7.0 GUARANTEE

The Supplier shall guarantee the cables against all defects arising out of faulty design or workmanship, or of defective material for a period of two (2) years from the date of delivery.

8.0 SUBMITTALS

8.1 Submittals required with the tender.

8.1.1 The supplier shall complete and return one copy of the attached Data Schedule for every type of cable offered.

8.1.2 Guaranteed delivery date.

8.1.3 Type test certificates and reports.

8.1.4 Dimensional cross-sectional drawings of each cable and cable drum along with technical data and catalogues.

8.2 Submittals required following the award of contract.

8.2.1 Details of manufacturing and test programs.

8.2.2 Factory test reports.



9.0

**TECHNICAL DATA SCHEDULE
15 KV TO 36 KV XLPE POWER CABLES**

(Sheet 1 of 4)

SEC Inquiry No:

Item No:

SEC REF	DESCRIPTION	SEC SPECIFIED VALUES	VENDOR PROPOSED VALUES**
4.0	DESIGN AND CONSTRUCTION REQUIREMENTS		
	1. Reference manufacturing standard	IEC 60502-2	
	2. Max. permissible continuous conductor temp. (°C)	90	
	3. Maximum short circuit temperature (°C)	250	
	4. Max. permissible cont. temp. of inner covering (°C)	*	
	5. Max. permissible cont. temp. of outer sheath (°C)	*	
	6. Rated voltage (kV)	15 kV or 36 kV	
	7. Number of cores	1 or 3	
	8. Conductor material	Cu or Al	
	9. Shape of conductor	Round	
	10. Conductor cross-section (mm ²)	As per Inquiry	
	11. Approximate diameter of conductor (mm)	*	
	12. Number of strands of conductor	*	
	13. Minimum thickness of conductor shield (mm)	*	
	14. Insulation material	XLPE	
	15. Nominal thickness of insulation (mm)	As per IEC	
	16. Min/max thickness of strippable semi-conducting insulation shield material (mm)	*	
	17. Diameter under insulation semicon (mm)	*	
	18. Number and nominal diameter of Cu wire screen (mm)	*	
	19. Minimum thickness of copper tape and width (mm)	0.1x15	
	20. Inner covering material	PE	
	21. Nominal thickness of inner covering (mm)	*	
	22. Armor type and thickness (mm)	*	
	23. Core identification (Red, Yellow, Blue)	Yes	
	24. Diameter under inner covering (mm)	*	
	25. Filler material	*	
	26. Outer sheath material	PVC Type ST2	
	27. Diameter under outer sheath (mm)	*	
	28. Thickness of outer sheath (mm)	As per IEC	



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TECHNICAL DATA SCHEDULE
15 KV TO 36 KV XLPE POWER CABLES

(Sheet 2 of 4)

SEC Inquiry No:

Item No:

SEC REF	DESCRIPTION	SEC SPECIFIED VALUES	VENDOR PROPOSED VALUES**
	29. Color of outer sheath	15 kV – Red 36 kV – Black	
	30. Marking embossed as specified	Yes	
	31. Overall diameter of the cable (mm)	*	
	32. Net weight of conductor (kg/km)	*	
	33. Conductor DC resistance at 20°C (Ω/km)	*	
	34. Conductor AC resistance at 90°C (Ω/km)	*	
	35. Inductance (mH/km)	*	
	36. Capacitance (uF/km)	*	
	37. Inductive reactance (Ω/km)	*	
	38. Capacitive reactance (Ω/km)	*	
	39. Conductor impedance at 90° C (Ω/km)	$(R + jX)$	
	40. Positive sequence impedance (Ω/km)	$(R_1 + jX_{L1})$	
	41. Zero sequence impedance (Ω/km)	$(R_0 + jX_{L0})$	
	42. Positive sequence charging admittance (μS/km)	(jB_1)	
	43. Zero sequence charging admittance (μS/km)	(jB_0)	
	44. Zero sequence impedance, assuming all currents in screens: R (Ω/km) X (Ω/km)	* *	
	45. Charging current (A/km)	*	
	46. Earth fault capacitive current (A/km)	*	
	47. Short circuit rating of cable based on maximum conductor operating temperature (1 second) - Conductor (kA) - Screen (kA)	* *	
	48. Conductor temperature before short circuit (° C)	*	
	49. Conductor temperature at the end of short circuit (° C)	*	
	50. Screen temperature before short circuit (° C)	*	
	51. Screen temperature at the end of short circuit (° C)	*	
	52. System short circuit for one second (kA)	21 for 15 kV 25 for 36 kV	



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TECHNICAL DATA SCHEDULE
15 KV TO 36 KV XLPE POWER CABLES

(Sheet 3 of 4)

SEC Inquiry No:

Item No:

SEC REF	DESCRIPTION	SEC SPECIFIED VALUES	VENDOR PROPOSED VALUES**
	53. Permissible load in amps under maximum service conditions given in this Specification (A)	*	
	54. Maximum pulling tension (kN)	*	
	55. Maximum side wall pressure (kN/m)	*	
	56. Maximum bending radius (m)	*	
	57. Meets strippability requirement of AEIC CS-8	Yes	
	58. Maximum partial discharge at 1.5 times rated voltage, 10 pC	Yes	
	59. Meets spark test requirement for jacket	Yes	
	60. Meets all test requirements of IEC 60502-2	Yes	
6.0	PACKING AND SHIPPING		
	1. Drum type	Returnable	
	2. Length of cable (m)	As per Inquiry	
	3. Dimensions (m)	*	
	4. Gross weight (kg)	*	
	5. Net weight (kg)	*	
	6. Marking as per the Specification	Yes	
8.0	SUBMITTALS		
	1. All submittals as per the Specification	Yes	

Note: (*) - Values to be provided/proposed by the Vendor.
 (***) - Please provide explanations for deviations, if any.



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TECHNICAL DATA SCHEDULE
15 KV TO 36 KV XLPE POWER CABLES
 (Sheet 4 of 4)

SEC Inquiry No: _____

SEC Item No: _____

- A) Additional Technical Information or Features Specified by SEC.
- B) Additional Supplementary Data or Features Proposed by Bidder/Vendor/Supplier.
- C) Other Particulars to be filled-up by the Bidder/Vendor/Supplier.
- D) List of Deviations and Clauses to which exception is taken by the Bidder/Vendor/Supplier.
(Use separate sheet, if necessary).

DESCRIPTION	Manufacturer of Material/Equipment	Vendor/Supplier
Name of Company		
Location and Office Address		
Name and Signature of Authorized Representative with Date		
Official Seal / Stamp		

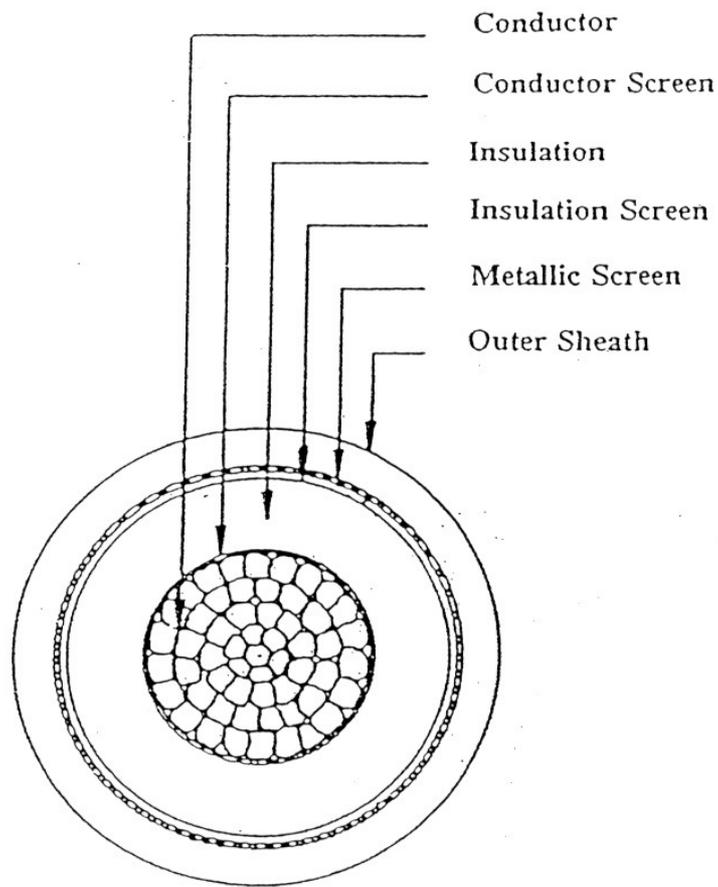


FIGURE - 1

CROSS - SECTION OF 1-CORE CABLE

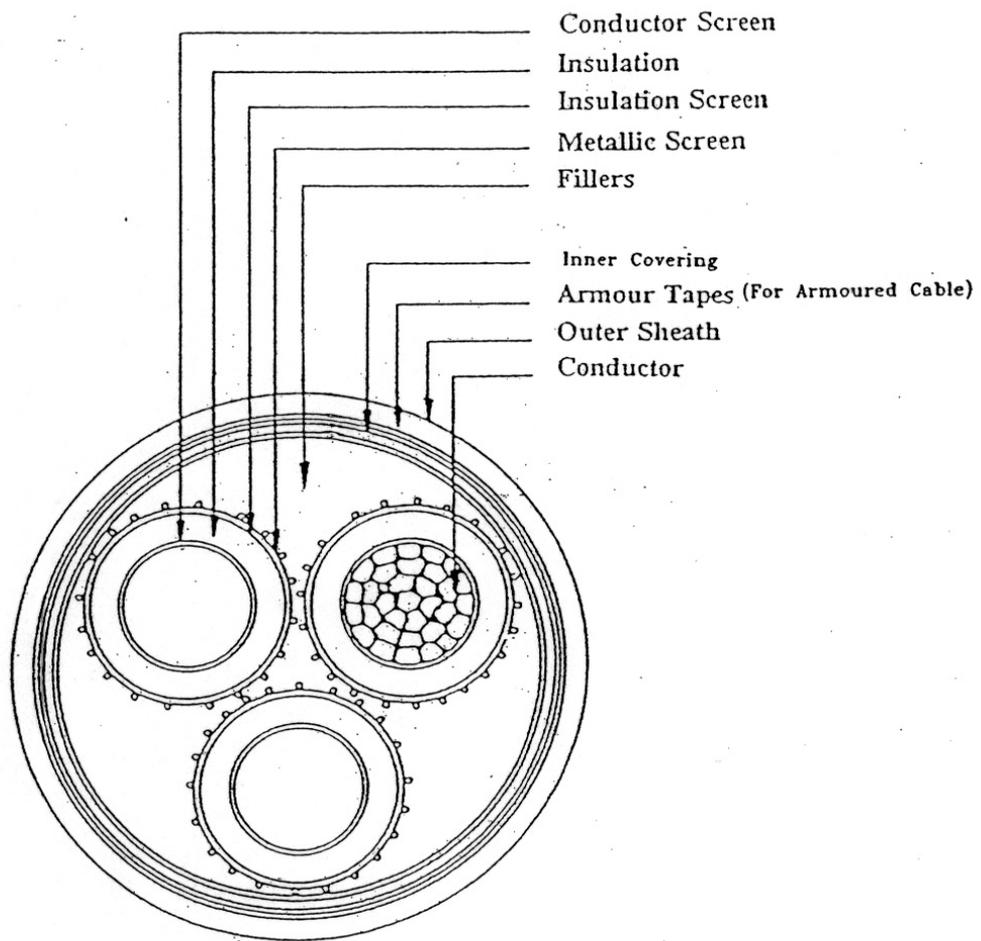


FIGURE - 2

CROSS - SECTION OF 3-CORE CABLE

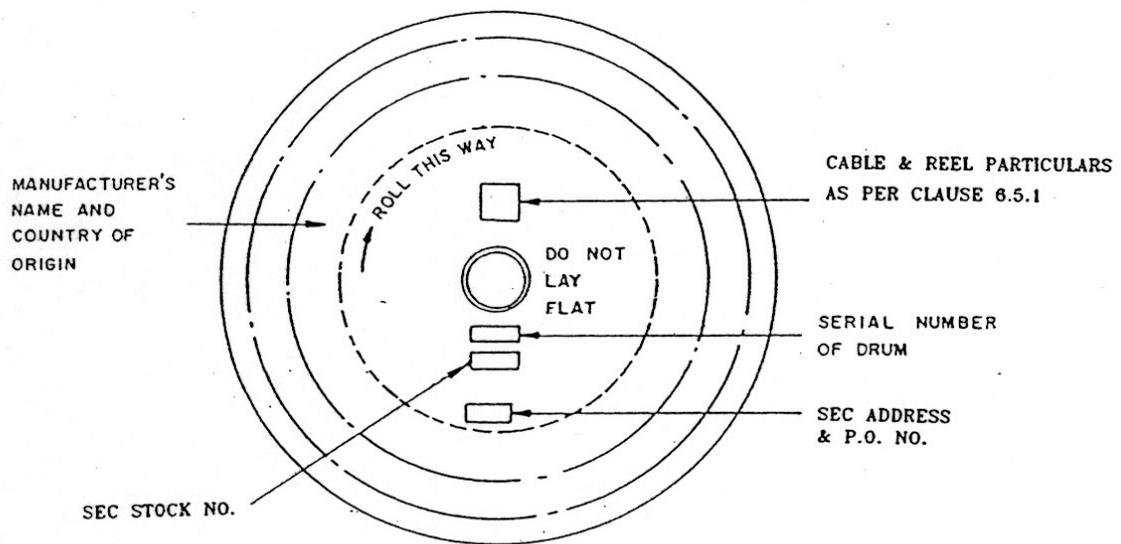


FIGURE - 3

REEL MARKING LOCATIONS