Ministry of Electricity
Planning and Studies Office
Baghdad – Iraq

Specification No.	**D-04**

TECHNICAL SPECIFICATION
OF
LOW VOLTAGE POWER CABLES

REVISION	**December 2013**

1. Scope:

The specification includes the design, manufacture, test, suitable packing, transportation of 0.6/1 (1.2) kV cables.

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:

Nominal voltage	400 volts
System	3-phase, 4 wire with neutral solidly grounded.
Frequency	50 Hz

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 Insulation:

The insulation of the cable shall be extruded polyvinyl chloride PVC, designed and manufactured for the specified voltage. The insulation shall withstand mechanical and thermal stress under steady state and transient operating conditions. 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.

6.3 Phase Identification:

Red, Yellow, Blue color for phases and black for neutral.

6.4 Filler:

The four 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.

6.5 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 60502-1/Clause 7.1.3 .

6.6 Metallic Armour:

The four cores then armoured with double galvanized steel tapes of thickness not less than that specified in IEC 60502-1/Clause 12.5 applied helically in two layers so that the outer tape is approximately central over the gap of the inner tape .The gap between adjacent turns of each tape shall not exceed 50 % of the width of the tape.

6.7 Outer sheath:

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

a. Material: extruded PVC .
b. Color: Grey .
c. Thickness: According to the formula (ts = 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; ..... mm² , copper cable; PVC 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.

6.8 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. Actual 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 unless the directorate specifies a certain length .Variation of ±5 % of the cable drum length is acceptable.

7. Types of Cables:

7.1 ***Single core cables***:

- 50 sq. mm
- 70 sq. mm
- 95 sq. mm
- 120 sq. mm
- 150 sq. mm
- 185 sq. mm
- 240 sq. mm

For these cables the applicable paragraphs are 6.1,6.2,6.7 and 6.8 .

7.2 ***Four core cables***:

- 3x240+120 sq. mm
- 3x185+95 sq. mm
- 3x150+95 sq. mm
- 3x120+70 sq. mm
- 3x95+50 sq. mm
- 3x70+35 sq. mm
- 4x50 sq. mm
- 4x25 sq. mm
- 4x16 sq. mm

For these cables the applicable paragraphs are 6.1,6.2,6.3,6.4,6.5,6.6,6.7 and 6.8.

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.

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 mm²	**Min. No. of wires**	**Max. D.C resistance at 20 °C (ohm/km)**	**Short circuit current for 1 sec. in kA**
1.	16	6	1.15	1.84
2.	25	6	0.727	2.88
3.	35	6	0.524	4.03
4.	50	6	0.387	5.75
5.	70	12	0.268	8.05
6.	95	15	0.193	10.9
7.	120	18	0.153	13.8
8.	150	18	0.124	17.3
9.	185	30	0.0991	21.27
10.	240	34	0.0754	27.6

Table No. (2)

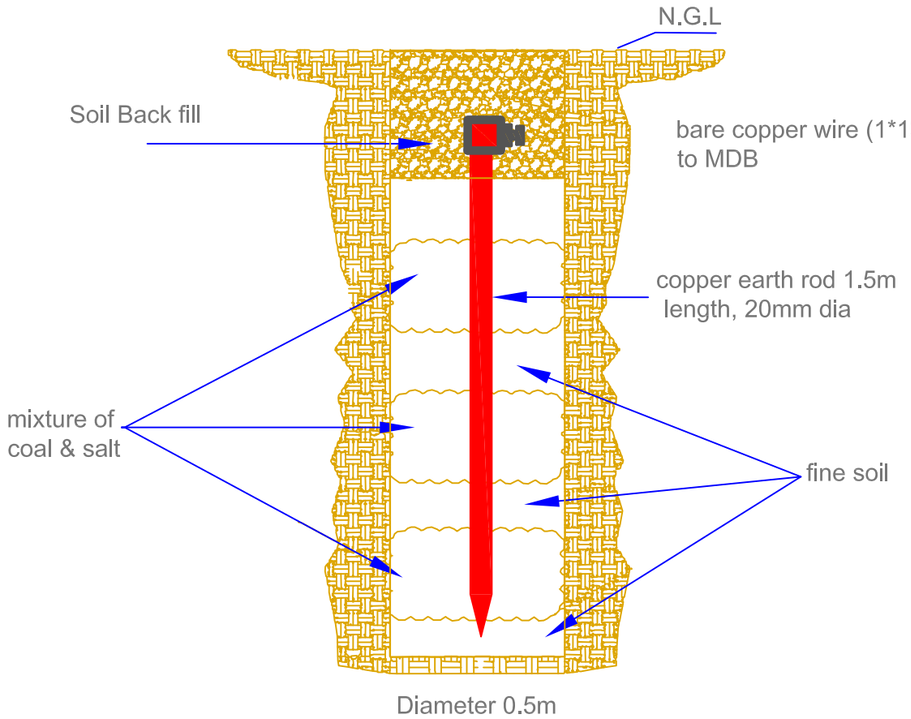
	Cable size	Drum length (m)		Cable size	Drum length (m)
1.	1x50 sq. mm	250	9.	4x25 sq. mm	1000
2.	1x70 sq. mm	250	10.	4x50 sq. mm	1000
3.	1x95 sq. mm	250	11.	3x70+35 sq. mm	500
4.	1x120 sq. mm	250	12.	3x95+50 sq. mm	250
5.	1x150 sq. mm	250	13.	3x120+70 sq. mm	250
6.	1x 185 sq. mm	250	14.	3x150+70 sq. mm	250
7.	1x240 sq. mm	250	15.	3x185+70 sq. mm	250
8.	4x16 sq. mm	1000	16.	3x240+120 sq. mm	250

Schedule A
GUARANTEED TECHNICAL INFORMATION

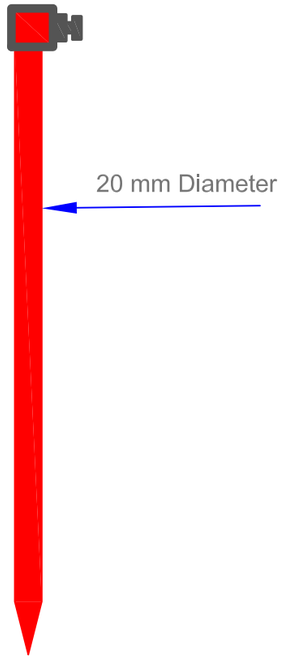
S.NO.	Description	Unit	Bidder's data
1.	Manufacturer and country of origin		
2.	Applicable Standards		
3.	Voltage grade of cable Vo/V (Vmax)	kV	
4.	Number of cores	Single/Three	
5.	Conductor details: a. Material b. Compacted c. Number of wires in each conductor d. Diameter of wire in each conductor e. Area f. Diameter of conductor in stranded shape	 Yes/No No. mm Sq. mm mm	
6.	Insulation: a. Material b. Nominal thickness of insulation c. Minimum thickness of insulation d. Total diameter	 mm mm mm	
7.	Phase identification description		
8.	Filler description		
9.	Inner covering: a. Material b. Extruded c. Nominal thickness d. Minimum thickness at any point	 Yes/No mm mm	
10.	Armour: a. Material b. Type c. Thickness of tape d. Total diameter e. Galvanizing thickness	 mm mm micron	
11.	Outer sheath: a. Material b. Nominal thickness c. Minimum thickness at any point d. Termite resistant e. Rodent resistant	 mm mm Yes/No Yes/No	
12.	Nominal overall diameter of completed cable	mm	

13.	Minimum weight of copper	Kg/km	
14.	Weight of completed cable	Kg/km	
15.	Allowable minimum radius of bend around which cable can be laid	mm	
16.	Maximum DC resistance of phase conductor at 20º C	Ohm/km	
17.	Maximum DC resistance of neutral conductor at 20º C	Ohm/km	
18.	Inductance of cable for 1000m length	mH	
19.	Capacitance of cable for 1000m length	μF	
20.	Maximum conductor temperature for continuous operation	deg. C	
21.	Maximum conductor temperature under short circuit	deg. C	
22.	Insulation resistance a) For phase insulation b) For neutral insulation	M.OHMS	
23.	Voltage drop per 1000 m cable at rated current: When laid in air at 40 deg. C	volts	
24.	Voltage drop per 1000 m cable at rated current: When laid in ground at 30 deg. C	volts	
25.	Maximum dielectric loss of three phase circuit when operating at normal voltage and frequency at maximum conductor temperature of 70º C	W/km	
26.	Maximum continuous current carrying capacity per conductor for a single circuit when laid direct in the ground at : Maximum conductor temperature 70 °C Ambient air temperature 30 °C Ground temperature 20 °C Depth of laying 0.8 m Thermal resistivity of soil 1.5 K.m/W	Amp	
27.	Conductor short-circuit current permissible for a period of 1 second	kA	
28.	Maximum dielectric loss angle at normal voltage and frequency at a conductor temperature of :- a. 20 º C b. 90 º C	Tan δ	
29.	Maximum permissible pulling force at total cable in drums	kN	
30.	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	 m Kg Kg mm	

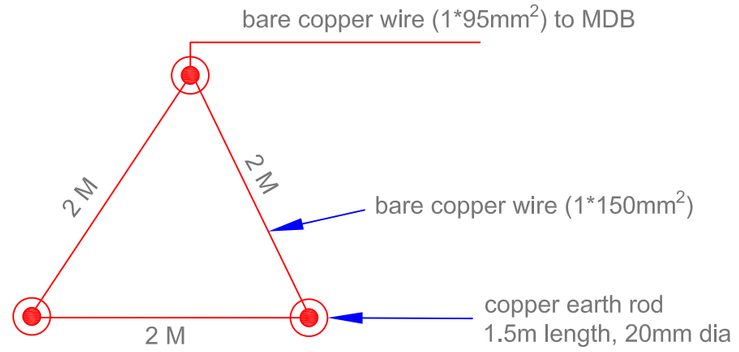
	• Bore diameter • Width	mm mm	
31.	Cross section drawing and details of cable layers and catalogues.		



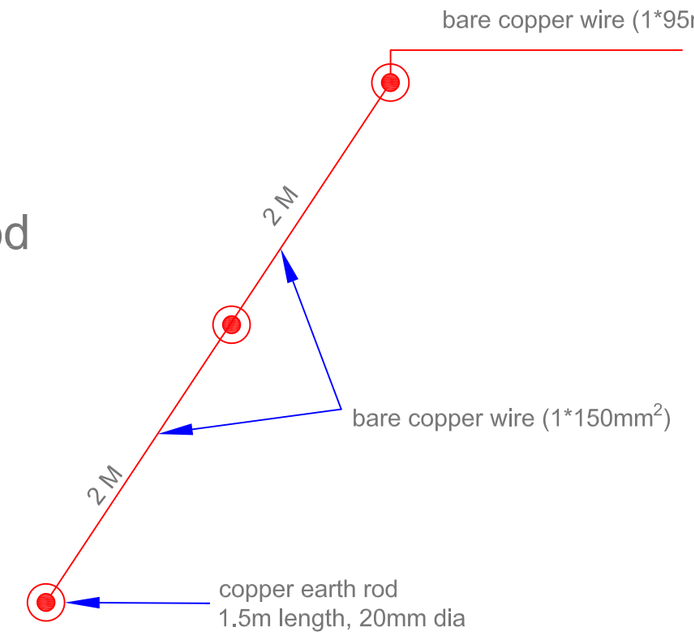
Diameter 0.5m



Copper Earth Rod



1a. Triangle formation of copper earth rod



1b. Straight formation of copper earth rod

		U N D P
Designed by:		
Earthing System		Sheet No.:
Scale: NTS	Date:	

Ministry of Electricity
Power Distribution Office
Baghdad - Iraq

Specification No.	**D 22-**

TECHNICAL SPECIFICATION
OF
TUBULAR STEEL POLES

REVISION	**YEAR 2001**	**YEAR 2009**	**YEAR 2012**

1- Scope of supply:

Suppliers are called upon to deliver tubular steel poles to MOE which are required for the installation of medium voltage (11 kV) and low voltage (0.4kv) Electricity Distribution Network.

The Japanese Industrial Standards (JIS) or British Standards (BS) are to be considered in the design, manufacture and testing have above mentioned materials. Similar or equivalent international standards such as A.P.I or DIN etc. Shall be likewise.

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 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)

2-5 Sand storm:

The equipments shall be suitable for outdoor installations and subjected to frequent sand storms and heavily polluted atmosphere.

2-6 Wind Velocity:

Max velocity (for design purpose) (140 KM/ HR) or 39m/sec.

2-7 Composition of Soil:

The soil consists mainly of hard clay containing deposit gravel.

3- Technical Requirement:

3-1 System Data

a.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

b. 0.4 kV system	
Nominal voltage	400 Volts
System	3phases, 4 wires with neutral solidly grounded.
Frequency	50 Hz

4- materials and process:

The poles shall be made from longitudinally welded tube sections of hot rolled structural carbon steel in accordance with JIS-G-3444 or in accordance with BS-4360 or in accordance with any international equivalent standards like DIN 17100 with considering the design factor of safety for design of the poles shall be considered (2.0).
Then the materials having the following properties.

Characteristics	Unit	type of steel standards			
		High tensile steel		Medium tensile steel	
		according to JIS-G-3444	according to BS-4360 DIN-17100	according to JIS-G-3444	according to BS-4360 DIN-17100
Tensile strength	Kg f /mm^2 (min)	ST-51	ST-52	ST-41	ST-42
Yield strength	Kg f /mm^2 (min)	36	36	24	24
Design bending stress	Kg f /mm^2 (min)	25.5	26	20.5	21

Poles shall be delivered in a swaged of stepped form.

Swaged poles shall be manufactured from tubes brought together when hot. Stepped poles shall be made from one length of tube with its diameter being reduced in parallel steps by passing the tube through a series of dies.
Stepped poles shall have the same wall thickness at any section of its whole length.

A swaged pole shall consist of three-tube section with diminishing diameters, the bottom Section being the biggest in size. See fig (1).

The length of the overlap shall be at least 3 times . The diameter of the smeller tube. The supplier should state the overlapping length in his offer. The upper edge of tube at the joint shall be chamfered off at an angle of 45^o

The top end of all poles shall be rounded off and sealed completely. Welded type poles made out of <u>three- sections</u> similar to the design but jointed together via reducers welded to the pole section shall also be accepted subject that the mechanical characteristics and tests are the same as for swaged or stepped poles.

a. The pole design shall be in accordance with the following: -

Characteristics	Unit	9m poles (LV)	11m poles (MV)
Effective length of pole	m	9	11
Length of top section	m	2	2.5
Outside diameter of top section	mm	89	114
Length of middle section	m	2.3	3
Outside diameter of middle section	mm	114	139
Length of bottom section	m	4.7	5.5
Outside diameter of bottom section	mm	139	165
Planting depth	m	1.5	2
Working load	kgf	210	285
Point of application of load		60 cm below top	120 below top
Allowable bending stress For JIS-G-3444 ST-51 & DIN-17100 ST-52	kgf/mm^2	26	26
Wall thickness (t) of the poles must be for ST-51 or ST-52	mm	≥ 3.7	≥ 4.4
Allowable bending stress For ST-41 JIS - G - 34444 & ST 42 according to DIN - 17100 and any equivalent	kgf/mm^2	21	21
Wall thickness (t) of the poles must be for ST-41 or ST-42	mm	≥ 4.4	≥ 5.3

b. All (11 m) pole shall be fitted with (A) shaped clamped welded to the poles top and having an approximate height of (25 cm). The clamp which shall be fixing the upper (11 kv) pin insulator, is to be made of plate steel having of chemical and mechanical properties similar to that of the tubular poles.

The plate shall have a width of (75mm) and (6mm) thickness with two holes (25 mm) diameter of steel (ST-41) or (ST-42), each drilled at center coincident with the centerline of the pole.

The extra length of ((A)) clamp shall not be considered in the effective length of the (11 m) pole.

c. Five nos. (17.5mm) dia. Through holes shall be drilled at the top sections of poles for the purpose of fixing low tension shackle insulators. The upper-most hole shall be located (120 cm) below the top of the (11 m) pole, the rest spaced (30 cm) between centers vertically downwards.

The same number of holes shall be drilled through the (9 m) poles, but the upper-most hole shall be drilled (15 cm) below the top.

For earthling purposes a (20-mm) dia. Hole shall be drilled at the bottom of each pole at a distance of (15-cm) there from and a suitable length (M-18) galvanized bolt, nut & washer shall be supplied with each pole.

Tolerance in diameter and thickness of tube section shall be within the limits specified in (JIS-G-3444, or BS 4360, or DIN 17100) the complete pole shall be out of straightness more than (1/1000) of length of pole.

d. Loading process (type test):

The design of each pole shall has the acceptance criteria as follows when conducting loading tests:

Load	Measuring item	Acceptance criteria
Ps	Specified working load	Any defect should not be produced
O	----------	----------
Pp	1.5 load × Ps	Any defect should not be produced
O	----------	Permanent set shall not exceed (13 mm) from zero position
Pb	2.0 load × Ps	Destruction

Where: -
Ps = Specified working load.
Pp = Load for permanent set not exceeding (13 mm).
b = Breaking load.

5- Protection: -

The poles shall be hot-dip galvanized thoroughly internally and externally as per (BS 729) but zinc distribution shall not be less than (650 gr. /m^2).

6- Testing and inspection:

The poles are subject to inspection by (MOE) inspection authority during manufacture and before shipment to verify compliance of poles with our specifications. The fees shall be borne by (MOE) but the supplier shall submit all necessary facilities to our inspector to conduct such tests without-extra charge.

7- Specification For Cross-Arms & Clamps

Generally these cross-arms and clamps shall be used for (11 m) poles at the rate of one set of cross-arm and clamp per each pole shall be steel (St-41) or (St-42). The set shall be fastened at a distance of (0.9 m) below pole top (excluding A - clamp). Generally the design shall be complying fully with the attached drawings No.2 & No.3 . Every set shall include the followings: -

a. One No. Channel steel (75x40x6 mm) length (1250 mm).
b. One No. Clamp having cross-section (75x6 mm).
c. Tow Nos. high stress ((M-16)) Hexagonal headed bolts, nuts, plain washer & spring washers, the length of bolt (excluding head shall be 60 mm, fully threaded 50 mm).With spare bolts, nuts. etc of 5% for the whole quantity required.

8. Protection:

a. All channel steels and clamps shall be hot dip galvanized to (BS 729), with same zinc distribution as above.

b. All bolts nuts and washers shall be electrically galvanized.

9. Packing:

a. Channel steels and clamps in bundles.

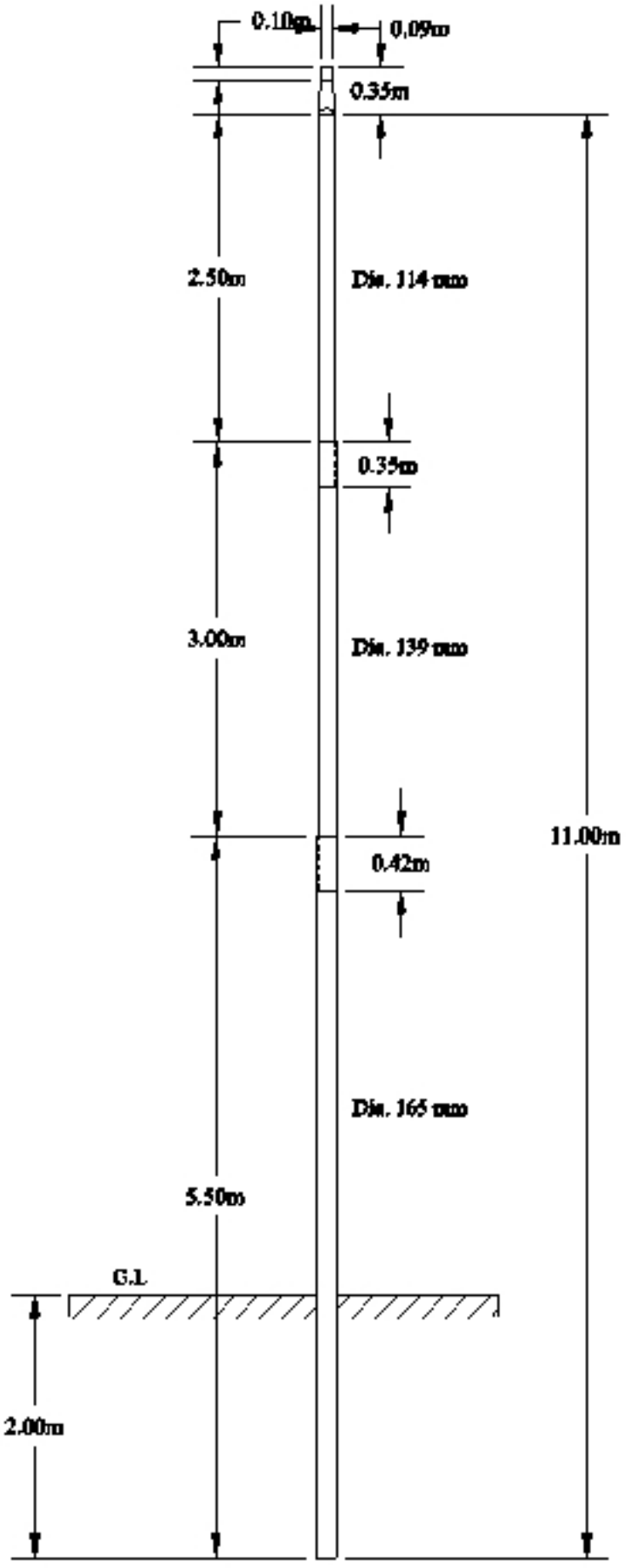
b. Bolts nuts and washers in proper wooden or steel cases.

Details shall be stated clearly in the offer.

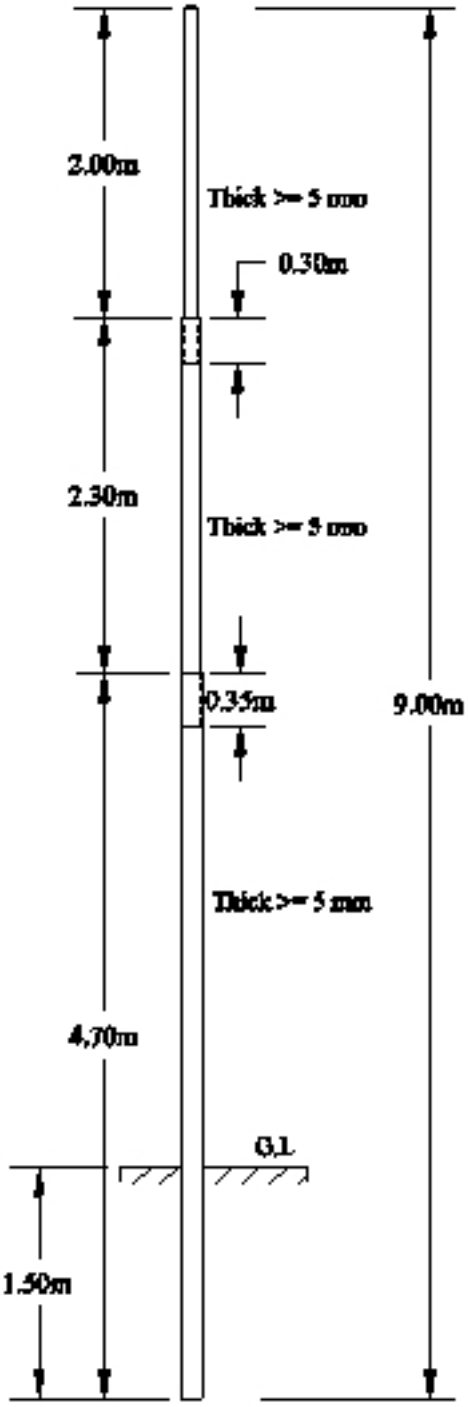
Note:

All drawings of the pole and its accessories subjected to our approval before start manufacturing.

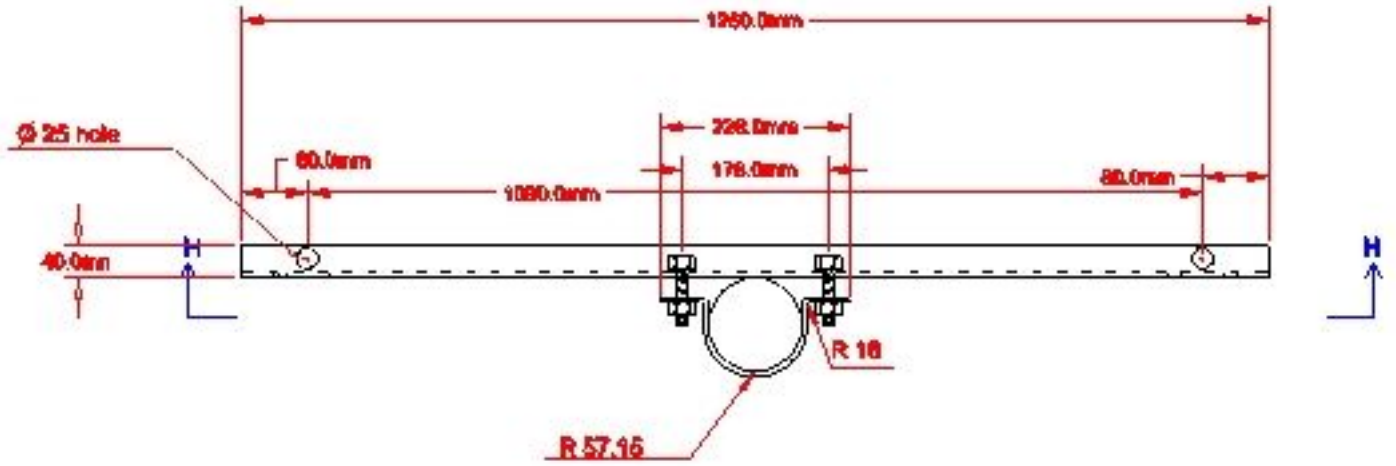
11m poles

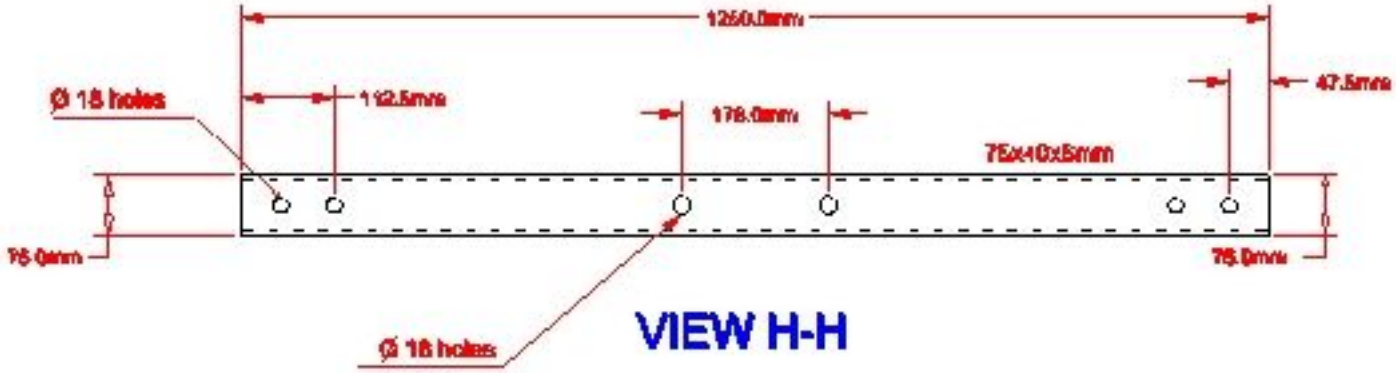


9m poles



Drawing no. (1) 11m & 9 m Tubular steel poles





VIEW H-H

All materials STK-41 or ST-42 or ST-44 Hot dip galvanization to B.S729 for all steel works except bolts which should be electrically galvanized

Drawing no. (2)

CROSS ARM FOR 11m TUBULAR POLES

Ministry of Electricity (MOE)
Power Distribution Office
Baghdad - IRAQ

Specification No.	D-26

Technical Specification of Distribution Transformer 11 / 0.416 kV

Revision	Year 2017

Table of Contents:

Clause	Item	Page no.
1.	Scope of the Tender	3
2.	General Requirements	3
3.	System Composition	5
4.	Technical Specifications	6
5.	Fittings and Accessories	8
6.	Painting	8
7.	Insulating oil	8
8.	Tender Price Evaluation (losses considerations)	9
9.	Test	10
10.	Drawing , Instruction Book and Literature	11
11.	Packing	13
12.	Spare parts and special tools for each rating	14

1- Scope of the Tender

Tenderer are invited for the design , manufacture , testing and supply of a 11000/416 volt, oil immersed copper winding outdoor type (Directly under the sun) transformers to be supplied complete with all necessary fittings , accessories off-load tap changer , insulating oil and spare parts . . . etc.

The transformer is to be hermetically sealed (without conservator tank) bolted cover with bushing insulators on both H.T and L.T sides for the following ratings: 100, 250, and 400. For 630, and 1000 kVA should be plug in type (according to the tender requirements), a valid ISO 9001 certificate required.

2- General Requirements

The transformers shall be of first class quality and design for continuous satisfactory operation as continuity of supply is of prime consideration. The design shall be allow all necessary precaution for the safety of operation and maintenance personnel. The transformers shall operate satisfactorily under variations of load, voltage or short circuit or other conditions which may occur on the system provided that these variations are within the assigned rating of the apparatus. All the equipment shall be designed to obviate the risk of accidental short circuit.

2-1 Climatic Conditions

The materials used shall_be suitable for the following climatic conditions prevailing at the site:

2.1.1 Ambient temperature

Highest maximum (in the shade) $+55^0$ C for about 6 hrs a day.

Lowest minimum	-10^0 C
Maximum yearly average	$+30^0$ C
Maximum daily average	$+40^0$ C

2.1.2 Sun temperature

Black objects under direct sunshine attain a temperature of 80^0 C.

2.1.3 Air humidity

Maximum	92% at 40^0 C
Minimum	12%
Yearly average	44%

2.1.4 Sand storm

In general, the atmosphere is dusty which may result in a layer of dust being deposited on all exposed surfaces. Also fine dust particles may penetrate even through minute openings.

2-2 Altitudes

From sea level up to (1000m).

2-3 System Data

2-3-1 High voltage side:-

Nominal voltage	11000 Volts
Short circuit level	25 kA at 11000 volts
Frequency	50 HZ.
Highest system voltage	12000 volts
System	3-phase, 3-wire with neutral isolated but provision is made for earthling through an earthling resistance of 21.1 ohms to limit the earth fault current to 300 Amp.

2-3-2 Low voltage side:-

Nominal voltage	400/230 volts ± 10%
System	3-Phase, 4-wire neutral solidly earthed.
Short circuit level	According to the short circuit level of H.T side and the rated power and impedance voltage of the transformer

2-4 Standards

All the equipment shall be in accordance with the latest issue of the International Electro-technical Commission (IEC specification).

2-5 Deviation:

The tenderer shall particularly mention in his tender all deviations from the specification described in these tender specification.

2-6 Schedules:

The tender shall duly fill in the schedules A&B of guaranteed technical particulars, prices, delivery and deviations attached to this specification. Incomplete tenders are liable to rejection.

2-7 Guarantee:

The tenderer shall confirm than the transformer guaranteed against all defects arising from faults design, materials and workmanship, for a period of (12) months from commissioning or (18) months from arrivals, whichever period expires earlier.

3- System Composition

The transformer shall operate in distribution systems where most of the network is overhead lines and comprising partly underground cable.

4- Technical Specification

4.1 The transformers shall be copper winding. Hermetically sealed of the bolted cover and should have the following characteristics:-

Rated outputs	100, 250, 400, 630, and 1000 kVA
Duty	Step-down, outdoor bushing type for 100, 250, and 400 kVA. Plug in type for 630 and 1000 kVA (according to the tender requirements)
Type	3-phase
Rated voltage at no load ...	HV side -11kV LV side - 416 volts
System Highest Voltage ...	HV side 12 kV
System frequency	50 HZ
Interphase Connection	HV side - Delta LV side - star with neutral brought out
Vector Group	Dyn 11
Type of cooling	ONAN
Temperature rise	(i) 45 K in top oil by thermometer (ii) 50 K in winding by resistance

4.2 The efficiency (at unity power factor and 100% of rated power) of the transformer should be not less than the following:

1. 100 kVA 98.1%
2. 250 kVA 98.6%
3. 400 kVA 98.7%
4. 630 kVA 98.8%
5. 1000 kVA 98.9%

4.3 The duration of the short circuit to rise the temperature of windings from 105 ^{0}C to 250 ^{0}C should be not less than (5 Sec.) according to IEC 60076, part 5 , clause (4.1.5).

4.4 The thickness of the radiator plates should be shock resistant and do not affect heat dissipation according to tender requirements as follows:

- For 250 and 400 kVA transformer, not less than 1.2 mm.
- For 630 and 1000 kVA transformer, not less than 1.5 mm.

4.5 The noise level should be ≤ 55 dB at 0.3 meter distance according to IEC standards

4.6 The low voltage winding must be of copper foil for 250, 400, 630, and 1000 kVA transformers.

4.7 Off-load tap changer should be five tapping for (± 2.5%, ± 5%) on the HV winding for off-circuit operation externally. The mechanical operation must be of the robust and definite position type with a click indicating position arrived during tap changing with suitable pad-lock.

4.8 Terminal arrangement of transformers.

4.8.1 The HV side:

- Terminal is to be a clamp type with eyebolt or flat bar type with nut suitable for conductors up to 70 mm^2 copper (for 100, 250, 400 kVA).

4.8.2 The low voltage terminals are to be flat bar type with holes suitable for compression type thimble the sizes of LV side:

- For 100 KVA transformer 4x1x70 mm^2 copper (1 hole per phase).
- For 250 KVA transformer 8×1×95 mm^2 copper (not less than 2 holes per phase).
- For 400KVA transformer 7×1×150 mm^2 copper (not less than 3 holes per phase).
- For 630 KVA transformer 11×1×240 mm^2 copper (not less than 3 holes per phase).
- For 1000 KVA transformer 14×1×240 mm^2 copper (not less than 3 holes per phase).

4.9 Terminal arrangement of outdoors transformers must be porcelain bushing insulator (brown colored preferable) mounted on the top cover of transformer for both HV and LV, with arcing horn (double air gap is preferable) on HV bushing for outdoor transformer only. Neutral bushing should distinguished from phase bushing by longer distance of separation.

5- Fittings and Accessories

- Terminal marking plate.
- Tapping switch.
- Two valves (3/4 inches) diameter fitted on cover and bottom of tank, switch locks.
- Thermometer pocket with thermometer including maximum temperature measurement indicator with two separate free contacts.
- Lifting lugs.
- Pressure relief valve.
- Earthling terminal on tank.
- Rating and diagram plate to be chromium plated of the engraved type with kVA rating and serial number engraved inside on the cover of the transformer at a suitable place.
- Skid mounting to be vertical with the length of the transformer.
- Oil level indicator, to be of mechanical type located on the top cover of transformer to indicate the oil level with the temperature variation, protected by metallic envelop.

6- Painting

- The painting should be oil and weather (dust, humidity and heat .... etc.) resistant type and the final coat is to be aluminum paint or equivalent. Any alternative finishing which gives better heat radiation is accepted and must be confirmed by calculations.
- Ministry of Electricity logo must be engraved on the cover or side of the transformer at a suitable place.

7- Insulating oil

The transformer is to be shipped with first filling of oil which shall be (uninhibited insulation oil), according to the latest IEC 60296.

8- Tender Price Evaluation (losses considerations)

8.1 Cost of the transformer

The cost of transformer will consider the age of the transformer, the iron losses, copper losses, and the initial price of the transformer. This cost will be used for comparison between the values of different tenderers and not the initial price of the transformer only.

The following equation will be applied to calculate the cost of transformer.

Cost according to loss evaluation (for one transformer) = Initial price + (Guaranteed Ie × 1800 + Guaranteed Cu x 600)

Where:

- Ie = Iron (no-load) losses: 1800 USD per kW at rated voltage and frequency.
- Cu = Copper (Load) losses: 600 USD per kW at rated power and principle tapping at 75^{0}C.

8.2 Loss evaluation

The tolerance permitted is +10% of the evaluated guaranteed total losses mentioned in the offer. Any transformer with total losses more than + 10% will be rejected. For transformer with total losses within +5% of the evaluated guaranteed losses , no penalty shall be made , for transformers where the total losses between 105% to 110% of the total evaluated guaranteed losses , the contract price shall be reduced by the cost of the difference between the total losses and the 100% of the total evaluated guaranteed losses according to the following values.

- Ie = Iron losses (kW).
- Cu = Copper losses (kW).
- Q = number of transformers required in the tender.

For any transformer with total losses less than 100% of the guaranteed losses, no variation to the contract price shall be made.

Total penalty (USD) = Q × [(Measured Ie- Guaranteed Ie) kW × 1800 USD/kW + (Measured Cu – Guaranteed Cu) kW × 600 USD/kW]

9- Tests

9.1 Inspection:

The material shall be subjected to inspection and test by owner inspectors or international inspector at any time during manufacture.
The manufacture shall provide all inspection facilities for the said inspection and inspection shall be made at the place of manufacture or at international testing facilities according to the tender requirements.
The inspector shall have the right of rejecting any portion of the material at any time during manufacture if it dose not meet with the requirements of this specification in all particulars. He shall have the right of overseeing the packing and shipping of all material to be supplied.

9.2 Tests at manufacture work:

Tests at manufacture's factory shall comprise type tests (if required according to the tender requirements) and routine tests according to the approved parameters in schedules A & B.

a) **Type tests**

The type tests prescribed shall be carried out on one unit of each capacity:

1- Test of temperature rise according to the latest IEC 60076.
2- Full wave impulse voltage withstand test according to the latest IEC 60076.
3- Cost of these tests to be borne by the manufacturer.

b) **Routine tests**

Each transformer shall be subjected to all the routine tests specified according to the latest IEC 60076.

c) **Special tests**

(If required according to the tender requirements).

9.3 Test reports

Five copies of the test reports will be mailed within 8 days after the tests have taken place. These reports will indicate:

a) The results of the tests.
b) The calculation of performance of the items.

c) The guarantee figures to show that each apparatus performs the conditions of the specification within the guaranteed values (schedules A & B).

9.4 Test Certificates

a) The tenderer shall furnish the Ministry of Electricity (MOE) with six copies of test certificates.
b) No equipment shall be shipped without obtaining the (MOE) inspector prior approval of the certificates.

9.5 Witnessing tests

Unless otherwise agreed to, all tests at factory shall be witnessed by an authorized representative from (MOE).
The cost of travelling & accommodation of the authorized inspectors to witness the test at the place of manufacture for required days, to be on tenderer account.

10- Drawing, Instruction Book and Literature.

10.1 Documents to be submitted with the tender

The following documents shall be submitted by the tenderer along with his offer:-

a) Full and technical specification of transformer including schedule A&B of guaranteed technical particulars.
b) An outline drawing showing the plan , front and side elevation of the transformers , dimensions , terminals , equipment , and all accessories of the transformers.
c) Catalogues of the manufacturer for transformers.
d) Valid ISO-9001 certificate of the manufacturer for transformers.
e) Test certificate for identical transformers.
f) Reference list of manufactured and exported transformers.
g) Incomplete offers are liable to rejection.

10.2 Documents to be furnished by the successful tenderer

Within a period of 2 weeks from the commencement date, the successful tenderer shall furnish the following documents for final approval:-

a) 24 sets (or according to the tender requirements) of prints on paper on all drawings.
b) 24 copies (or according to the tender requirements) of all instruction books and technical maintenance of the transformer, OFF Load tap changing gear and other ancillary equipment.
c) 24 copies (or according to the tender requirements) of instruction for erection of the equipment.
d) 24 copies (or according to the tender requirements) of spare parts list with catalogue number.

10.3 Language

The language to be used in the drawings and instruction book shall be English.

10.4 Dimension:

Due to the space requirement in our system it is important for the participants in this tender to make sure that the dimension of each type of the required transformers to be as small as possible the following table is indicative as a maximum for each single dimension:-

Table of Dimension

Transformer (kVA)	Length (mm)	Width (mm)	Height (mm)
100	1220	600	1200
250	1230	700	1300
400	1400	1000	1400
630	1500	1200	1600
1000	1700	1400	1800

10.5 Approval of drawings:

The successful tenderer shall prepare and submit to the (MoE) all necessary drawings and specifications (schedule A & B) complete with explanations in due time and obtain approval of the same before commencing manufacture.
Failure to comply with this clause shall make the equipment or parts or parts there of liable to rejection.

11- Packing

The supplier will pack or protect the goods in the most appropriate manner.

He will be responsible for any loss or damage arising from careless packing or protection up to the place of final destination after completion of the inspection and tests at the factory, each item shall be packed for export shipment. All parts provided for shipping purposes only and which are to be removed at the time of erection shall be conspicuously tagged.

The method of packing shall be such as to protect all the items against excessive corrosion of dampness, and shall afford adequate protection against breakage or other injury, or loss due to breakage of cases or crates from the time the items leaves the factory until finally installed at the substation during which time, the apparatus will travel by rail by a long sea voyage again by rail or truck to the site of the substation. The equipment will also undoubtedly stand on wharves and in the open during and in between periods of transportation and will thereby be exposed to heavy rain, hot sun, humid climate and sudden changes of temperature.

Owing to the numerous handlings, the containers should be very strong also extra ordinary care should be given to the packing of the equipment and especially the items having insulating material to prevent the injury due to moisture, from sources external to the packing or from excessive condensation with the packing.

12- Spare parts and special tools for each rating

This clause is optional according to tender requirements.

12.1 Spare parts

No.	Item	Quantity (from the total quantity of the contract)
1	HV / LV winding	3%
2	HV bushing with its accessories	10%
3	LV bushing with its accessories	10%
4	Tap changer	3%
5	Pressure relief valve	2%
6	Oil level indicator	10%
7	Cover gasket	10%

Note: Unit price per set and per piece for each item are required.

12.2 Special tools:

All special tools required for maintenance of transformer shall be included in the scope of supply. An itemized list of special tools together with prices shall be submitted with the tender.

Schedule "A"

Schedule of the Guaranteed Performance and Other Technical Particulars (To be filled by the Tenderer for each rated capacity of 100, 250, 400, 630, and 1000 kVA).

No.	Description	Unit	Specifications	
			Required	Proposed
1	General			
1.1	Manufacturer Name		To be filled in	
1.2	Country of Manufacturing		To be filled in	
1.3	Type			
1.4	Model		To be filled in	
1.5	Applicable Standards		IEC 60076	
1.6	Location of service		Outdoor	
1.7	Short circuit Test Report			
1.8	Date of carried out		To be filled in	
1.9	Testing laboratory name and country		To be filled in	
1.10	Certificate Provided		Yes	
2	Ratings			
2.1	Continuous maximum rating	KVA	To be filled in	
2.2	Rated voltage ratio			
	• Primary	kV	11(+2 x 2.5%/-2 x 2.5%)	
	• Secondary	kV	0.416Y/0.24	
2.3	Number of phase		3	
2.4	Frequency	Hz	50	
2.5	Vector group symbol		Dyn11	
2.6	Cooling method		ONAN	
2.7	Maximum temperature rise at rated power			
	• Top oil by thermometer	K	45	
	• Winding by resistance	K	50	
	• Hot spot of winding max ambient temperature (55^0 C)	K	To be filled in	
2.8	Impedance voltage at continuous rated power	%	To be filled in	
2.9	Winding connection:			
	• Primary		Delta	
	• Secondary		Star (Neutral brought out)	

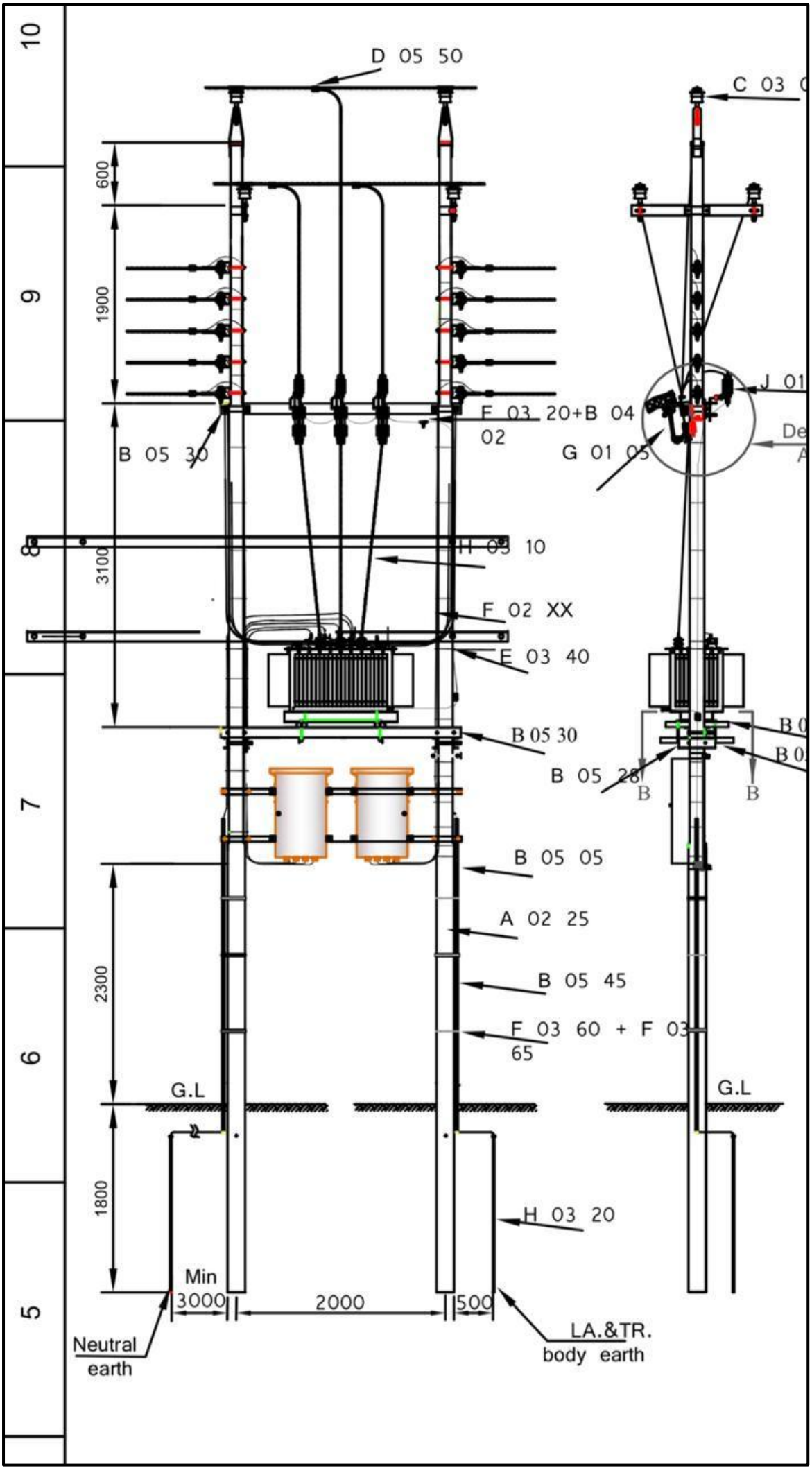
3	**Rated insulation level for Primary**			
	• Impulse withstand voltage (1.2/50μs)	kV peak	75	
	• One minute 50Hz withstand voltage	kV rms	28	
4	**Design Details**			
4.1	Off-load tap changer			
	• manufacturer		To be filled in	
	• Tapping range		+5%/-5%	
	• Tapping step		2.5%	
4.2	Exciting current referred to HV side and 50 Hz			
	• At 90% rated voltage.	A	To be filled in	
	• At 100% rated voltage.	A	To be filled in	
	• At 110% rated voltage.	A	To be filled in	
4.3	Power factor of exciting current at 100% rated voltage and 50 Hz	%	To be filled in	
4.4	Iron losses at 50 HZ			
	• At 90% rated voltage.	kW	To be filled in	
	• At 100% rated voltage.	kW	To be filled in	
	• At 110% rated voltage.	kW	To be filled in	
4.5	Copper losses at full load (on rating) and at 75^0 C	kW	To be filled in	
4.6	Total losses.	(kW)	To be filled in	
4.7	Resistance voltage at full load and at 75^0.	(%)	To be filled in	
4.8	Reactance voltage at full load and at 75^0	(%)	To be filled in	
4.9	Impedance voltage at full load 75^0:			
	• At normal tap.	(%)	To be filled in	
	• At highest tap.	(%)	To be filled in	
	• At lowest tap.	(%)	To be filled in	
4.10	Resistance of HV winding per phase at 20^0 C	Ω	To be filled in	
4.11	Resistance of LV winding per phase at 20^0 C	Ω	To be filled in	
4.12	Regulation at full load at 75^0 C			
	• At 1.0 power factor.		To be filled in	
	• At 0.8 p.f lagging.		To be filled in	
4.13	Efficiency at 75^0 C:			
	• At 100% load	(%)	To be filled in	
	• At 75% load	(%)	To be filled in	

	• At 50% load	(%)	To be filled in	
	• At 25% load	(%)	To be filled in	
4.14	Calculated thermal time constant	Hrs.	To be filled in	
4.15	Maximum flux density at normal voltage and frequency and at normal ratio for:			
	• Core.	(Kl/sq.cm)	To be filled in	
	• Yoke.	(Kl/sq.cm)	To be filled in	
4.16	Maximum flux density at 110% voltage and frequency and at normal voltage and frequency and at normal ratio for:			
	• Core	(Kl/sq.cm)	To be filled in	
	• Yoke	(Kl/sq.cm)	To be filled in	
4.17	Insulation level of:			
	• Core bolts.	kV	To be filled in	
	• Core bolts washer.	kV	To be filled in	
	• Side plates.	kV	To be filled in	
	• Core laminations.	kV	To be filled in	
4.18	Current destiny in windings for:			
	• H.V. winding	(Amps/sq.cm)	To be filled in	
	• L.V. winding	(Amps/sq.cm)	To be filled in	
4.19	Insulation on copper.	kV	To be filled in	
4.20	Insulation strength of winding.			
	a) Impulse full wave for:			
	(I) H.V.	(kV)	To be filled in	
	(II) L.V.	(kV)	To be filled in	
	b) Impulse chopped wave for:			
	(I) H.V.	(kV)	To be filled in	
	(II) L.V.	(kV)	To be filled in	
	c) Applied voltage test	(kV)	To be filled in	
	d) Induced voltage test	(kV)	To be filled in	
4.21	Insulation strength of terminals.			
	• Over voltage test	(kV)	To be filled in	
	• Minimum wet withstand voltage	(kV)	To be filled in	
	• Minimum impulse withstand	(kV)	To be filled in	
	• Minimum puncture or oil-immersed withstand voltage	(kV)	To be filled in	

4.22	Type of core		To be filled in	
4.23	Max. noise level at 0.3 meter	(dB)	55	
4.3	Type of oil (As per IEC requirement)		Yes	
4.4	Standards		IEC 60296	
4.5	Type of corrosion protection			
	• Inside tank		To be filled in	
	• Outside tank		To be filled in	
4.6	Type of valves		Clobe or gate valve	
5	**Dimension And Weight**			
5.1	Dimension of Transformer			
	• Under base to top most point.	mm	To be filled in	
	• Under base to bushing mounting flanges.	mm	To be filled in	
	• Overall breadth.	mm	To be filled in	
	• Overall length.	mm	To be filled in	
	• Crane lift for untanking core and coils	mm	To be filled in	
	• Crane lift for removal of bushings	mm	To be filled in	
5.2	Overall shipping dimensions of the largest package	mm	To be filled in	
5.3	Thickness of transformer tank			
	• Sides.	(mm)	To be filled in	
	• Bottom.	(mm)	To be filled in	
	• Corrugated radiators.	(mm)	To be filled in	
5.4	Volume of insulating oil	(liter)	To be filled in	
5.5	Net weight of insulating oil	(Kg)	To be filled in	
5.6	Total weight of transformer less oil	(tons)	To be filled in	
5.7	Weight of the largest shipping package	(tons)	To be filled in	
5.8	Net weight of core	(Kg)	To be filled in	
5.9	Net weight of copper			
	• H.V.	(Kg)	To be filled in	
	• L.V.	(Kg)	To be filled in	
5.10	Net untanking weight of:			
	• Core	(Kg)	To be filled in	
	• Frame	(Kg)	To be filled in	
	• Coil	(Kg)	To be filled in	

Schedule "B"
Oil Characteristics Table (To be filled by the Tenderer).

No.	Description	Unit	Specifications	
			Required	Proposed
1	Name of manufacturer		To be filled in	
	Country of manufacturing		To be filled in	
	Type		To be filled in	
	Standards		IEC 60296	
2	Reference Name of Oil		To be filled in	
3	Sludge Value	%	0	
4	Flash Point (Closed)	^{0}C	To be filled in	
5	Pour Point	^{0}C	To be filled in	
6	Viscosity at 21^0 C	CST	To be filled in	
7	Breakdown voltage (after treatment)	kV	>60 ex works (>70 upon treatment)	
8	Acidity(Neutralization Value): • Total • Inorganic	mgKOH/g	To be filled in	
9	Saponification Value	mgKOH/g	To be filled in	
10	Copper Diceleration		To be filled in	
11	Crackle		To be filled in	
12	Specific Gravity		To be filled in	
13	Sulfur Content		To be filled in	
14	Dielectric Dissipation Factor at 90 °C (after treatment)		≤ 0.001	


D 05 50
C 03 0
600
1900
F 03 20+B 04 02
B 05 30
G 01 05
J 01
De
A
3100
H 03 10
F 02 XX
E 03 40
B 05 30
B 05 28
B
B
B 05 05
A 02 25
2300
B 05 45
F 03 60 + F 03 65
G.L
G.L
1800
H 03 20
Min 3000
2000
500
Neutral earth
LA.&TR. body earth
10
9
8
7
6
5

COMMISSION of ELECTRICITY
Planning and Studies division
Baghdad – IRAQ

Specification NO.	D-47

Technical Specification

OF

ALMINUM – BARE WIRES

REVISION	Year 2001		

STATE COMPANY FOR ELECTCITY DISTRIPUTION FOR MIDDLE

AL- BARE WIRES

1. SCOP OF THE TENDER: -

This tender includes for the manufacturing, testing, packing, and shipping delivery exworks, FOP & CIF of bare conductors.

2. GENERAL REQUIRMENT: -

The materials shall be of first class quality and designed for continuos 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 conditions.

2-1 Ambient temperature:

Highest maximum in the shade 50C^{o} for about 6 hours a day.
Lowest minimum (-10) C^{o}.
Maximum yearly average (+ 30) C^{o}.
Maximum daily average (+ 40) C^{o}.

2-2 Sun temperature:

Black objects under direct sunshine attain a temperature of 75 C^{o}.

2-3 Air humidity:

Maximum	92% at 40C^{o}
Minimum	12%
Yearly average	44%

2-4 Altitudes:

From sea Laval up to (1000 m).

3. TECHNICAL REQUIREMENT:

3-1 STANDARDS:

3.1.1. The bare aluminum conductor shell be in accordance with the latest issues DIN (48201) and IEC (207) publication.

3.1.2. The aluminum conductors, steel reinforced shall be in accordance with the latest issues of the DIN (48204) & IEC (209) publication.

3.1.3. The copper conductors shall be in accordance with the latest issues of BSS 125.

3-2 DEVIATIONS:

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

4. GENERAL CONDUCTOR CHARACTERISTICS:

4-1 The bare copper conductor should be composed of stranded hard drawn electrolytic copper conductor of 99.97% purity.

4-2 The bare aluminum conductor should be composed of stranded hard drawn aluminum.

4-3 The A.C.S.R conductor shall have bare stranded hard drown aluminum conductor's steel reinforced. The conductors shall be internally protected with appropriate grease suitable for a working temperature of 80C^{o}.

4-4 Packing

The required conductor lengths are to be supplied on seaworthy wooden drums of lengths as specified in item 5.

The drums should be steel reinforced radically and round the borehole after winding the conductor on the drum, it should be covered with suitable stand. Wooden lagging the overall construction must be of robust. Quintile to withstand rough handling.

The drum should have a nameplate stating the following in both English and Arabic languages.

a- Type & size of conductor.
b- Net weight & gross weight.
c- Total length of conductor on the drum.
d- Our purchase order number.

5. TYPE OF CONDUCTOR:

5-1 Copper conductor

For this conductor, the applicable paragraphs of article 4 are: 4.1 & 4.4

The sizes of conductor required are as follows:

- 16 mm^2, conductor details 7/1.75 mm & 3000 m $\pm$ 2% per drum.
- 25 mm^2, conductor details 19/1.32 mm & 3000 m $\pm$ 2% per drum.
- 50 mm^2, conductor details 19/1.8 mm & 2000 m $\pm$ 2% per drum.
- 70 mm^2, conductor details 19/2.1 mm & 2000 m $\pm$ 2% per drum.
- 95 mm^2, conductor details 19/2.5 mm & 1500 m $\pm$ 2% per drum.

5-2 AL – Aluminum conductor - AAC

For this conductor, the applicable paragraphs of article 4 are: 4.2 & 4.4

The sizes of conductor required are as follows:

- 95 mm^2 19/2.5 mm & 2000 m $\pm$ 2% per drum.
- 70 mm^2 19/2.1 mm & 3000 m $\pm$ 2% per drum.
- 50 mm^2 19/1.8 mm & 3000 m $\pm$ 2% per drum.
- 35 mm^2 7/2.5 mm & 3000 m $\pm$ 2% per drum.

5-3 A. C. S. R conductor

For this conductor, the applicable paragraphs of article 4 are: 4.3 & 4.4

The sizes of conductor required are as follows:

- 210/35 AL 26/3.20 mm St 7/2.49 mm & 2000 m ± 2% per drum.
- 120/20 AL 26/2.44 mm St 7/1.90 mm & 2000 m ± 2% per drum.
- 95/15 AL 26/2.15 mm St 7/1.67 mm & 2000 m ± 2% per drum.

6. TECHNICAL INFORMATION:

The tenderer is requested to give the following information with his offer:

6-1 Nominal sectional area in sq. mm.

6-2 Stranding details i.e. number of strands and strand diameter.

6-3 Sectional and overall diameter.

6-4 Weight of conductor in Kg. Per Km – in case of ACSR the weight of steel is also to be given.

6-5 Percentage conductivity at 20 C^o.

6-6 Percentage elongation.

6-7 Minimum breaking strength.

6-8 Maximum resistance at 20 C^o.

6-9 Maximum permanent current carrying capacity under Iraqi climatic conditions (A).

6-10 (1) sec. Short – circuit current carrying capacity (KA).

7. TESTS:

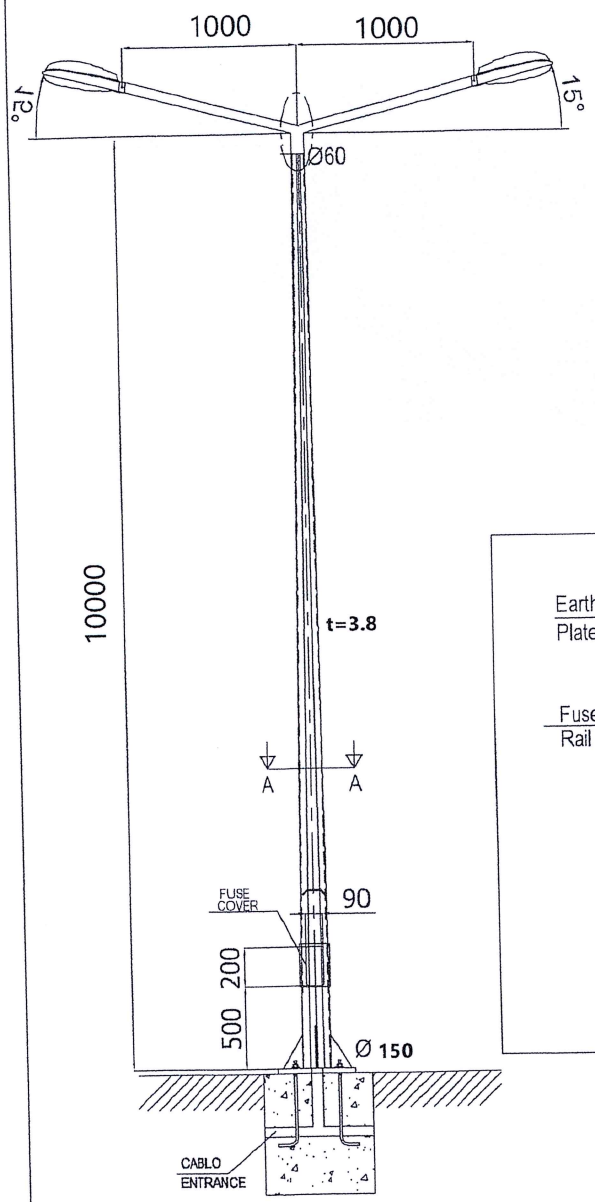
7-1 All tests are to be carried out according to the relevant specifications.

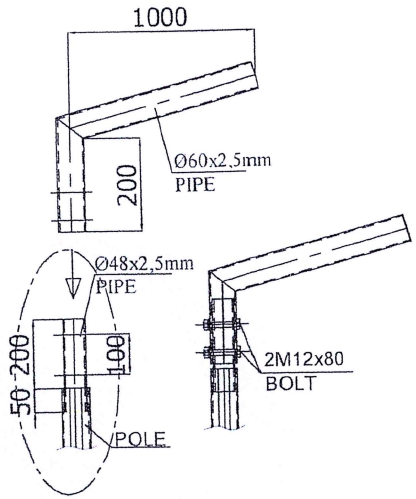
7-2 The tests shall be carried out in the presence of an authorized body appointed and paid by you to verify the compliance with the specifications. The contractor shall at his own expense, provide all necessary-testing facilities at his work for carrying out the requested tests.

7-3 The test repots shall contain clear and detailed references to the relevant IEC recommendations and national standards, comparing the requested values and the actual ones.

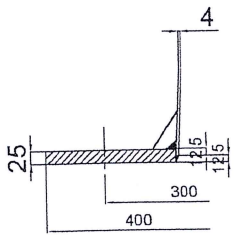
NOTE

- The prices for Aluminum should be based on L. M. E USD 1600/MT.
- Variation formula should be stated clearly to indicate the price.
- Variation related to Km of manufactured conductors.

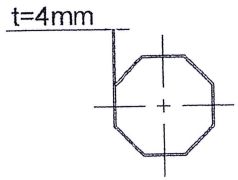




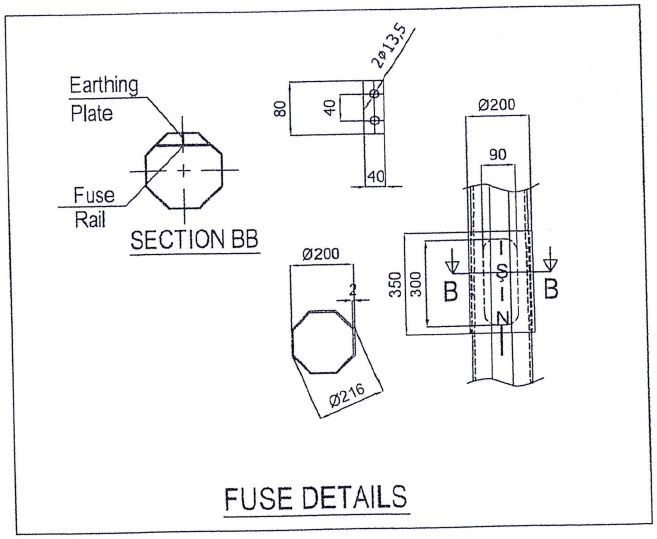
SINGLE BRACKET ARM DETAIL



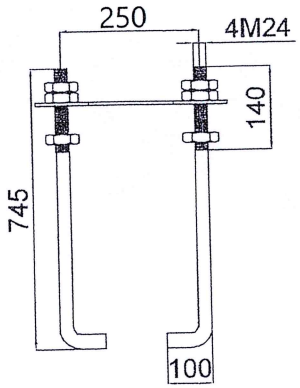
BASE PLATE
WELDING DETAIL



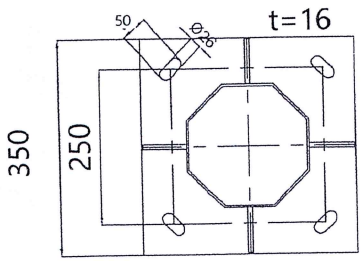
SECTION AA



FUSE DETAILS



ANCHOR BOLT



BASE PLATE

TECHNICAL SPECIFICATION

1- Unless otherwise specified, all dimensions are in mm.
2- Columns are manufactured in compliance to EN40
3- Materials;
- 3.1 For shaft EN 10025 Steel grade is S235 JR (ST 37)
- 3.2 Anchor bolts grade 1040
- 3.3 Brackets pipes ST 37
- 3.4 All screws, nuts, bolts steel grade ISO 4016

4- Hot dip galvanization as per ENISO 1461/ASTM A123

PROJECT NAME	10 m Octagonal Lighting Pole AD1		
	DRAWN BY	CONTROL	APPROVE
	TUGBA KALCI	ETEM M.YILMAZ	ZAFER KORKMAZ
DATE	DRAWING NO	REVISION	SCALE
	T16-090	00	NTS