

**Ministry of Electricity
Planning and Studies Office
Baghdad – Iraq**

Specification No.	D-03
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**TECHNICAL SPECIFICATION
OF
MEDIUM VOLTAGE POWER CABLES**

REVISION	December 2013
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1. Scope:

The specification includes the design, manufacture, test, suitable packing, transportation of 18/30 (36) kV and 12/20 (24) kV cables. Including installation , energizing

2. General Requirements:

The materials shall be of first class quality and designed for continuous satisfactory operation as continuity of supply is of prime importance and to operate satisfactorily under variation of load, voltage and short circuit or other conditions which may occur on the system provided that these variations are within the assigned rating of the apparatus. The materials used shall be suitable for the following climatic and soil conditions.

2.1 Ambient temperature:

Highest maximum (in the shade) 55 °C for about 6 hours a day

Lowest minimum (-10) °C

Maximum yearly average (+30) °C

Maximum daily average (+40) °C

2.2 Sun shine temperature:

Black objects under direct sunshine attain a temperature of 80 °C

2.3 Air humidity:

Maximum: 92% at 40 °C

Minimum : 12%

Yearly average : 44%

2.4 Altitudes:

From sea level up to (1000m)

3. Technical Requirement:

System Data:

a. 33 KV System	
Nominal voltage	33000 volts
Highest system voltage	36000 volts
System	3-phase, 3 wire with neutral grounding zig-zag transformer to limit the earth fault current to 1000 Amp.
Frequency	50 Hz
Short circuit breaking current	25KA. R.M.S at 33000 volts

b. 11 KV System	
Nominal voltage	11000 volts
Highest system voltage	12000 volts
System	3-phase, 3wire neutral earthed through resistance of 21.1 Ohm limiting the earth fault current to 300A
Short circuit breaking current	25 KA R.M.S at 11000 volts

4. Standards:

The cable should be in accordance with the latest edition of the IEC standard particularly IEC no. 60502, 60228 and all other relevant IEC standards.

5. Deviations:

The tenderer shall particularly mention in the tender all deviations of the offer from the specifications described in these tender documents.

6. General Cable Characteristics:

6-1 Conductor:

The conductor shall be class 2 compacted annealed stranded circular copper conductor having resistance within the limits specified in table No.1 mentioned below. The minimum number of strands in the conductor shall not be less than the appropriate minimum numbers specified in table No.1. The conductor shall be according to the IEC 60228 and all other relevant IEC standards.

6-2 Conductor screen:

Conductor screen shall be non-metallic and shall consist of a layer of extruded semi-conducting compound which shall be firmly bonded to the inner surface of the insulation. The contact of the semi-conducting shields with the cable insulation must be perfect without void creation at the inner surfaces. The interfaces must be smooth in a regular geometric shape and avoid stress concentration and the semi-conducting compound must have homogeneous structure particularly at the interfaces. The semi-conducting shields must be mechanically stable under load cycling of the power cable and high temperature conditions.

6-3 Insulation:

The insulation of the cable shall be extruded XLPE cured with dry curing process, designed and manufactured for the specified voltage. The manufacturing process shall ensure that insulation shall be free from voids. The insulation shall withstand mechanical and thermal stress under steady state and transient operating conditions. The extrusion method should give very smooth interface between semi-conducting screen and insulation. The insulation of the cables shall be of high standard quality. The thickness of the insulation shall not be less than that specified in the relevant standards.

- a- For 24 kV , nominal thickness is 5.5 mm
- b- For 36 kV , nominal thickness is 8 mm

Conductor screen, insulation and insulation screen shall be extruded by triple extrusion method.

6-4 Insulation screen:

- a- Non-metallic screen: shall consist of a layer of extruded semi-conducting compound firmly bonded provided over the insulation simultaneously with the extrusion of the insulation. Semi-conducting swelling tape with suitable overlap over the extruded semi-conducting layer of compound shall be applied.
- b- Metallic screen: a combination of copper wires with copper counter spiral tape shall be applied over the non-metallic insulation screen. The equivalent total cross sectional area of metallic screen shall be not less than:
 - a. 25 sq. mm for cables having a conductor size up to 150 sq. mm.
 - b. 35 sq. mm for cables having a conductor size more than 150 sq.mm.

6.5 Phase Identification:

For 3 core cables, Red, Yellow and Blue colored strips shall be applied under the metallic screen throughout the length of the cable for phase identification.

6.6 Filler:

The three cores then laid up with a suitable extruded material to provide a substantially circular cross section before the inner covering is applied. The filler material should be non-hygroscopic, easy to be removed and good flexibility material, suitable for the operating temperature and compatible with the insulating material. The materials shall be new, unused and of finest quality.

6.7 Inner sheath:

a PVC inner covering then extruded over the circular assembly with a thickness proportional to the fictitious diameter over laid-up cores as specified in IEC 60502-2/Clause 8.1.3 .

6.8 Waterproof tape:

A layer of suitable tape (swelling tape) for water proofing to be laid over the armour layer.

6.9 Metallic Armour:

The three cores then armoured with double galvanized steel tapes of thickness not less than 0.5 mm and the gap between adjacent turns of each tape shall not exceed 50 % of the width of the tape. The metallic armour shall confirm to IEC 60502 standard with latest addendums and amendments.

6.10 Outer sheath:

Over all, an oversheath is extruded and should be as follows:

- a. Material: extruded PVC .
- b. Color: RED for 36 kv and BLACK for 24 kv .
- c. Thickness: According to the formula ($t_s = 0,035 D + 1,0$) where D is the fictitious diameter immediately under the oversheath, in millimeters.
- d. Suitable for the operating temperature.
- e. Has a good corrosion and humidity protection.
- f. Suitable additives to be added to prevent attack by rodents and termites.
- g. Identification:

The following identification marks shall be permanently embossed along two lines diametrically opposite to each other on the cable at suitable intervals:

----- Volts; mm^2 , copper cable; XLPE insulated , MoE - IRAQ , Year of manufacture , manufacturer's name.

Length of cable on one meter intervals shall be embossed on the outer jacket. Marking on the over-sheath shall indicate cumulative length of the cable, wound on the drum, such marking starting with "000" on the inner end and actual length on the drum.

6.11 Packing:

Packing shall be sturdy to protect the cable from any injury during transportation, handling and storage. The cut ends of the cable shall be sealed by means of non-hygroscopic sealing material. The cable shall carry the following information either stenciled on the drum or contained in a label attached to it:-

- a. Reference to the standard.
- b. Manufacturer's name, brand or trade mark.
- c. Type of cable and voltage grade.
- d. Order No. .
- e. No. of cores, material and nominal cross-sectional area of conductor.
- f. Length of cable on drum.
- g. Drum number.
- h. Gross and net weight of the cable.
- i. Country of manufacture.
- j. Year of manufacture.
- k. Direction of rotation of drum (an arrow).

No drum shall contain more than one length of cable. The inner as well as outer end of cable shall be brought out on the drum flange and shall be clamped in such a manner to make the cable length marking easily visible. The diameter of bore for the cable drum for inserting the shaft shall not be less than 120 mm.

Cable Drum Length:

The length of cable for drum shall be according to the table No.2 below, variation of $\pm 5\%$ of the cable drum length is acceptable.

7. Types of Cables:

7.1 36 KV cables:

7.1.1 1x400 mm²

For this cable the applicable paragraphs of article 6 are :-
6.1, 6.2, 6.3, 6.4, 6.8, 6.10, 6.11 with rated voltage 18/30 (36) kV.

7.1.2 3x150 mm²

For this cable the applicable paragraphs of Article 6 are :-
6.1,6.2,6.3,6.4,6.5,6.6,6.7,6.8,6.9,6.10,6.11 with rated voltage 18/30 (36) kV.

7.2 24 KV cables:

7.2.1 1x400 mm²

For this cable the applicable paragraphs of Article 6 are :
6.1,6.2,6.3,6.4,6.8,6.10,6.11 with rated voltage 12/20 (24) kV.

7.2.2 1x150 mm²

For this cable the applicable paragraphs of Article 6 are: 6.1,6.2,6.3, 6.4,6.10,6.11, (same note as para.7-2-1) .

7.2.3

1x95 mm²

1x70 mm²

1x50 mm²

(same statement as 7.2.2)

7.2.4 3x150 mm²

For this cable, the applicable paragraph of Article 6 is:
6.1,6.2,6.3,6.4,6.5,6.6,6.7,6.8,6.9,6.10,6.11 with rated voltage 12/20 (24) kV.

8. Tests:

Certified copies of type test certificates shall be submitted along with the offer. Cables and accessories shall be subjected to inspections and tests by our inspectors or international inspectors at any time during manufacture. The manufacturers shall provide inspection facilities for the said inspection shall be made at place of manufacture or at international testing facilities.

9. Technical Information for Cables:

The tenderer is requested to give the following information with the offer as listed in schedule A below.

10. Cables joints and terminations:

Cable joints and terminations to be slip on or heat shrinkable type complete with all necessary jointing materials suitable for 24 & 36 kV underground cable from qualified manufacturers, The terminations and joints should be as follows :-

- A. Straight through joint for cable shown under 7.1.1 complete.
- B. Outdoor terminations suitable for cable shown under 7.1.1 complete.
- C. Indoor terminations suitable for cable shown under 7.1.1 complete.
- D. Straight through joint suitable for cable shown under 7.1.2 complete.
- E. Outdoor terminations suitable for cable shown under 7.1.2 complete.
- F. Indoor terminations suitable for cable shown under 7.1.2 complete.
- G. Straight through joint suitable for cable shown under 7.2.4.
- H. Indoor terminations suitable for cable shown under 7.2.4 complete.
- I. Outdoor terminations suitable for cable shown under 7.2.4.
- J. Indoor terminations suitable for cable shown under 7.2.2.
- K. Indoor terminations suitable for cable shown under 7.2.3.

N.B:-

1. The prices shall be based on L.M.E. price for copper bar () US\$/ton. The formula for price variation shall be given.
2. The total length of the cable on drums should not exceed the total required amount stated in the contract. Otherwise, any extra amount should be free of charge.

Table No. (1)

	cross sectional area mm ²	Min. No. of wires	Max. D.C resistance at 20 °C ohm/km	Short circuit current for 1 sec. in KA
1.	50	6	0.387	7.5
2.	70	12	0.268	10.5
3.	95	15	0.193	15
4.	150	18	0.124	21.5
5.	400	53	0.0470	55

Table No. (2)

	Cable size	Drum length (m)		Cable size	Drum length (m)
1.	1x400 sq. mm / 36 kv	500	5.	1x95 sq. mm /24 kv	500
2.	3x150 sq. mm /36 kv	250	6.	1x70 sq. mm /24 kv	500
3.	1x400 sq. mm /24 kv	250	7.	1x50 sq. mm /24 kv	500
4.	1x150 sq. mm /24 kv	500	8.	3x150 sq. mm /24 kv	250

Schedule A
GUARANTEED TECHNICAL INFORMATION

S.NO.	Description	Unit	Bidder's data
1.	Manufacturer and country of origin		
2.	Applicable Standards		
3.	Voltage grade of cable Vo/V (Vmax)	kv	
4.	Number of cores	Single/Three	
5.	Conductor details: a. Material b. Compacted c. Number of wires in each conductor d. Diameter of wire in each conductor e. Area f. Diameter of conductor in stranded and compacted shape	Yes/No No. mm Sq. mm mm	
6.	Conductor screen: a. Material b. Nominal thickness c. Minimum thickness d. Total diameter after conductor screen e. Whether extruded f. Resistivity	mm mm mm Yes/No Ohm-m	
7.	Insulation: a. Material b. Nominal thickness of insulation c. Minimum thickness of insulation d. Total diameter	mm mm mm	
8.	Insulation screen: A. Semi-conducting screen (extruded) i. Material ii. Nominal thickness iii. Minimum thickness iv. Total diameter v. Resistivity B. Semi-conducting tape i. Material ii. Nominal thickness iii. Minimum thickness iv. Width v. Total diameter vi. Swelling	mm mm mm Ohm-m mm mm mm mm mm Yes/No	

	<p>C. Metallic screen</p> <p>i. Material</p> <p>ii. Electrical cross section</p> <p>iii. Minimum cross section of each wire</p> <p>iv. Number of wires</p> <p>v. Total diameter</p> <p>vi. Fault current rating for 1.0 sec</p> <p>vii. Spiral equalizing tape</p> <ul style="list-style-type: none"> • Material • Width and thickness • Lay length 	<p>Sq. mm</p> <p>Sq. mm</p> <p>Pcs</p> <p>mm</p> <p>kA</p> <p>mm</p> <p>mm</p>	
9.	Phase identification strips	Yes/No	
10.	<p>Filler:</p> <p>a. Material</p> <p>b. Extruded</p>	Yes/No	
11.	<p>Inner covering:</p> <p>a. Material</p> <p>b. Extruded</p> <p>c. Nominal thickness</p> <p>d. Minimum thickness at any point</p>	<p>Yes/No</p> <p>mm</p> <p>mm</p>	
12.	<p>Armour:</p> <p>a. Material</p> <p>b. Type</p> <p>c. Thickness of tape</p> <p>d. Total diameter</p> <p>e. Galvanizing thickness</p>	<p>mm</p> <p>mm</p> <p>micron</p>	
13.	<p>Waterproof tape</p> <p>a) Tape description</p> <p>b) location</p>		
14.	<p>Outer sheath:</p> <p>a. Material</p> <p>b. Nominal thickness</p> <p>c. Minimum thickness at any point</p> <p>d. Termite resistant</p> <p>e. Rodent resistant</p>	<p>mm</p> <p>mm</p> <p>Yes/No</p> <p>Yes/No</p>	
15.	Nominal overall diameter of completed cable	mm	
16.	Minimum weight of copper (conductor + metallic screen)	Kg/m	
17.	Weight of completed cable	Kg/m	
18.	Allowable minimum radius of bend around which cable can be laid	mm	
19.	Maximum DC resistance of conductor at 20° C	Ohm/km	
20.	Maximum DC resistance of metallic screen	Ohm/km	

21.	Inductance of cable for 1000m length	mH	
22.	Capacitance of cable for 1000m length	μ F	
23.	Maximum conductor temperature for continuous operation	deg. C	
24.	Maximum conductor temperature under short circuit	deg. C	
25.	Insulation resistance between cores / screen	M.OHMS	
26.	Voltage drop per 1000 m cable at rated current: When laid in air at 40 deg. C	volts	
27.	Voltage drop per 1000 m cable at rated current: When laid in ground at 30 deg. C	volts	
28.	Maximum dielectric loss of three phase circuit when operating at normal voltage and frequency at maximum conductor temperature of 90° C	W/km	
29.	Maximum continuous current carrying capacity per conductor for a single circuit when laid direct in the ground at : Maximum conductor temperature 90 °C Ambient air temperature 30 °C Ground temperature 20 °C Depth of laying 1 m Thermal resistivity of soil 1.5 K.m/W	Amp	
30.	Conductor short-circuit current permissible for a period of 1 second	kA	
31.	Maximum dielectric loss angle at normal voltage and frequency at a conductor temperature of :- a. 20 °C b. 90 °C	Tan δ	
32.	Maximum permissible pulling force at total cable in drums	kN	
33.	Cable drum details :- a. Nominal delivery length per drum b. Maximum gross weight of full drum c. Steel or wooden drums d. Weight of empty drum e. Drum dimensions: • Flange diameter • Bore diameter • Width	m Kg Kg mm mm mm	
34.	Cross section drawing and details of cable layers and catalogues.		

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