

UNITED ARAB EMIRATES

FEDERAL ELECTRICITY & WATER AUTHORITY

**FEWA SPECIFICATION NO. 2.3 –
SPECIFICATION FOR
HEAT SHRINKABLE KITS FOR
JOINTS AND TERMINATIONS**

SPECIFICATION NO. 2.3
(Revised in May 2002)

SPECIFICATION FOR HEAT SHRINKABLE KITS FOR
11kV AND 33kV XLPE AND PAPER INSULATED CABLES
AND TRANSITION JOINTS FROM PAPER TO XLPE CABLES

1.1 Standard Specifications:

The Heat Shrinkable terminations and joints shall conform to the latest edition of ESI-09-13 or any other equivalent international standard, which shall be subject to the approval of the Authority. One copy of each specification in English language to which the terminations and joints are manufactured and tested shall be submitted with the offer.

1.2 Site conditions:

The joints and terminations shall be installed indoors and outdoors in U.A.E. in salt laden dusty atmosphere where the maximum humidity of 100% and maximum ambient temperature of 50 Deg.C. can be experienced. The terminations and joints shall be suitable for continuous operation at the above site conditions.

1.3 Scope of nature of work:

The specification provides for design, manufacture, test at manufacturer's works in presence of FEWA representatives, suitable packing, transportation and off loading at FEWA stores in satisfactory condition and proper stacking as directed by FEWA or otherwise specified else- where. These terminations and joints shall be used for XLPE and paper insulated cable, indoor or outdoor for 11kV and 33kV system and also for transition joints from paper to XLPE insulated cables.

1.4 System voltage, quality of joints etc.

Heat shrinkable kits are required for XLPE and paper insulated cables in 11kV and 33kV nominal voltage, 50Hz, 3 phase system with system highest voltages of 12kV and 36kV respectively. Both outdoor and indoor type of joints and terminations are required as per the Bill of Quantities. For outdoor and indoor terminations, the tubing length shall be stated during tendering for items requested in the Bill of Quantity.

Components shall not be adversely affected in any manner by contact with other materials normally used in the construction of cable joints and terminations, and shall not increase the rate of corrosion of any metal with which they may come into contact. Assembled components forming part of a supply system shall perform without distress under the following conditions.

- | | | | |
|-----|-------------------|---|---|
| i) | Normal conditions | : | Continuous operation at a conductor temperature of 90 Deg. C. for XLPE insulated cables. |
| | | : | Continuous operation at a conductor temperature of 70 Deg. C. for paper insulated cables. |
| ii) | Fault conditions | : | Operation at a conductor and screen temp. of 250 Deg.C. for XLPE. |
| | | : | Operation at a peak transient conductor/metal sheath temp. of 160 Deg.C. and 250 Deg.C. respectively for Paper. |

1.5 Type of cables for which joints/terminations are required.

1.5.1 11 KV Cables:

3 core, XLPE insulated, copper tape/wire screened, single steel wire armoured, PVC Sheathed Aluminium conductor cables or otherwise as stated in the Bill of Quantity.

Single core copper conductor of compacted circular stranded annealed plain wires, XLPE insulated, copper tape/wire as stated in B.O.Q.

3 core, Aluminium/Copper conductor, paper insulated, MIND cable as stated in the Bill of Quantity.

1.5.2 33 KV Cables:

Single core copper conductor of compacted circular stranded annealed plain wires, XLPE insulated, copper tape/wire screened and PVC over sheathed cables as per IEC 502/78 or otherwise as stated in the Bill of Quantity.

Three core copper conductor XLPE insulated, copper tape/ wire screened steel wire armoured, PVC sheathed cable as per IEC 502/78 or otherwise as stated in bill of quantity.

1.6 Technical Specifications:

The term "heat shrinkable" is applied to extruded or moulded polymeric materials, which are cross-linked either by irradiation or chemical means, such that when their temperature is raised beyond the normal base polymer crystalline melting point, they do not melt but merely become rubbery. In this state if the material is then mechanically expanded and held in this position until the temperature falls below the crystalline melting point, it remains in the expanded state. Sub-sequent heating in an unconstrained state will then result in the material recovering or "shrinking" to its original extruded or moulded size and shape.

Electric stress control for the cable insulation screen in termination and joints shall be achieved by heat shrinkable tubing. Joints shall include ferrules and all necessary items.

This tubing shall have defined impedance characteristic, volume receptivity, and dielectric constant in accordance with IEC. 93 and IEC. 250.

Sealing of the interfaces between heat shrinkable materials and/or cable surfaces shall be achieved by using a track resistant sealant or a hot melt adhesive. This sealant/ adhesive shall be precoated inside the heat shrinkable components and activated by the heat applied to shrink the components.

Complete external leakage insulation between the high voltage conductor and ground shall be achieved by utilizing heat shrinkable tubing and moulded parts. No filling medium shall be required.

These components shall be weather, ultra violet light and salt pollution resistant.

Full drawing of a joint and termination including all parts must be forwarded with the tender documents.

Technical characteristics already established for termination and joints must meet the minimum requirements of lists 1,2,3 and 4 of ESI standard 09-13.

1.7 Component types and sealants:

1.7.1 Tubing components:

The tubing components shall consist of following tubes and shall conform to the requirements given in List 1 of ESI-09-13.

- i) Internal insulating tubing.
- ii) Stress control tubing.
- iii) Anti-track tubing (Indoor)
- iv) Anti-track tubing (Outdoor)
- v) External protective tubing.

1.7.2 Moulded components:

The moulded components shall consist of following components and shall conform to the requirements given in List 2 of ESI 09-13.

- i) Anti-track insulating Glove (Indoor)
- ii) Anti-track insulating Glove (Outdoor)
- iii) Conducting Glove.
- iv) Anti-track shroud (Indoor)
- v) Anti-track weather shed (outdoor)
- vi) Crutch Di-electric Fillers.

1.7.3 Sealants:

The sealants shall conform to the requirements given in List 3 of ESI 09-13.

1.8 GENERAL REQUIREMENTS OF INSTALLED JOINTS AND TERMINATIONS:

The installed joints and terminations must provide the following:

- 1.8.1 Complete external leakage insulation between the high voltage conductor and earth potential using anti-track heat shrink material.
- 1.8.2 Electrical stress control using semi-conducting heat shrinkable tubing over the cores and by the insertion of high di-electric strength insulating material into the crutch of the termination such that electrical discharge activity does not occur in the termination after it has been energized at its rated voltage.
- 1.8.3 Hermetic sealing of the interfaces between heat shrinkable materials and cable surfaces, bushings or cable lugs by use of track resistant hot melt adhesive which can accommodate the creep and relaxations that may occur with recovered heat shrink materials.

This sealant shall be pre-coated inside the heat shrinkable components and activated by the heat applied to shrink the components, which shall be in excess of 125 Deg. C.

Uniform adhesive flow from the adhered heat shrink component into the adjoining surfaces will be used as an indicator that shrinking is complete, and therefore, the adhesive must be suitable for this purpose.

- 1.8.4 The installed terminations and joints shall meet the electrical requirements laid down in this Specification.
- 1.8.5 Outdoor terminations shall incorporate a design feature to prevent flexing of the terminated cores under short circuit conditions.
- 1.8.6 Joints and terminations must be insensitive to cable manufacturers tolerances allowed under BSS 6480-1969.
- 1.8.7 The successful tenderer will be required to supply overhead line insulators and support brackets for outdoor terminations in line with the schedule of quantities. These brackets must be designed for mounting on wooden poles such that the terminating cores may be cut to the same length, measured up from the sheath terminus of the cable termination.
- 1.8.8 The length of core insulation required with switchgear and transformer terminations is 450 mm per phase.
- 1.8.9 The length of core insulation required with outdoor pole-top terminations is 900 mm per phase.
- 1.8.10 Cable crutch filling shall be such that it blocks the oil of paper insulation from draining out.
- 1.8.11 Copper braid should be provided to connect the metal shield of XLPE cable to the lead sheath of paper cable and to make electrical contact with the outer screen of the joint for transition joints.
- 1.8.12 Galvanized steel joint case comprising two interlocking half shells should be provided for mechanical strength of joints.
- 1.9 SUPPLY OF TECHNICAL INFORMATION, TEST CERTIFICATES AND SAMPLES:
- 1.9.1 Tenderers must submit full specification and samples of the materials offered.
- 1.9.2 Tenderers must submit a detailed design of the overhead line support brackets for outdoor terminations offered, including details of the materials used in manufacture of the bracket.
- 1.9.3 Manufacturers who have not previously supplied heat shrinkable joints and terminations to FEWA must submit a list of all electrical utilities in the Middle East to whom they have supplied heat shrinkable joints and terminations at voltages of 11kV and above. The information listed below must be supplied for each order quoted.
 - 1. Name of utility
 - 2. Order Number
 - 3. Order period (From.....to.....)
 - 4. Order value
 - 5. Total number of joints and terminations supplied
 - 6. Number and details of each size of joint or terminations supplied.
 - 7. System voltage for which joints and terminations were supplied.
 - 8. Specification of the cable for which the joints or terminations were supplied.
 - 9. Set of installation instructions for the joints and terminations supplied showing clearly the components used in making the joint or termination.

1.10. Testing:

Electrical performance tests mentioned in clause 1.10.4 shall be carried out on samples chosen at random in presence of FEWA representatives at manufacturer's works. Certified copies of the type test certificates mentioned in clause 1.10.2 & 1.10.3 shall be supplied along with the offer. The supplier shall make provision in his offer to bear all costs that are incurred in carrying out these tests to the satisfaction of FEWA. However, costs towards travel, accommodation etc. of FEWA representatives shall not be included in the quoted price.

1.10.1 Material Tests:

The following tests shall be performed to verify the quality of material requirements. The tests shall be carried out in the manner specified in ESI 09-13, Parts 3 and 4 and shall satisfy the requirements stated therein:

1.10.2 Tests for Tubing and Moulded Components:

1. Corrosion Resistance
2. Density
3. Dimensions
4. Electric strength
5. Flame Retardance
6. Fungus resistance
7. Heat Shock
8. Low Temperature Flexibility
9. Relative permittivity
10. Secant Modulus
11. Solvent Resistance
12. Tensile strength and ultimate elongation
13. Thermal Ageing
14. Tracking Resisting
15. Visual Examination
16. Volume Resisting
17. Water Absorption
18. Water Vapour Permeability
19. Weather Resistance

1.10.3 Tests for Sealants:

1. Corrosion Resistance
2. Electric strength
3. Flow at elevated temperature
4. Internal pressure sealing ability
5. Low temperature flexibility
6. Peel strength
7. Solvent Resistance

1.10.4 Electrical Performance Tests:

The following tests shall be carried out to check the electrical performance of the components:

	<u>Standard</u>
i) A.C. Voltage withstand - for indoor termination	IEC.60
ii) Partial discharge - for screened cables	IEC.270
ii) Impulse voltage withstand	IEC.60 & IEC.230
iv) Load cycling	IEC.230
v) Thermal short circuit	VDE.0278
vi) D.C. Voltage withstand	IEC.60
vii) Humidity - for termination	IEC.466
viii) Dynamic short circuit	VDE.0278
ix) Salt fog - Outdoor termination	IEC.507

Test values shall be forwarded in four copies to FEWA representative.

The preferred test sequence shall be :

1. A.C. Voltage withstand
2. Partial discharge
3. Impulse voltage withstand
4. Load cycling
5. Partial discharge
6. Thermal short circuit
7. Load cycling
8. Partial discharge
9. Impulse voltage withstand
10. D.C. voltage withstand
11. Humidity
12. A.C. Voltage withstand
13. Dynamic short circuit
14. Salt Fog.

1.10.5 Test Methods:

1. A.C. Voltage Withstand:

This test shall be carried out in accordance with IEC 60. For test No. 1 in the Sequence, the test voltage shall be applied for 1 minute. For outdoor terminations, the test shall be carried out under rain. The rain shall have an incidence angle of 45 Deg., a rate of 3mm/minute and a conductivity of 100uS/cm.

The test voltage shall be 35kV for the 11kV system and 75kV for the 33kV system. The voltage shall be applied between the phase and ground.

For test No. 12 in the sequence, the test voltage shall be 24kV for the 11kV and 72kV for the 33kV system, and the voltage shall be maintained for 4 hours.

2. Partial Discharge:

This test shall be carried out in accordance with IEC 270. The test voltage shall be 7.5kV phase/ground for the 11kV and 22.5kV for the 33kV system. The requirement is that the discharge level shall not exceed 20 pc.

3. Impulse Withstand Test:

The test shall be in accordance with IEC 60 and IEC 230. The phase/ground test values for indoor and outdoor use shall be 75kV/95kV (peak) for 11kV and 170kV/200kV (peak) for 33kV systems. 10 positive and 10 negative, 1.2/50 uS impulse shall be applied.

4. Load Cycling Test:

The test shall be in accordance with VDE 0278 or IEC 230. The test voltage shall be 15kV and 45kV for 11kV and 33kV systems respectively.

5. Thermal Short Circuit Test:

Test shall be in accordance with VDE 0278. Two of one second tests each shall be performed.

6. D.C. Voltage Withstand Test:

The D.C. Voltage withstand Test shall be in accordance with IEC 60 for 11kV and 33kV systems respectively.

7. Humidity Test:

Terminations shall be tested in accordance with IEC 466 Appendix C. The sample shall be subjected to an A.C. Voltage for 100 hours in a humidity chamber, where water with a conductivity of 800 uS/cm. shall be sprayed at a rate of 0.4 L/h per cubic metre of the test chamber. The test voltages shall be 7kV and 21kV for 11kV and 33kV systems respectively.

8. Dynamic Short Circuit:

The test shall be in accordance with VDE 0278 on accessories for 3 core cables. The cable used shall be of a cross-sectional area not less than 120 sq.mm.

9. Salt Fog Test:

This test shall be carried out in accordance with IEC 507 on outdoor terminations only. The sample shall be exposed for one hour to a salt solution with a concentration of 160 g/litre. The phase/ground test voltages shall be 7.5kV and 22.5kV for 11kV and 33kV systems respectively.

1.11 Identification and Packaging:

For the purposes of identification, gloves shall be marked clearly and permanently in a prominent position with the supplier's name and reference number.

Electrically conducting components shall be marked "Conducting clearly and permanently".

Components shall normally be supplied in a package as a complete joint or termination, which shall be clearly marked with the supplier's name, reference number, batch references, voltage, application and cable size. In addition, FEWA part numbers as indicated in the bill of quantity shall be marked on the package.

Packaging shall be designed to protect against ingress of moisture and mechanical damage. Components supplied with adhesive coatings shall have means to prevent the coated surfaces from adhering to each other.

The complete heat shrinkable components, required to complete in all respects one termination shall be supplied in a kit form; one joint to be supplied in kit form.

1.12 Storage:

Components shall be capable of being stored without deterioration within the temperature range of - 10 Deg.C. to + 45 Deg.C. Components or materials, if subject to a shelf life limitation shall have the final date of use prominently and permanently shown on all packaging.

SCHEDULE 'A'

SUB-MANUFACTURERS

The Tenderer shall state below the names of the sub-manufacturers to the main manufacturer and details of the equipment proposed to be manufactured or supplied by them:

Name & Address of the Sub-Manufacturer	Description of Equipment

Signature : _____

Designation : _____

Name of Tenderer ; _____

Date : _____

SCHEDULE 'B'

PLACE OF MANUFACTURE, TESTING AND INSPECTION

The Tenderer to complete the following schedule for all materials he proposes to supply

Item No.	Description	Manufacturer	Place of manufacture	Place of testing and inspection

Signature : _____

Designation : _____

Name of Tenderer : _____

Date : _____

SCHEDULE 'C'

DEVIATION FROM TENDER SPECIFICATION

The Tenderer to state in the following schedule the deviations from the tender specifications proposed in his offer. Deviations other than those specifically listed below will not be taken note of:

Item No.	Description	Precise Details of the Deviations

Signature : _____

Designation : _____

Name of Tenderer ; _____

Date : _____

SCHEDULE 'D'

GUARANTEED PARTICULARS FOR HEAT SHRINKABLE KITS

Tenderers are to give the following particulars for straight through joints and terminations. Tenderers are also required to submit a detailed list of the components of each joint and termination.

Sl No.	Description	Termination						Straight Joint	
		Outdoor		Indoor with					
		33kV	11kV	Right Angle boot		Straight Angle Boot		33kV	11kV
1.	Manufacturers Name								
2.	Applicable Standard								
3.	Nominal Voltage KV								
4.	One minute dry withstand Voltage KVrms								
5.	One minute wet withstand Voltage KVrms								
6.	DC withstand voltage for 30 minutes in KV								
7.	Impulse withstand voltage Dry in KV(Peak)								
8.	Partial discharge level in pc								
9.	a) Discharge inception voltage KV b) Discharge extinction voltage KV								
10.	Material of the heat Shrinkable kit								
11.	Dielectric strength KV/mm								
12.	Volume resistivity Ohm/cm								
13.	Dielectric constant								
14.	Dissipation factor								
15.	Tensile strength N/mm ²								
16.	Elongation %								
17.	Moisture absorption %								

(Contd.....)

(Contd.....)

SCHEDULE 'D'

GUARANTEED PARTICULARS FOR HEAT SHRINKABLE KITS

SI No.	Description	Termination						Straight Joint	
		Outdoor		Indoor with					
		33kV	11kV	Right Angle boot		Straight Angle Boot		33kV	11kV
18.	Brittle temperature								
19.	Standards								
20.	Safe continuous operating temp.								
21.	Tail length in termination								
22.	Stress control distribution, attach literature for joints and terminations	1200	900	450	450	450	450	-	-
23.	Provision of catalogues for joints and terminations								

Signature : _____

Designation : _____

Name of Tenderer : _____

Date : _____

SCHEDULE 'E'

DETAILS OF PAST EXPERIENCE OF MANUFACTURER

JOINTS / TERMINATION KITS

Name and address	Quantity supplied	Year of supply	Remarks

Signature : _____

Designation : _____

Name of Tenderer ; _____

Date : _____