



EEHC DISTRIBUTION MATERIALS SPECIFICATION

EDMS 13 - 100 - 1

Date: 09-03-2020

EDMS 13-100-1

TECHNICAL SPECIFICATION FOR

CABLE TERMINATION FOR

XLPE INSULATED CABLES 12/20 (24) kV

(Indoor and outdoor)

Issue: Mar-2020 / Rev- 1

توجد بنود اختيارية (Option items) يجب تحديدها بواسطة شركة التوزيع قبل الطرح.



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1. SCOPE:

This specification covers the minimum technical requirements for design, engineering, manufacture, testing, inspection, installation and performance of all kinds of terminations for medium voltage power cables, XLPE insulation, with the following different constructions:

- Three core and single core
- Indoor and outdoor
- Copper and aluminum conductors
- The termination for the level of 11kV system (12/20 kV cable) should meet the requirements of the 24kV Level.
- The termination kits should be supplied completely with all relevant components
- Unless otherwise specified termination should comply with all relevant standards described in table no.1

This specification does not cover

- Accessories for special applications, such as aerial cables, submarine or ship cables or hazardous situations (explosive environments, fire-resistant cables or seismic conditions).

2- DEFINITIONS

.2.1. Indoor Termination

A device fitted to the end of a cable to ensure electrical connection with other parts of the system and to maintain the insulation up to the point of connection, where termination intended for use where it is not exposed to either solar radiation or weathering.

.2.2. Outdoor Termination

A device fitted to the end of a cable to ensure electrical connection with other parts of the system and to maintain the insulation up to the point of connection, where termination intended for use where it is exposed to either solar radiation or weathering.



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2.3. Conductor Temperature:

The termination should be suitable for use on cables having maximum conductor temperature of 90°C at normal conditions, and maximum temperature of the cable conductors under short-circuit condition of 250°C.

2.4. Rated voltage: U_0/U (U_m)

The rated voltages U_0/U (U_m) of the cable termination considered in this specification is 12/20 (24) kV.

- U_0 : is the rated power frequency voltage between conductor and earth or metallic screen for which the cable is designed (phase voltage).
- U : is the rated power frequency voltage between conductors for which the cable is designed (line voltage).
- U_m : is the maximum value of the "highest system voltage" for which the equipment may be used.

3- APPLICABLE STANDARDS

The Terminations' components, performance and testing should be complied with latest revision of standards as described in the table(1).

Table (1)

S. N.o	Standard No.	Description
1.	<u>IEC 60502-2</u>	Cables for rated voltages from 6 kV ($U_m = 7,2$ kV) up to 30 kV ($U_m = 36$ kV)
2.	<u>IEC 60502-4</u>	Test requirements on accessories for cables with rated voltages from 6 kV ($U_m = 7,2$ kV) up to 30 kV ($U_m = 36$ kV)
3.	<u>IEC 61442</u>	Test methods for accessories for power cables with rated voltages from 6 kV ($U_m = 7,2$ kV) up to 30 kV ($U_m = 36$ kV)
4.	<u>HD 629.1 S2</u>	Test requirements on accessories for use on power cables rated voltage from 3.6/6(7.2) kV up to 20.8/36(42) kV - Part 1



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	<u>CENELEC</u>	
5.	<u>IEC 61238-1</u>	Compression and mechanical Lugs for power cables for rated voltages up to 30 kV ($U_m = 36$ kV) – Part 1: Test methods and requirements
6.	<u>IEC 60228</u>	Conductors of insulated cables
7.	<u>DIN 46235</u>	Cable lugs for compression connections cover plate type for copper conductor
8.	<u>DIN EN 13600</u>	Seamless copper tube for electrical purpose
9.	<u>DIN EN 755</u>	Aluminum and Aluminum alloy – Extruded rod/bar, tube, and profile, Part 7 - seamless tube tolerance on dimensions and form
10.	<u>IEC 60060</u>	High-voltage test techniques
11.	<u>IEC 60230</u>	Impulse tests on cables and their accessories
12.	<u>IEC 60885-3</u>	Electrical test methods for electric cables Part 3: Test methods for partial discharge measurements on lengths of extruded power cables
13.	<u>VDE 0278</u>	Test requirements on accessories for use on power cables of rated voltage from 3,6/6 (7,2) kV up to 20,8/36 (42) kV
14.	<u>IEEE 048</u>	Standards for test procedure and requirements for alternating-current cable Termination used on shielded cables.
15.	<u>IEEE 404</u>	Standards for Extruded and Laminated Dielectric shielded cable joints rated 2.5 kV to 500 kV



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4- ENVIRONMENTAL CONDITIONS

The performance of the Termination components in the kits should be guaranteed for following the environmental conditions, any differences in the guaranteed performance should be clearly set out in the offer.

Minimum ambient temperature	: -5°C.
Maximum ambient temperature	: 45°C (50 °c as option).
Maximum relative humidity	: 95%.
Maximum altitude	: 1000 m.

5- SERVICE CONDITIONS

- The sunlight is very intense and the temperature of exposed 70°C.
- The maximum solar radiation intensity on a horizontal surface is 1000 w/m².
- Severe surface contamination from salt, dust, heavy industrial pollution, sandstorms, fine dust often carried in suspension in the atmosphere even on calm days, can be expected.

6- SYSTEM DETAILS :

Frequency	50 HZ
Number of phases	1 or 3
Nominal voltage	11 kV
Highest voltage	12 kV
Maximum prospective Fault level	25 KA for Duration of 1 sec.

7-TERMINATION KIT MATERIAL, RATINGS, AND PERFORMANCE

- 7.1** The Termination kits should be supplied completely with all relevant components including the main insulation part(s), DIN or equivalent standards (Lugs) , tinned



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copper Braid of sufficient length, cleaning solvent, solder, outer jacket tubes , and/or any special accessories required.

7.2. The material for bonding the cable screen , the cable armouring with the termination screen (copper braid or mesh) should be suitable for fault levels specified in clause 6 .

7.3. The cross-sectional area of the copper mesh or braid should be at least equal to the effective cross-sectional area of the cable copper screen with a minimum size as indicated in the following tables.

Minimum Copper Screen of termination for the Single & three-Phase Cable 12/20 kV

C.S.A (mm ²)	35	50	70	95	120	150	185	240	300	400	500	630	800	1000
Total Copper weight for the 1 phases gm/m	130	130	130	130	130	200	200	200	200	315	315	315	315	315
Min. length of the copper Baird per phase cm	90	90	90	90	90	90	90	90	90	90	90	90	90	90

7.4. Each kit should be supplied with installation instructions in Arabic (and English).

7.5. Termination should in general be compatible with cables used by ...EDC.

7.6. Testing of the termination should be meet the requirments described in the relevant clause and either requirements of IEC or , VDE tests as per table 12 of these specifications, or according to CENELEC.

7.7. The minimum guaranteed performance should be suitable with the enviromental conditions mentioned in item (4).

7.8. The 24 kV termination should be suitable for use with the following type of cables:



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12/20 kV, one/three core, underground power cables, Aluminum/ Copper stranded-compacted circular conductor, extruded semi-conducting layer, XLPE insulation, extruded semi-conducting layer well bonded, copper tape screening, filler, separation sheath ST2 (bedding), double steel tape armour, black PVC over sheath, according to the requirements of IEC 60502-2.

7.9. The materials of the termination and the installation instructions should be compatible with the cable materials 12/20 (24) kV, hence the cable insulation, and semi-conductive screening layers are extruded type.

7.10. Lugs should be compression type (crimped).

7.11. The termination lugs for aluminium cables should be Bi-metallic lugs, and it can be one of the following types of BI metallic lugs :(as required by ...EDC)

- BI metallic Insert lugs (AL lug with copper ring)
- BI metallic Friction welded lugs (AL lug with copper palm)
- BI metallic tinned aluminium Alloy

7.12. The termination lugs for copper cables should be copper lugs.

7.13. Lugs length as per termination manufacturer design and termination type on his own responsibility.

7.14. Lugs inner and outer diameters, die size, min. length, and tolerances as following tables.



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TABLE 2

Bi-metallic Lugs for medium votage AL cables					
Cable C.S.A (mm2)	Lug inner diameter (mm)	Lug outer diameter (mm)	Crimping die Size (mm)	Min. Total length (mm)	Stud size (mm)
50	10	16	16	84	M10
70	10.8	18	18	101	M12
95	13.2	22	22	106	M12
120	14.7	22	22	108	M12
150	15.5	25	25	120	M12
185	18.5	28	28	127	M12
240	20	32	32	140	M16
300	22.2	34	34	149	M16
400	25	38	38	194	M16
500	29	44	44	214	M16
630	32	44	44	214	M16
800	36	52	52	214	M20
1000	41.5	58	58	214	M20

Note:

- * The above dimation are subjecting for a manufacturing tolerance up to +/- 0.4mm for diameters
- * The recommended die is the Hexagonal type, with hydraulic crimping tool
- * The crimping area of the Lug should not be less than 70% of the Lugbarrel length.
- * The stude hole diameter is more the the stude size by 1.0 mm.



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TABLE 3

CU Lug for medium votage cables					
Cable CSA mm ²	Lug inner diameter (mm)	Lug outer diameter (mm)	Crimping die Size (mm)	Min. Total length (mm)	Stud size (mm)
35	8.2	12.5	12	54	M10
50	10	14.5	14	64	M10
70	11.5	16.5	16	68	M12
95	13.5	19	18	78	M12
120	15.5	21	20	83	M12
150	17	23.5	22	91	M12
185	19	25.5	25	98	M16
240	21.5	29	28	108	M16
300	24.5	32	32	116	M16
400	27.5	38.5	38	137	M20
500	31	42	42	147	M20
630	34.5	44	44	157	M20
800	38	52	52	187	M20
1000	44	58	58	187	M20

Note:

- * The above dimation are subjecting for a manufacturing tolerance upto +/- 0.4mm
- * The recommended die is the Hexagonal type, with hudrolic crimping tool
- * The crimping area of the Lug should not be less than 70% of the Lug barrel length
- * The stude hole diameter is more the the stude size by 1.0 mm.



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Lugs data sheets for termination complying with this specification:

Table 4 For Aluminium Lug Data Sheet

Description	Aluminium Lugs
Application	For Stranded Aluminum Compacted Conductors Complying to IEC 60228
Material	One piece seamless tube, (AL99.5) According to Din EN755-7
Finishing	Chemical Treatment
Identification	Manufacturer name, conductor size, die size, number of crimping, and crimping positions
Dimention and codeing	As per drawing and table of dimentions
Mechanical proparties	Pure and soft AL
Chemical composition	Min. AL ratio 99.5% (mass friction)
Electrical conductivity	Min. conductivity +58% according to IACS. IACS: International anneled copper standard

Table 5 For Copper Lugs Data Sheet

Description	CopperLugs
Application	For Stranded CoppeerCompacted Conductors Complying to IEC 60228
Material	One piece seamless tube, Electrolytic tough pitchCopper (Cu-ETP) according to DIN EN 13600:2002 (supersedes DIN 40500)
Finishing	Tinned coating not less than 3 micro meter
Identification	Manufacturer name, conductor size, die size, number of crimping, and crimping positions
Dimention and codeing	As per drawing and table of dimentions
Mechanical proparties	Pure copper
Chemical composition	Min. Copper ratio 99.9% (mass friction)
Electrical conductivity	Min. conductivity = 96.6% according to IACS. IACS: International anneled copper standered



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7.15.ADDITIONAL ACCESSORIES FOR TERMINATION KIT

1. Skirts must be coated inside (with protective release paper) with mastic or the terminations should be guaranteed (by the performance bond 10% of termination price) for 3 year from delivery to stores. (**for outdoor heatshrinkable termination**) .

Note:

Minimum Creepage distance for Indoor termination 2.5cm/kV.

Minimum Creepage Distance for Out Door termination 3.5cm/kV and 4 cm/kV for Normal and high pollution area condition respectively).

2. Cleaning solvent ≥ 100 c.c(m.l).
3. Tin wire solder (with flux): length > 1 m for 1 or 3 core cables, or any other applicable solution.
4. Silicon grease: (6 Packets) each of weight ≥ 5 gm (for 3 core cables).
5. Galvanized steel clamps: 1 pcs for binding steel armour layer. (only applicable For Three Core cables with a Galvanized steel wrap armouring).
6. Stainless clamps: 1 pcs for binding ALarmour layer. (only for single Core cables, and only applicable when using an Aluminum wrap armouring).
7. Mastick paste (or tape) to be used as sealant at least at:
 - Between breakout & cable outer jacket.
 - Between non-tracking tubes and breakout necks. (for heatshrinkable termination)
 - Underneath and over cu. braid, cable steel tape and cu. tape to cover welding point.
 - Shrinkable non-tracking tubes shall be marked with diam. before and after free shrink (for heat shrinkable termination).
8. Red mastic to fill over lug barrel and end of cable insulation and gap between them (to seal ends of non-tracking tubes).
9. Minimum total length of termination (from phases distributer till terminal lugs hole) should be 120 cm.
- 10- 3 pcs of sandpaper size 180 with length 40 cm, cloth type (non-easy cut).(for 3 cores)
- 11- 1 pcs of sandpaper size 180 with length 40 cm, cloth type (non-easy cut).(for 1 core)
- 12- 1 piece of sandpaper size 320 with length 40 cm, cloth type (non-easy cut).



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8. CABLE DIMENSIONS GUIDANCE

The following data for cables dimensions, termination components and dimensions should comply with these cables data:

Table 6: Data for cables dimensions

C.S.A (mm ²)	70	95	150	185	240	300	400	500	630
Average Conductor Diameter mm	9.8	11.5	14.1	15.8-16	18.5	20.6	23.1	26.6	30
Average diameter over insulation mm	22 – 23	23-24.5	27 – 28	27.5-30	30.5 – 32	33 – 35	36 – 38	38 – 41	42 – 45.5
Average overall diameter mm , for 3core armoured cables	63 – 68	70-73	75 – 80	79-84	86 – 90	92 – 96	98 – 103	-	-
Average overall diameter mm , for 3core non armoured cables	56 – 58	62-64	66 – 70	73.8-75	80	81 – 86	89 – 91	-	-
Average overall diameter mm , for 1core armoured cables	35 – 37	37-39	40 – 41	42-43	44 – 47	48 – 49	51 – 53	54 – 60	58 – 64
Average overall diameter mm , for 1core non armoured cables	30	33.1	34.5	38	39	41.5	44.5	47 – 54	52 – 58.5

N.B:

- The above data is applicable for cables with Copper or Aluminium conductor
In case of Non-compacted cables, Conductor cross section area will be provided by EDC in the tendering phase

9.MARKING AND IDENTIFICATION

All components of the termination kit should be distinctly and clearly marked with the manufacturer's name and reference numbers. The marking should be done before packing the component. Electrically conducting components should be marked 'conducting' clearly and permanently unless they are very small to accommodate respective marking.

All components should be capable of being stored without deterioration within the temperature range of -5°C to +45°C (+50 °C as option). Components or materials, if subjected to a shelf life limitation, should have the final date of use prominently and permanently shown on all packages.



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The electrical relevant components of cable accessories must be marked with the following data:

1. Manufacturer name
2. Production indicator for traceability
3. Cross-section, diameter, or application range should be marked

Packaging as well for each cable accessory should be printed with the following information:

1. Manufacturer's name
2. Manufacturer's Type No. / catalog number
3. Purchase order number/tender
4. Cable size/diameter
5. Application (indoor or outdoor)
6. Nominal Voltage (12/20kV) / Max. Voltage (24kV)
7. Year of manufacture
8. Date of expiry
9. Manufacturer's batch No. or any code for tracing the quality assurance records maintained by the manufacturer.
10. Shipping Mark Guid.
11. Kit components for electrical stress control, and non-tracking tubes shall durably marked for identification.
12. Kit components for indoor/outdoor premolded termination stress control modules should be also durably marked for identification

* It should be possible to read all information directly.

10. PACKING

- 10.1. Packing should be robust and able to withstand very rough handling during transportation. It should be protected against ingress of moisture.
- 10.2. The details of method of packing should be submitted with the offer.
- 10.3. Each kit should be supplied with a packing note stating the quantities and descriptions of components contained in the kits, and the documents described below:

The kits should include:

- Termination Instructions of installation (Arabic and English) for the offered accessories which must include the steps of installation, the number of dies, detailed



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drawing of the lugs explaining the number & sequence of crimping and the width of each crimping, (Each crimping should be hexagonal).

- Instructions of installation (Arabic and English preferred) of the offered accessories.

11.INSPECTION AND TESTING

11.1. Routine Tests

11.1.1. The routine tests should be done as per latest revision of applicable standards mentioned in table No.1

11.1.2. Tests should be done by the manufacturer on each finished product or component of accessories in the manufacturer facility to check that each product/ component meets the specified requirements.

11.1.3. Routine tests for the cable termination should be like those of the cables:

11.1.3.1 AC dry withstand voltage test

(54kV for 1 min. as per IEEE 404 or 42 kV for 5 min. as per IEC 60502-2)

11.1.3.2 Partial Discharge test (the PD at 20 kV should less than 5 pc)

11.1.4. vendor should keep records for the routine tests

11.1.5. vendor should keep records for the calibration of the instruments and testing facilities which using in the routine tests.

11.2. Sample and inspection Tests (optional)

11.2.2 Sample tests should be made by the manufacturer on samples of finished product or components taken from a finished product store, at a specified frequency, so as to verify that the finished product meets the specified requirements.

11.2.3 Inspection test should be done in the manufacturer/vendor facilities in attendance of EDC representatives per each order before delivery..

11.2.4 Inspection tests should be conducted as per submitted/approved inspection plan during the tender stage,



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- 11.2.5 the inspection plan should include a visual examination on each component, there should be no visual defects in the material, manufacture, workmanship and markings.
- 11.2.6 The Tenderer should provide free of charge all the testing facilities required at work.
- 11.2.7 The routine tests should be done as per applicable standards up on manufacturer choice
- 11.2.8 The inspection sample should be 1% of the order quantity and should not be more than 5 pcs of each termination size.

11.3 Electrical tests after installation

tests made to demonstrate the integrity of the cable and its accessories as installed
as per IEC 60502-2 clause 20.3.1 (AC testing):

- 11.3.1 By agreement between the purchaser and the contractor, an a.c. voltage test in accordance with IEC 60060-3 and in accordance with item a), b) or c) as below may be used:
- a) Test for 15 min with the phase-to-phase voltage U , at a frequency between 20 Hz to 300 Hz shall be applied between the conductor and the metal screen/sheath;
 - b) Test for 24 h with the normal rated voltage U of the system.
 - c) Test for 15 min with the RMS rated voltage value of $3 U_0$ at a frequency of 0,1Hz applied between the conductor and the metal screen/sheath.

NOTE 1:

During the A.C. test, $\tan \delta$ and/or partial discharge may be monitored.

NOTE 2 :

For installations which have been in use, lower voltages and/or shorter durations may be used. Values should be negotiated, taking into account the age, environment, history of breakdowns and the purpose of carrying out the test.

12.TYPE TESTING

- 12.1 Type Testingshould be made to demonstrate satisfactory performance characteristics according to the latest standard to meet the intended application.



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- 12.2 It is not necessary to repeat these tests, once successfully completed, unless changes are made in the materials, design or manufacturing process which might affect the performance characteristics
- 12.3 Cables used for testing shall comply with IEC 60502-2 and shall be of the same rated voltage as the accessories to be tested
- 12.4 Accessories should be assembled in the manner specified by the manufacturer's instructions.
- 12.5 Type tests should be done in certified independent and approved test laboratory
- 12.6 Type test for cable termination should be conducted as per IEC60502-4 table 5 or CENELEC standards.
- 12.7 Test method shall be as per IEC 61442 or CENELEC standards.
- 12.8 The test values and requirements should be as per IEC60502-4 table 14 or CENELEC standards.
- 12.9 Type testing complying with the full requirements of CENELEC HD 629.1 S2 is or VDE as per Annex 1 in this specification are accepted.
- 12.10 Type test certificates should be submitted with the offers (if not before submitted) to be reviewed by(...EDC), ...EDC should require its representative to assess the quality control and tests.
- 12.11 The test program dates should be advised by the contractor in advance to permit witnessing by ...EDC.
- 12.12 ...EDC reserves its right to send inspector for that purpose, and ...EDC representative should sign the test certificates in case of acceptance.
- 12.13 Tests described above should not release contractor from his full responsibility towards supplies, guarantee, and compliance with this specification.
- 12.14 Range of approval for the type test should be as per IEC 60502-4 clause 7.



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Table: 5
Test sequences and requirements for terminations

Tests ^a		requirements	Test methods of IEC 61442	Test sequences (See figure 1)				
				1.1	1.2	1.3	1.4	1.5
1	AC and DC voltage	AC for 5 min at 4.5 U_0 and d.c for 15 min at 4 U_0	Clauses 4 and 5	x	x	x		
	AC (Wet)	1 min at 4 U_0 ^b	Clause 4	x				
2	Partial discharge ^c	10 pc max. At 1.73 U_0	Clause 7	x				
3	Impulse at θ_t ^d	10 impulses of each polarity	Clause 6	x				
4	Heating cycles in air	60 cycles ^e at θ_t ^d and 2.5 U_0	9.2 and 9.3	x				
5	Immersion test ^b	10 cycles ^e at θ_t ^d	9.5	x				
6	Partial discharge ^c at ambient temperature and θ_t ^{d, f}	10 pc max. At 1.73 U_0	Clause 7	x				
7	Thermal short-circuit (screen) ^g	Two short -circuits at I_{SC} of the cable screen. No visible deterioration	Clause 10		x	X ^h		
8	Thermal short-circuit (conductor)	Two short -circuits to raise conductor to θ_{sc} of the cable . No visible deterioration	Clause 11		x	X ^h		
9	Dynamic short-circuit ⁱ	One short -circuits at I_d . No visible deterioration	Clause 12			x		
10	Impulse	10 impulses of each polarity	Clause 6	x	x	x		
11	AC Voltage	15min at 2.5 U_0	Clause 4	x	x	x		
12	Humidity ^{jk}	300 h at 1.25 U_0 see Table 13	Clause 13				x	
13	Salt fog ^{b k}	1000 h at 1.25 U_0 see Table 13	Clause 13					x
14	Examination	For information only ^l		x	x	x	x	x

a Unless otherwise specified, tests shall be carried out at ambient temperature.

b For outdoor terminations only.

c Not required for accessories installed on 3.6/6 (7.2) kV cables having unscreened insulation.

d θ_t is the maximum cable conductor temperature in normal operation +5 k to 10 k.

e 8 h total with ≥ 2 h steady and ≥ 3 h cooling.

f Measurement is made at the end of heating period.

g This test is only required for terminations that are equipped with a connection to, or adaptor for, the metallic screen of the cable.

h Thermal short-circuit may be combined with the dynamic short circuit.

i Only required for single-core cable accessories designed for initial peak currents $i_p > 80$ kA and three-core accessories designed for $i_p > 63$ kA. Value of I_d shall be declared by the manufacturer.

j For indoor terminations only. Not required for compound-filled terminal boxes. Shrouded terminations shall be tested in a three-phase condition.



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K Not required for terminations having porcelain insulators.

l it is advised that the accessory be examined for sings of any the following:

- (i) cracking in the filing media and/or tape or tube components; and/or
- (ii) a moisture path across a primary seal; and/or
- (iii) corrosion and/or tracking and/or erosion; and/or
- (iv) leakage of any insulating material.

12.15 Extension of approval to a range wider than that given above should be achieved by carrying out the additional tests specified at IEC 60502-4 listed in Table 11 on the smallest and/or largest conductor cross sectional areas of the required range.

IEC 60502-4

Table 11

Additional tests for smaller and/or larger conductor cross-sectional areas (see 7.1)

Tests ^a		requirements	Test methods of IEC 61442	Test sequences (see figures 1,2 and 3)		
				1.1 ^b	2.1 ^c	3.1 ^d
1	AC and DC voltage	AC for 5 min at 4.5 U ₀ and d.c for 15 min at 4 U ₀	Clauses 4 and 5	x	x	x
2	Partial discharge ^{a, e}	10 pC max. at 1.73 U ₀	Clause 7	x	x	x
3	Impulse ^a	10 impulses of each polarity	Clause 6	x	x	x
4	Heating cycles in air ^f	10 cycles ^h at θ_t^I and 2.5 U ₀	9.2 and 9.3	x	x	
5	Examination	For information only ^g		x	x	x



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- a Unless otherwise specified, tests shall be carried out at ambient temperature.**
- b Terminations: test half the number of samples given in figure 1.**
- c Joints: test half the number of samples given in figure 2.**
- d Stop ends: test half the number of samples given in figure 3.**
- e Not required for accessories installed on 3.6/6(7.2) kV cables having unscreened insulation.**
- f the test is not applicable to stop ends.**
- g it is advised that the accessory is examined for signe of any the following:**

12.16 The additional tests specified at IEC60502-4 lested in Table 12 should be carried out to achieve extension of approval for different types of cable insulation semiconducting screens



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IEC 60502-4

Table 12

Additional tests for different types of cables insulation semiconducting screen and approval from round to shaped conductors (not applicable to stop ends, see 7.1 and 7.3)

	Tests ^a	requirements	Test methods of IEC 61442	Test sequences (see figures 1 to 5)		
				1.1 ^b	2.1 ^c	3.1 ^d
1	AC and DC voltage	AC for 5 min at 4.5 U ₀ and d.c for 15 min at 4 U ₀	Clauses 4 and 5	x	x	x
2	Partial discharge ^e at ambient temperature and $\theta_t^{f, g}$	10 pC max. at 1.73 U ₀	Clause 7	x	x	x
3	Heating cycles in air	60 cycles ^h at θ_t^i and 2.5 U ₀	Clause 9	x	x	x
4	Partial discharge ^e at ambient temperature and $\theta_t^{f, g}$	10 pC max. at 1.73 U ₀	Clause 7	x	x	x
5	Impulse	10 impulses of each polarity	Clause 6	x	x	x
6	AC voltage	15 min at 2.5 U ₀	Clause 4	x	x	x
7	Examination	For information only ⁱ		x	x	x

a Unless otherwise specified, tests shall be carried out at ambient temperature.

b Terminations: test half the number of samples given in figure 1.

c Joints: test half the number of samples given in figure 2.

d Separable connectors: test half the number of samples given in figure 4 and 5.

e Not applicable to accessories installed on 3.6/6(7.2) kV cables having unscreened insulation.

f θ_t is the maximum cable conductor temperature in normal operation +5 K to 10K

g Measurement is made at the end of heating period.

h 8 h total with ≥ 2 h steady and ≥ 3 h cooling.

i it is advised that the accessory is examined for signe of any the following:

- (i) cracking in the filing media and/or tape or tube component, and/or
- (ii) a moisture path across a primary seal: and/or



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Table 14 - Summary of test voltages and requirements (see clause9)

Test	Test Voltage	1.6/6 (7.2)	6/10 (12)	8.7/15 (17.5)	12/20 (24)	18/30 (36)	Requirements
Humidity and salt fog	1.25 U ₀	4.5	7.5	11	15	22.5	No breakdown or flashover No more than three trappings No substantial damage b
Partial discharge a	1.73 U ₀	6	10	15	20	30	Maximum partial discharge: 10pc
Heating cycles and a.c voltage/15 min and 500 h	2.5 U ₀	9	15	22	30	45	No breakdown or flashover
AC voltage/1 min	4 U ₀	14.5	24	35	48	72	No breakdown or flashover
DC voltage/15 min	4 U ₀	14.5	24	35	48	72	No breakdown or flashover
AC voltage/5 min	4.5U ₀	16	27	39	54	81	No breakdown or flashover
Impulse (peak)	...	60	75	95	125	170	No breakdown or flashover

a Not required for accessories installed on 3.6/6 (7.2) kV cables having unscreened insulation.

b It is considered that substantial damage has occurred when it is evident that the performance of the accessory has been severely reduced by:

- 1 - loss of dielectric quality due to tracing, and /or
- 2 - erosion to a depth of 2 mm or 50% whichever is the smaller, of the wall thickness of the insulating materials as applied, and/or
- 3 - splitting of the materials: and/or
- 4 - puncture of the material



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13 TENDER DOCUMENTS AND SUBMITTAL

The tenderer should submit with his offer a duly completed and signed package of all the required documents as:

- 13.1 A reference list showing that the proposed technique has been extensively used by recognized utility companies outside the manufacturer's country for 3 years (for foreign manufacturers only).
- 13.2 Copies of recently (latest) conducted type test certificates (electrical and mechanical) or qualification reports from certified independent and approved test laboratory for the offered terminations that verify all the requirements as listed at table (5) of IEC 60502-4 or VDE 0278-629-1 or CENELEC HD 629-1 standards.
- 13.3 Data sheet for the lugs used within the accessories should include at least the following data:
 - 13.3.1 Lug material details (alloy, conductivity, chemical composition ...)
 - 13.3.2 Assembly technique,
 - 13.3.3 Tooling, dies and necessary setting,
 - 13.3.4 Preparation of contact surfaces, if applicable,
 - 13.3.5 Type, reference number and any other identification of the lug,
 - 13.3.6 Lug details of the type test approval, the standard with which they comply (i.e. IEC 61238-1) or DIN
- 13.4 The Factory Acceptance Test (FAT), which carried out at manufacturer/vendor facilities on each finished product and components of accessories to check that each product and components meets the specified requirements
- 13.5 A detailed list of inspection tests that have been carried out at manufacturer's facilities in attendance of the ...EDC representative(s).
- 13.6 The name of the laboratory where tests can be conducted
- 13.7 Complete technical details with dimensional drawings, showing description of material, the following data at least should be included:
 - 13.7.1. Name of manufacturer and manufacturing location.
 - 13.7.2. Type, designation, or code.
 - 13.7.3. Rated voltage,
 - 13.7.4. Minimum and maximum cable insulation diameters,
 - 13.7.5. Minimum and maximum cable cross-sections for this rated voltage
 - 13.7.6. Applicable cable construction including the material and shape of cable conductor
 - 13.7.7. Installation instructions (reference)



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- 13.8 Catalogue and Instructions of installation (Arabic and English preferred) of the offered accessories. The catalogues must include the number of dies, detailed drawing of the lug explaining the number of crimping and the width of each crimping, each crimping should be hexagonal.
- 13.9 Details of storage, shelf life under Egypt service conditions mentioned in clause 6 (It must not be >30 months).
- 13.10 Lifetime of termination should not be less than 30 years starting from the date of operation.
- 13.11 One sample of complete kit will be submitted with the offer.
- 13.12 Details of any special tool requirement.
- 13.13 Schedule of guarantee duly completed and signed by the manufacturer and vendor/Agent, otherwise the tenderer should be rejected.
- 13.14 Kit content lists stating the quantities and descriptions of components, showing dimensions of lugs galvanized steel wrap, and tinned copper mesh or Braid.
- 13.15 Vendor should be guarantee supplies against all defects arising out faulty design manufacture or defective materials for 2 years from date of delivery to EDC.

14 INSTALLATION INSTRUCTIONS

- 14.1 The installation instructions should be clearly assigned to the respective termination according to the application of this Technical Specification.
- 14.2 All necessary steps for installing the termination are to be described in an easily readable manner including images for each step.
- 14.3 The installation instructions must be approved by ...EDC prior to tender.
- 14.4 The installation instructions must contain the required designations and sheath-opening (cutback) dimensions.
- 14.5 The termination components, the kit content list, and the respective installation instructions must be clearly and unambiguously identifiable.
- 14.6 The installation instructions should be enclosed in English and Arabic Language (where applicable) and are printed in color.



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- 14.7 Any modifications to the assembly or the material, even insignificant, which have an effect on the installation instructions, must be clearly noted on each installation instruction and packaging unit for at least half a year (e.g. with a colored sticker with exact reference to which point was changed), as agreed with ...EDC.
- 14.8 The revision level, the date of creation or revision must be recognizable on the installation instructions.
- 14.9 The final pages of each installation instructions is a full-page completely assembled cable termination in a cut-away/sectional view showing all active components of the kits.

15 TRAINING.

The Vendor should provide a sufficient practical training wherever applicable for the installation and commissioning of the terminations. (if required by ...EDC).

ملحوظة: بالنسبة لأي منتج جديد (اجنبي او محلي):

- يلزم مراجعة مواصفاته الفنية ومعاينة خطوط الإنتاج ومراحل التصنيع من قِبَل أعضاء اللجنة الدائمة لمراجعة وتحديث المواصفات الفنية لمهمات التوزيع ودعم التصنيع المحلي وبناءً عليه يتم اصدار تقرير من اللجنة بقبول او رفض المنتج (مع توضيح الأسباب) كشرط لدخول شبكة كهرباء مصر.
- يتم زيادة مدة الضمان لتكون 4 سنوات من تاريخ التوريد.



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Table –annex 1 - Requirements of 24 kV.
..... TERMINATIONS X mm² .

A – 1st BATCH OF TEST SAMPLES

Test sequence	IEC 60502-4
1- A.C withstand	5 min. 54 KV.
2- AC (wet) (for outdoor termination)	1 min. under rain 48 kV
2 - Partial discharge	≤ 10 pc 20 KV.
3 – Impulse	10 impulses of each polarity at 95 - 100 °C 125kV
4- Heating cycle voltage in air	60 cycl. at 95 - 100 °C. 8h total, ≥ 3h cooling, ≥ 2h steady. 30 kV.
5- Partial discharge	at 95-100 °C & ambient temp. ≤ 10 pc. 20 KV.
6- Thermal cycles in air	60 cycles at 95 - 100 °C as above 30 kV.
7 - Partial discharge.	at 95 - 100 °C and ambient temp. ≤ 10 pc. 20 kV
8- Impulse.	10 impulses of each polarity at ambient temp. 125kV.
9-A.C. withstand	15 min. 30 kV.
10-Humidity	300 h. at 15 KV.
11-Salt fog (for outdoor termination)	1000 h. at 15 kV
Test sequence	VDE 0278 parts 1 – 6
1- A.C withstand	5min. 54 kV
2- AC (wet) (for outdoor termination)	1 min. 48 kV
3 - Partial discharge	<10 pc 24 kV.
4 – Impulse	10 impulses of each polarity 125 kV
5- Heating cycles in air	126 cycles. at 30kV (no breakdown or flashover)
6- Partial discharge	<10 pc 24 kV
7- Thermal S.C (screen)	Two S.C. at 1sc. (no breakdown)
8- Thermal S.C.(conductor)	Two 1sc. to rise conductor temp to 250 oC
9 - Partial discharge.	<10 pc. 24 kV.
10- Impulse.	10 impulses of each polarity 125 kV.
11-Humidity	300 h. in satur. air, water cond. 70 +10 m s/m, spray rate 0.3L / m2 / h. at 15 kV.
12-Salt fog (for outdoor termination)	1000 h. in salt. air, water cond. 1.6 +10 s/m, spray rate 0.4 L / m2 / h. 15kV

- Test no "6" Can be performance with test no "4".
- Humidity test on a new sample acc. IEC 60502 –4.
- N.B Type test certificate according to CENELEC should be accepted.



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B – 2nd BATCH OF TEST SAMPLE

Test sequence	IEC 60502-4
1 - Thermal S.C (screen)	2 s.c at I s.c of the cable screen(1000A may be used) no visibledeterioration.
2 - Thermal S.C (conductor)	2 S.C. to raise conductor to 250 °C of the cable.No visible deterioration
3 - Impulse	at ambient temp. 10 impulses of each polarity 125 kV.
4 - A.C. Withstand	15 min 30 kV.

Test sequence	VDE 0278 parts 1 – 6
1 - Dyn.s.c. KA.peak	1 test with a current 80 KA (peak)
2 - Impulse	10 impulses of each polarity 125 kV.

- N.B: Type test certificate according. to CENELEC shall be accepted.

TABLE 3 - TESTS OF 24 kV.

.....TERMINATION FOR XLPE CABLES ... X ... mm²

Test sequence	IEC 60502-4
1- A.C withstand	5 min. 54 KV.
2- AC (wet) (for outdoor termination)	1 min. under rain 48 kV
2- Partial discharge	≤ 10 pc 20 kV
3- Impulse	10 impulses of each polarity at 95-100 °C 125kV
4- Thermal cycles in air.	60 cycl. at 95-100°C 8h total, ≥ 3h cooling, ≥ 2h steady 30 kV
5- Partial disch.	at 95-100 °C and ambient, ≤ 10 pc. 20kV
6- Impulse.	10 Impulses of each polarity 125kV
7- A.C.or D.C volt withstand.	15 min 30 kV. AC
8- Humidity	300 h at 15 kV



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9. Salt fog (for outdoor termination)	1000 h. at 15 kV
Test sequence	VDE. 0278 parts 1 -6
1- A.C withstand	5 min. 54kV
2- AC (wet) (for outdoor termination)	1 min. 48kV
3- Partial discharge	≤10 pc 24 kV
4- Impulse	10 impulses of each polarity 125 kV
5- heating cycle voltage in air.	126 cycles. at 30kV (no breakdown or flashover)
6- Thermal S.C.(screen)	Two S.C. at 1sc. (no breakdown)
7- Thermal S.C. (conductor)	Two 1sc. to rise conductor temp to 250 oC
8- Partial discharge.	≤10 pc. 24 kV
9- Impulse.	10 impulses of each polarity 125kV
10- Humidity	≥300 h in satur. air, (water cond. 400 + 10 ms /m spray rate 0.3 L/m ² /h) at 15 kV.
11-Salt fog (for outdoor termination)	1000 h. in salt. air, water cond. 1.6 +10 s/m, spray rate 0.4 L / m ² / h. 15kV

- The tests shall be conducted according to one of the above test sequences either acc. to IEC 60502-4 or to VDE 0278.

-In case of testing according to IEC. testing other sample according to table "2" B (2nd batch of test samples) shall be done for those terminations that it is the first time to be delivered to ...EDC.

- Humidity test on a new sample acc. to IEC 60502 – 4.

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10	Length of tin wire solder with flux-----cm.	-----
11	Weight of silicon grease -----gm.	-----
12	Binding tapes : A-Two PVC tapes:- Length / thickness---- m./mm	-----
13	Mastic pastes : - A – 1 st type: type / number/ weight. each B – 2 nd type: type / number/ weight. each	----- ----- -----
14	Any other tape : type , length -----	
15	Attach details on rated short circuit current capacity : - a) Copper mesh or BRAID b) Armour c) Bonded mesh or BRAID with armour	
16	Copy of works routine test reports and if requested by EDC also batch / type test reports on the kits being supplied shall be cleared by EDC prior to shipment confirm compliance.	Yes / No
17	Confirm that visual inspection and routine tests shall be carried out on each kit -----	Yes / No
18	Confirm compliance to the appropriate requirements of table 2-----	Yes / No
19	Marking and packing:- a) Marking shall be to clause 4.4 ----- b) Packing shall be to clause 4.5 ----- c) Each kit with components shall be complete in itself and separately packed ----- d) Submit detailed method of packing	Yes / No Yes / No Yes / No Submitted / not subm.
20	Guarantee confirm compliance to clause 6.3 ----	Yes / No
21	For direct technical clarification from the manufacturer submit the details mentioned below of the persons responsible : - Name :----- Designation : ----- Address : ----- Telephone : ----- FAX : -----	

We guarantee above mentioned data for our offered material for EDC

Vendor / Agent

Important: Each tenderer shall submit with his offer the above tender " specifications for cable terminations ...x mm² 24 kV. With each page signed by the tenderer.

This signature means that tenderer confirms verification of his offer for these specifications.

Tenders not accompanied with signed specifications shall not be considered



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SCHEDULE GUARANTEE

Schedule of deviations from -----

Technical specification

This schedule be filled and signed by every tenderer. If there are no deviations or reservations.

This should be explicitly stated in this schedule.

Item Number on tender	Precise details of minor deviations included in the offer.

Signature -----

(Manufacturer)

Signature-----

(Vendor / Agent)



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8	Any special accessories required	-----
9	Type /Quantity of cleaning soivent -----	-----
10	Lenght of tin wire solder with flux,----- cm.	-----
11	Weight of silicon grease ----- gm.	-----
12	Binding tapes : A - Two PVC tapes : - Length / thickness -----m./mm B - Textile tape : - number / length each ----- m.	----- ----- -----
13	Mastic pastes : - A - First type : type / number/ weight. each B - 2 nd type : type / number/ weight. each	----- ----- -----
14	Any other tape : type , length -----	-----
15	Attach details on rated short circuit current capacity: - a) Copper braid b) Armour c) Bonded braid with armour	-----
16	Copy of works routine test reports and if requested by EDC also Batch / type test reports on the kits being supplied shall be cleared by EDC prior to shipment confirm compliance ----- yes / no	-----
17	Confirm that visual inspection and routine tests shall be carried out on each kit ----- yes / no	-----
18	Confirm compliance to the appropriate requirements of Table 2----- yes/no	-----
19	Marking and packing a) Marking shall be to clause 4.4 -----yes / no b) Packing shall be to clause 4.5 -----yes / no c) Each kit with components shall be complete in itself and separately packed ----- yes / no d) Submit detailed method of packing -----ubmitted / not subm.	-----
20	Guarantee confirm compliance to clause 6.3 ----- yes / no	-----
21	For direct technical clarification from the manufacturer submit the details mentioned below of the persons responsible : - Name :----- Designation : ----- Address : ----- Telephone : ----- Telex : -----	-----

we guarantee above mentioned data for our afford material for EDC



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vendor / Agent

Important :

- Each tenderer shall submit with his offer the above tender " specifications for cable terminations x mm² 24 kV. With each page signed by the tenderer
- This signature means that tenderer confirms verification of his offer for these specification.
- Tenders not accompanied with signed specifications shall not be considered.



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Date: 09-03-2020

SCHEDULE GUARANTEE

Schedule of deviations from -----

Technical specification

This schedule be filled and signed by every tenderer.

If there are no deviations or reservations.

This should be explicitly stated in this schedule.

Item Number on tender	Precise details of minor deviations included in the offer.

Signature -----

(Manufacturer)

Signature -----

(Vendor / Agent)