



TITLE:
SPECIFICATION FOR LOW VOLTAGE AERIAL BUNDLED CABLES (LV ABC) : PART 2: 2X16MM² + 1X25MM² AERIAL BUNCHED CABLES FOR STREET LIGHTING

Doc. No.	KP1/6C.1/13/TSP/05/013-2
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Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

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Date: 2016-02-04

Date: 2016-02-04



TITLE:
SPECIFICATION FOR LOW
VOLTAGE AERIAL BUNDLED
CABLES (LV ABC) : PART 2:
2X16MM² + 1X25MM² AERIAL
BUNCHED CABLES FOR STREET
LIGHTING

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0.1 Circulation List

COPY NO.	COPY HOLDER
1	Head of Department, Standards
Electronic copy (pdf) on KPLC server currently: http://172.16.1.40/dms/browse.php?fFolderId=23	

0.2 Amendment Record

Rev No.	Date (YYYY-MM-DD)	Description of Change	Prepared by (Name & Signature)	Approved by (Name & Signature)
0	2016-02-02	New Issue	Michael Apudo Nancy Wairimu	Eng. Dr. Peter Kimemia

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

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FOREWORD

This specification has been prepared by the Standards Department in collaboration with Street Lighting Department both of The Kenya Power and Lighting Company Limited (abbreviated as KPLC) and it lays down requirements for 2 x 16mm² + 1x 25mm² Aerial Bunched Cables for use in street lighting cabling. It is intended for use by KPLC in purchasing the cables.

The bidder shall submit information which demonstrates satisfactory capacity and service experience of the manufacturer with products which fall within the scope of this specification.

1. SCOPE

1.1. This specification covers the requirements of Cross linked Polyethylene insulated (XLPE) Aluminium Cables twisted over a central bare Aluminium alloy messenger wire (along with associated accessories) for use on Low Voltage (LV) overhead lines in Street Lighting and Rural/ Urban Electrification Systems.

1.2. The designation of the LV XLPE AB Cables are :
a) 2 core x 16 mm² + 1 x 25 mm²

The first part of the designation refers to the number and size (nominal cross sectional area) of the phase conductor and the last part to size of the bare AAA neutral-cum-messenger.

1.3. The specification stipulates the minimum requirements for XLPE LV AB cables acceptable for use in the company (KPLC) and it shall be the responsibility of the supplier to ensure adequacy of the design, good workmanship, good engineering practice and adherence to applicable standards, regulations and specifications in the manufacture of the cables for The Kenya Power and Lighting Company Limited.

The specification does not purport to include all the necessary provisions of a contract.

2. REFERENCES

The following standards contain provisions which, through reference in this text constitute provisions of this specification. Unless otherwise stated, the latest editions (including amendments) apply.

ISO 9001: Quality Management System-Requirements

ISO/IEC 17025: General requirements for the competence of testing and calibration laboratories

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- IEC 60502-1: Power cables with extruded insulation and their accessories for rated voltages from 1 kV ($U_m = 1.2$ kV) up to 30 kV ($U_m = 36$ kV) – Part 1: Cables for rated voltages of 1 kV ($U_m = 1.2$ kV) and 3 kV ($U_m = 3.6$ kV)
- ISO 4892-2: Plastics- Method of Exposure to Laboratory Light Sources – Part 2: Xenon Arc lamps
- BS 7870-5: LV and MV polymeric insulated cables for use by distribution and generation utilities. –Part 5: Polymeric insulated aerial bundled conductors (ABC) of rated voltage 0.6/1 kV for overhead distribution
- BS 2627: Specification for wrought aluminium for electrical purposes. Wire
- ENA TS 43-13: Aerial Bundled Conductors (ABC) insulated with cross-linked polyethylene for low voltage overhead distribution systems

3. TERMS AND DEFINITIONS

For the purpose of this specification the definitions given in the reference standards shall apply.

4. REQUIREMENTS

4.1. Service conditions

4.1.1. Physical conditions

The XLPE ABC cables shall be suitable for continuous use outdoors in tropical areas at:

- Altitudes of up to 2200m above sea level,
- Humidity of up to 95%,
- Average ambient temperature of +30°C with a minimum of -1°C and a maximum of +40°C and
- Heavy saline conditions along the coast.
- Isokeraunic level: 180 thunderstorm days per year

4.1.2. System conditions

The system conditions shall be as per Table 1.

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Table 1: Electrical Data

1	Nominal system voltage	230/400V
2	Voltage designation $U_0/U(U_m)$, V	600/1000(1200)
3	The rated voltage of the cables	0.6/1kV
4	Voltage Test	2.5 kV / 50 Hz/ 5 minutes for routine tests. 4 kV / 50 Hz/ 4 Hrs. for type tests.
5	Max short circuit current for 1 Sec.	1.0 KA.
6	Current carrying capacity at different ambient air temperatures of different sizes of phase conductors	Tabulated in Table 4.

4.2. Design and construction

4.2.1. General

- 4.2.1.1. The insulated phase conductors shall be twisted around the bare aluminium alloy messenger wire, which shall take all the mechanical stress. The messenger wire shall also serve as the earth cum-neutral wire.
- 4.2.1.2. The cable shall consist of one to three black weather resistant cross linked polyethylene (XLPE) insulated aluminium phase conductor's, stranded around a bare all aluminium alloy messenger which is also the neutral conductor. The construction data are specified in BS 7870-5 and Table 2.
- 4.2.1.3. The detailed design drawings shall be submitted along with the bid documents for purposes of tender evaluation.
- 4.2.1.4. The resistance of the phase conductors and the messenger shall be determined with direct current and the same are corrected to 20°C using the formula and co-efficient given in clause-8.1 of the standard IEC 60189-1. The values obtained shall not exceed the resistance given in Table 3

Table 2: Construction data and dimensions of LV Aerial Bunched Cables

Number and cross sectional area of conductors	Phase conductors				Messenger		Complete cables
	Number and sectional area	Diameter of uninsulated conductor max.	Insulation thickness	Overall diameter of conductors (approx.)	Diameter of uninsulated conductor max.	Breaking load (approx.) min.	Overall diameter (approx.)
mm ²	mm ²	mm	mm	mm	mm	kN	mm
2 x 16 + 25	2 x 16	4.6	1.2	7.0	6.0	7.0	13

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Table 3: D.C Resistance and insulation of the LV AB cable

Nominal cross sectional area of conductor mm ²	Number of strands No.	DC resistance at 20°C max	Insulation thickness average min.
		Ω/km	mm
16 (Aluminium)	7	1.910	1.2
25 (Aluminium alloy)	7	1.38	Bare

NOTE:

1. The average value of thickness of the insulation shall not be less than the specified average value.
2. The thickness at any place may be less than the specified average value, provided that the difference does not exceed 0.1 mm + 0.1mm (tolerance) of the specified average value.
3. For thickness of insulation, six measurements are made radially on a piece of insulation, as far as possible equally spaced around the circumference but not on the ridges

Table 4: Current carrying capacity (A) (approximate) of phase conductors at different ambient air temperature

No. and area of conductor mm ²	0°C	+5°C	+10°C	+15°C	+20°C	+25°C	+30°C	+35°C	+40°C	+45°C	+50°C	+55°C	+60°C
Current carrying capacity in Amps													
2x16+25	99	96	93	89	85	81	77	73	69	64	58	52	44

4.2.2. Phase conductors

4.2.2.1. The 16 mm² phase conductor shall be of designation H68 of BS 2627 or equivalent grade of aluminium round, stranded and compacted (the flexibility is as per IEC 60502-1, class-II), 25 mm² messenger wire shall be round stranded and suitably compacted and outer diameter shall be within the limits specified in Table 2.

4.2.2.2. The phase conductors shall be insulated with black weather resistant (Ozone resistant and UV stabilized) Cross linked Polyethylene (XLPE) suitable to 1100 V insulation. The insulated conductors shall generally conform to IEC 60502-1 and BS 7870-5.

4.2.3. Conductors

4.2.3.1. The properties of the Aluminium wires before stranding shall be as below.
 a) Tensile strength not less than 90 N/mm²

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b) Resistivity at 20⁰C not exceeding 0.02845 Ω/m.

4.2.3.2. The outer layer in standard conductor shall have a right handed direction of lay (Z), the surface of the conductors shall be smooth.

4.2.4. Insulation

4.2.4.1. Material

The insulation shall be black weather – resistant cross linked polyethylene (XLPE). The XLPE compound shall be treated with anti-UV chemicals to prevent UV attack by sunlight. When exposed to a light of wavelength of 300nm to 400nm with an irradiance of 60±2 W/m² at a black standard temperature of 65 ± 3⁰C and a humidity of 50% for a period of 102 min day, the insulation shall not fail. UV stability shall be tested in accordance to ISO 4892-2 method A (1).

Table 5: Properties of XLPE

	Property	Requirement	
1	Tensile strength , min , N/mm ²	12.5 N/Sq.mm.	
2	Elongation at break, %	≥200.	
3	Hot set percentage elongation under load, %	≤175	
4	Permanent set, %	≤15	
5	Volume Resistivity of insulation, minimum, Ω.cm	At 27 ⁰ C.	1 x 10 ¹³
		At 70 ⁰ C	1 x 10 ¹¹
6	Shrinkage at 130 ⁰ C for 1 Hour, max. %	4%	

4.2.4.2. Phase Identification

Durable and clearly visible longitudinal ridges shall be provided on each insulated conductor for identification phases. The cores of aerial bundled conductor shall be identified in accordance with Section 3.3 of ENA TS 43 –13 and laying up shall be in accordance with Section 3.4 of ENA TS 43 –13:

- a) For 2 Core Cable - 1.2
- b) Approximate ridge dimensions shall be :
 - (i) Width = 1.00 mm
 - (ii) Height = 0.4 mm
 - (iii) Distance between consecutive ridges = 2.7 mm.

4.2.5. Messenger (Neutral Conductor)

4.2.5.1. The messenger shall be an All Aluminium Alloy conductor composed of seven (7) wires each of diameter of 2.34 mm drawn from rod, which is manufactured in a continuous

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casting and rolling procedure. The properties for the individual wires before stranding shall be:

- a) Tensile strength not less than 278 N/mm².
- b) Resistivity at 20^oC not exceeding 0.0328 Ωmm²/m
- c) Density at 20^oC of 2.7 Kg/ dm³.

4.2.5.2. No joints are allowed in the messenger except those made on the base rod or wire before final drawing. The messenger shall be round, stranded and compacted to have smooth round surface. The messenger takes all the mechanical stress and also serves as neutral conductor.

- a) Neutral conductor over all diameter (max) of 6.5.mm
- b) D.C resistance at 20^oC (max) 1.38 Ω/km.
- c) Minimum breaking load of 7.0 KN.

4.3. QUALITY MANAGEMENT SYSTEM

4.3.1. The bidder shall submit a quality assurance plan (QAP) that will be used to ensure that the cable design, material, workmanship, tests, service capability, maintenance and documentation, will fulfill the requirements stated in the contract documents, standards, specifications and regulations. The QAP shall be based on and include relevant parts to fulfill the requirements of ISO 9001:2008.

4.3.2. The Manufacturer's Declaration of Conformity to reference standards and copies of quality management certifications including copy of valid and relevant ISO 9001: 2008 certificate shall be submitted with the tender for evaluation.

4.3.3. The bidder shall indicate the delivery time of the cables, manufacturer's monthly & annual production capacity and experience in the production of the type and size of conductor being offered. A detailed list & contact addresses (including e-mail) of the manufacturer's previous customers for similar rating of cables sold in the last five years as well as reference letters from at least four of the customers shall be submitted with the tender for evaluation.

5. TESTS AND INSPECTION

5.1. The cable shall be inspected and tested in accordance with requirements of IEC 60502-1, ISO 4892-2, BS 7870-5, BS 2627, ENA TS 43-13 and the requirements of this specification. It shall be the responsibility of the supplier to perform or to have performed all the tests specified.

5.2. Copies of previous Test Reports of not more than five (years) confirming full compliance to clause 4 requirements for the cable issued by a **third party testing laboratory that is accredited to ISO/IEC 17025** shall be submitted with the tender for the purpose of technical

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evaluation. The accreditation certificate for the third party testing laboratory (copy) shall also be submitted with the tender (all in English Language).

5.3. Test Reports for the cable to be supplied under the contract shall be submitted to The Kenya Power & Lighting Company for approval before shipment/delivery and shall include the following:

A. Tests on phase/street light conductor

- a) Tensile Test
- b) Wrapping Test
- c) Resistance Test

B. Tests on messenger conductor

- a) Breaking Load
- b) Elongation Test
- c) Resistance Test

C. Physical Test for XLPE Insulation

- a) Tensile strength and elongation at break
- b) Hot Set index
- c) Shrinkage Test
- d) Ageing test in air oven
- e) Water absorption (Gravimetric)
- f) Test for thickness of insulation
- g) Insulation resistance (volume resistivity)
- h) High voltage test

D. Bending test on complete cable

The test shall be performed on a sample of complete cable. The sample shall be bent around a test mandrel at room temperature for at least one complete turn. It shall then be unwound and the process shall be repeated after turning the sample around its axis 180°. The cycle of these operations shall be carried out 3 times. The diameter of the mandrel shall be 10 (D+d).

Where

D= actual diameter of the cable (i.e., minimum circumscribing circle diameter in mm)

d= actual diameter of the conductor in mm.

NOTE: No cracks visible to the naked eye are allowed.

5.4. Routine and sample test reports for the cable to be supplied shall be submitted to KPLC for approval before shipment of the goods.

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5.5. The cable shall be subject to acceptance tests at the manufactures' works before dispatch. Acceptance tests (routine & sample tests) will be witnessed by two Engineers appointed by The Kenya Power and Lighting Company Limited (KPLC). Tests to be witnessed by KPLC Engineers at the factory before shipment shall be in accordance with IEC 60502-1, ISO 4892-2, BS 7870-5, BS 2627, ENA TS 43-13 and the requirements of this specification and shall include:

- a) Tensile tests for phase/street light conductor
- b) Wrapping Test for phase/street light conductor
- c) Breaking load test for messenger conductor
- d) Elongation test for messenger conductor.
- e) Conductor resistance test.
- f) Test for thickness of insulation.
- g) Tensile strength and elongation at break
- h) Insulation resistance test
- i) High voltage test
- j) Hot Set
- k) Bending test on complete cable

5.6. Upon delivery of the cable, KPLC will inspect them and may perform or have performed any of the relevant tests in order to verify compliance with the specification. The supplier shall replace/rectify without extra or additional charge to KPLC, cables which upon examination, test or use fail to meet any of the requirements in the specification.

6. PACKING AND MARKING

6.1. PACKING

6.1.1. The cable shall be wound on non-returnable wooden drums. The ends of the cable shall be sealed by means of non-hygroscopic sealing materials. The drum shall be marked with the following.

- a) Manufacturer's Name or Trade Mark.
- b) Type of cable and voltage grade.
- c) Drum number or identification number.
- d) Number of cores and size of cable.
- e) Number and length of pieces of cable in each drum.
- f) Gross and Net mass of the cable.
- g) Direction of rotation of drum. (By means of an arrow).
- h) The words, "Property of KPLC".

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6.1.2. The drums shall be of such construction as to assure delivery of conductor in the field free from displacement and damage, and shall be able to withstand all stresses due to handling and the stringing operation so that cable surface is not dented, scratched or damaged in any way during transport and erection. The cable shall be properly lagged on the drums.

6.1.3. The cable drum should be suitable for wheel mounting.

6.1.4. The mass of finished cable in a drum (without mass of drum) of various designation shall not exceed by more than 10% of the following values.

- Designation gross mass for 2 x 16mm² + 25 mm² shall be approximately 800 Kg
- The minimum length of each cable in a drum shall be 1 Km.

NOTE: While longer length shall be acceptable, shorter lengths not less than 500m shall be acceptable to the extent of 10% of the size wise ordered quantity only.

6.2. MARKING

All the cables shall have the markings embossed on the insulated phase conductors for identification at regular intervals of not more than one meter.

- Cable manufacturer - Manufacturer's name and their unique factory identifier
- Electric cable ELECTRIC CABLE
- Voltage designation i.e. 600/1000V
- Standard number i.e. IEC 60502-1 and BS 7870-5
- Number of cores, nominal area of conductor and messenger (Neutral Conductor) as appropriate e.g. 2 x 16mm² + 25 mm²
- Year of manufacture ZZZZ
- Standard core colour identifier H
- The letters "Property of KPLC"

NOTE:

- A simplified version of the manufacturer's name, or a trading name of the manufacturer, may be used in place of the full name.
- Any suitable method may be used to unambiguously identify the manufacturer's factory.
- The manufacturer's own trademark or equivalent may be added but this cannot be used instead of the manufacturer's name or identifier.
- The year of manufacture may take the form of the actual year (e.g. 2013) or a coded year identifier assigned by the manufacturer.

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7. DOCUMENTATION

- 7.1. The bidder shall submit its tender complete with technical documents required by Annex A (Guaranteed Technical Particulars) for tender evaluation. The technical documents to be submitted (all in English Language) for tender evaluation shall include the following:
- a) Fully filled clause by clause description of the item on offer as per Annex A (Guaranteed Technical Particulars) and signed by the manufacturer;
 - b) Copies of the Manufacturer's catalogues, brochures, drawings and technical data;
 - c) Sales records for the last five years and customer reference letters;
 - d) Details of manufacturing capacity and the manufacturer's experience;
 - e) Copies of required type test reports by a third party testing laboratory accredited to ISO/IEC 17025;
 - f) Copy of accreditation certificate to ISO/IEC 17025 for the third party testing laboratory;
 - g) Manufacturers letter of authorization, quality certificate and other technical documents required in the tender.
- 7.2. The successful bidder (supplier) shall submit the following documents/details to The Kenya Power & Lighting Company for approval before manufacture:
- a) Guaranteed Technical Particulars signed by the manufacturer;
 - b) Design Drawings with details of cable to be manufactured for KPLC.
 - c) Quality assurance plan (QAP) that will be used to ensure that the design, material; workmanship, tests, service capability, maintenance and documentation will fulfill the requirements stated in the contract documents, standards, specifications and regulations.
 - d) Detailed test program to be used during factory testing;
 - e) Manufacturer's undertaking to ensure adequacy of the design, good engineering practice, adherence to the specification and applicable standards and regulations as well as ensuring good workmanship in the manufacture of the cables for The Kenya Power & Lighting Company;
 - f) Packaging details and quantity per package.
- 7.3. The supplier shall submit recommendations for use, care, storage and routine inspection/testing procedures, all in the English Language, during delivery of the cables to KPLC stores

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TENDER NO. **BIDDER'S NAME & ADDRESS**

Sr. No.	Mandatory Requirements	Bidders Offer based on the Manufacturers Test Reports and Catalogues
	Manufacturer's Name and address	State
	Country of manufacture	State
	Bidders Name and address	State
	Tendered items	State
1.0	SCOPE	
	1.1-1.3	Specify
2.0	Applicable standards	Specify
3.0	TERMS AND DEFINITIONS	Specify
4.0	REQUIREMENTS	
4.1	Service conditions	Specify
4.2	Design and construction	
4.2.1	Cable construction	Specify
	Material of construction of messenger wire and phase conductors	Specify
	Insulation material of phase conductors	Specify
	Insulation thickness of phase conductors	Specify
	Design details and drawings	Provide drawing
	Applicable standards	
	Phase conductors	Specify
	Insulation material	Specify
	Messenger	Specify
	Number of strands	
	Phase conductors	Specify
	Messenger	Specify
	Nominal diameter of strand	
	Phase conductors	Specify
	Messenger	Specify
	Max diameter of bare conductor	
	Phase conductors	Specify
	Messenger	Specify
	Nominal cross-section area of bare conductor	
	Phase conductors	Specify
	Messenger	Specify
	DC resistance at 20°C max	
	Phase conductors	Specify
	Messenger	Specify
	Diameter of insulated conductor	Specify
	Tensile strength of (min)/breaking load	
	Phase conductor	Specify
	Messenger	Specify

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Sr. No.	Mandatory Requirements	Bidders Offer based on the Manufacturers Test Reports and Catalogues
	(KN)	
	Total weight (kg/km)	Specify
	Standard drum length offered (mtrs) and tolerance.	Specify
	Gross weight of the cable drum	Specify
	Code or method of cable identification.	Specify
	AC resistance at – 90 ^o C phase conductor (ohms/km)	Specify
	AC resistance at – 75 ^o C messenger/ neutral conductor (ohms/km)	Specify
	Approx. inductive reactance at 50 Hz. Phase conductor (ohms/km)	Specify
	Approx. inductive reactance at 50 Hz. Messenger/neutral conductor (ohms/km)	Specify
	Approx. zero sequence reactance at 50 Hz. Per phase (ohms/km):	Specify
	Short circuit current for 1 Sec. Max. (KA)	Specify
	Current carrying capacity (amps) at various ambient temperatures of	0 ^o C
		25 ^o C
		35 ^o C
		60 ^o C
4.2.2	Sizes of conductors	Specify
	Designation, and grade of aluminium	Specify
	Insulation material is black and weather resistant	Specify
4.2.3	Tensile strength of wires before stranding	Specify
	Resistivity at 20 ^o C	Specify
	Lay direction of conductor	Specify
	Conductor surface finish	Specify
4.2.4	UV stability test on insulation material	Specify and Provide test report
	Tensile strength of insulation	Specify
	Elongation (%) at break	Specify
	Phase identification	Specify and provide drawing
4.2.5	Specify material, dimensional details, method of manufacture	Specify
	Tensile strength, resistivity and density at 20 ^o C	Specify
	Breaking load and DC resistance	Specify
4.3	Embossing on cable oversheath	Specify
4.4	Quality Management System	Specify
	Quality Assurance Plan	Specify
	Copy of ISO 9001:2008 Certificate	Specify
	Manufacturer's experience	Specify
	Manufacturing capacity (units per month)	Specify
	List of previous customers	Specify
	Customer reference letters	Specify
5.1	Test standards and responsibility of carrying out tests	Specify
5.2	Design and construction validated by Type Tests and applicable Tests	Specify
5.3	Copies of Type Test reports submitted with tender	Specify
5.4	Test reports to be submitted by supplier to KPLC for approval before shipment	Specify

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2016-02-04

Date: 2016-02-04



TITLE:
SPECIFICATION FOR LOW VOLTAGE AERIAL BUNDLED CABLES (LV ABC) : PART 2: 2X16MM² + 1X25MM² AERIAL BUNCHED CABLES FOR STREET LIGHTING

Doc. No.	KP1/6C.1/13/TSP/05/013-2
Issue No.	1
Revision No.	0
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Sr. No.	Mandatory Requirements	Bidders Offer based on the Manufacturers Test Reports and Catalogues
5.5	Acceptance tests to be witnessed by KPLC at factory before shipment	Specify
5.6	Replacement of any rejected equipment or component	Specify
6.1	Marking	Specify
6.2	Packing	Specify
7.1	Documents submitted with tender	Specify
7.2	Documents to be submitted by supplier to KPLC for approval before manufacture	Specify
8.0	Manufacturer's Guarantee and Warranty	Specify
9.0	Statement of compliance to specification (Indicate deviations if any & supporting documents)	Specify

ANNEX B: SCHEDULE OF TENDERERS EXPERIENCE

The tenderer shall furnish a list of similar orders executed and to whom reference may be made.

Sr. No.	Name of client	Description of order	Value of order	Period of supply and commissioning	Name and address where reference may be made

.....
Manufacturer's Name, Signature, Stamp and Date

Issued by: Head of Section, Standards Development	Authorized by: Head of Department, Standards
Signed: 	Signed: 
Date: 2016-02-04	Date: 2016-02-04

