Saudi Electricity Company	الشركة السعودية للكهرباء

SEC DISTRIBUTION MATERIALS SPECIFICATION	20-SDMS-01, Rev. 02
	DATE: 26-11-2008G

20-SDMS-01

REV. 02

SPECIFICATIONS

FOR

OCTAGONAL STEEL POLES

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1.0 SCOPE

This SEC Distribution Material Specification (SDMS) specifies the minimum technical requirement for design, engineering, manufacturing, inspection, testing and performance of Octagonal Steel Poles intended to be used in the medium and low voltage system (MV/LV) of Saudi Electricity Company (SEC).

2.0 CROSS REFERENCES

The Material Standard Specification shall be read in conjunction with SEC General Specification No. 01-SDMS-01 (latest revision) for General Requirement for all Equipment/Materials as an integral part of this SDMS.

This SDMS shall also be read in conjunction with SEC purchase order requirements.

3.0 APPLICATION CODES AND STANDARDS

The latest revision of the following codes and standards shall be applicable for the equipment/materials covered in this SDMS. In case of any deviation, the vendor/manufacturer may propose equipment/materials conforming to alternate codes or standards. However, the provisions of this specification shall supersede the provisions of these alternate standards in case of any difference.

3.1	SASO/SSA 39	Mechanical testing of welded joints
3.2	SASO/SSA 107	Tensile steel testing
3.3	SASO/SSA 157	Charpy method of impact test on metals
3.4	ASTM	A36MStandard Specification for Carbon Structural Steel
3.5	ASTM A123	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings of Iron and Steel Products
3.6	ASTM A143	Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
3.7	ASTM A153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

3.8	ASTM	A215	Martensitic Stainless Steel and Alloy Steel Castings for Pressure Containing Parts Suitable for High Temperature Service
3.9	ASTM	A239	Standard Test Method for Locating the Thinnest Spot in a Zinc (Galvanized) Coating on Iron or Steel Articles by the Preece Test (Copper Sulfate Dip)
3.10	ASTM	A307	Standard Specification for Carbon Steel Bolts and Studs, 60000 PSI Tensile Strength
3.11	ASTM	A320	Alloy-Steel Bolting Materials for Low Temperature
3.12	ASTM	A351	Austenitic Steel Castings for High Temperature Service
3.13	ASTM	A325	Standard Specification for Structural Bolts, Steel, Heat-Treated, 120/105 PSI Minimum Tensile Strength
3.14	ASTM	A354	Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs and Other Externally Threaded Fasteners
3.15	ASTM	A370	Standard Test Methods and Definitions for Mechanical Testing of Steel Products
3.16	ASTM	A384	Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
3.17	ASTM	A385	Standard Practice for Providing High Quality Zinc Coatings (Hot-Dip)
3.18	ASTM	A394	Standard Specification for Carbon and Alloy Steel Nuts
3.19	ASTM	A490	Quenched and Tempered Alloy Steel Bolts for Structural Steel Joints
3.20	ASTM	A537	Pressure Vessel Plates, Heat Treated, Carbon-Manganese-Silicon

3.21	ASTM	A572	High-Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality
3.22	ASTM	A588	Standard Specification for High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4-inch (100 mm) Thick
3.23	ASTM	A633	Standard Specification for Normalized High-Strength Low-Alloy Structural Steel Plates
3.24	ASTM	A673	Standard Specification for Sampling Procedure for Impact Testing of Structural Steel
3.25	ASTM	A687	Standard Specification for High-Strength Non-Headed Steel Bolts and Studs
3.26	ASTM	A577M	Standard Specification for Ultrasonic Angle Beam Examination of Steel Plates
3.27	ASTM	A578M	Standard Specification for Ultrasonic Straight Beam Examination of Plain and Clad Steel Plates for Special Application
3.28	ASTM	E165	Standard Test Method for Liquid Penetrant Examination
3.29	ASTM	E709	Standard Guide for Magnetic Particle Examination
3.30	ASCE	72	Guide for Design of Steel Transmission Pole Structures
3.31	AISC		Manual of Steel Construction, 9th Edition
3.32	AWS	D1.1	Structural Welding Code, Steel
3.33	AWS	D10.9	Specification for Qualification of Welding Procedures and Welders for Piping and Tubing
3.34	NEMA	TT-1	Tapered Tubular Steel Structures
3.35	ISO	630	Standards for Structural Steels
3.36	ISO	R657	Recommendation for Hot-Rolled Steel Sections

3.37	ISO	1459	Metallic Coatings - Protection Against Corrosion by Hot Dip Galvanizing - Guiding Principles
3.38	ISO	1460	Metallic Coatings - Hot-Dip Galvanized Coatings on Ferrous Materials - Gravimetric Determination of the Mass per Unit Area
3.39	ISO	1461	Metallic Coatings - Hot Dip Galvanized Coatings on Fabricated Ferrous Products - Requirements
3.40	ISO	3575	Continuous Hot-Dip Zinc-Coated Carbon Steel Sheet of Commercial, Lock-Forming and Drawing Qualities
3.41	ISO	4997	Cold-Reduced Steel Sheet of Structural Quality
3.42	ISO	4998	Continuous Hot-Dip Zinc-Coated Carbon Steel Sheet of Structural Quality
3.43	ISO	7413	Hexagon Nuts for Structural Bolting, Style 1, Hot-Dip Galvanized (Oversize Tapped) - Product Grades A and B - Property Classes 5, 6 and 8
3.44	ISO	7417	Hexagon Nuts for Structural Bolting - Style 2, Hot-Dip Galvanized (Oversize Tapped) - Product Grade A - Property Class 9

4.0 SERVICE AND SYSTEM CONDITIONS

The poles shall be suitable for operation under the service conditions given in the latest revision of SEC General Specification No. 01-SDMS-01.

5.0 DESIGN, MATERIALS AND FABRICATION

5.1 General

5.1.1 The galvanized steel poles shall be in a single piece of required length. Their cross sectional shapes shall be tapered octagonal and conform to dimensions given in the tables and drawings in this specification.

5.1.2 Poles shall satisfy the dimensional length and pole top loading requirements as per the design parameters listed in this specification. The dimensions across flats for top and bottom for all poles are listed in this specification as a preferred design to utilize one dimension for each type of pole length in so far as design criteria is met.

5.1.3 Poles shall be pre-drilled and supplied complete with pole top cap and base plate.

5.2 Design

5.2.1 Types, dimensions and characteristics of standard steel poles included in this specification are given in Table 1.

5.2.2 Applications of the standard steel poles are given in Tables 2 and 3.

5.2.3 The standard poles shall be suitable for the specified applications based on the design parameters given in Tables 4 and 5.

5.2.4 Poles are designed to withstand the worst possible combination of simultaneous loading of:

- Lateral loads consisting of wind forces on conductors corresponding to wind spans, wind force on insulators, wind force on pole and maximum conductor tension.
- Vertical loads consisting of pole self-weight, weights of conductors, insulators, cross-arm, additional equipment, lineman and compressive force due to reaction of stays wherever applicable.

5.2.5 The maximum design unit stress shall not exceed the minimum yield stress as stated in this specification for the particular application and types of loads, including overload capacity factors.

Table 1
Types, Dimensions and Characteristics of Standard Octagonal Steel Poles

Pole Type	Brief Description	Top Across Flat Dia. (mm)	Bottom Across Flat Dia. (mm)	Shaft Thick-ness (mm)	Shaft Weight (kg)	Ultimate Load (Kg)	Color Code (No. of Bands)
OC10	10m Steel Pole, Low Voltage	100	345	4	227	803	White (1)
OC13S	13m Steel Pole, Medium Voltage, Single Circuit	155	410	4	377	1530	Red (1)
OC14S	14m Steel Pole, Medium Voltage, Single Circuit	155	430	4	420	1564	Yellow (1)
OC14D	14m Steel Pole, Medium Voltage, Double Circuit	155	600	4	544	2431	Yellow (2)
OC15S/D	15m Steel Pole, Medium Voltage, Single & Double Circuit	155	450	4	466	1545	Green (1)
OC10SFS	10m Steel Pole, Self Support, Low voltage	230	590	5	527	4968	White (3)
OC13SFS	13m Steel Pole, Self Support, Single Circuit	230	750	7	1143	8781	Red (3)
OC14SFS	14m Steel Pole, Self Support, Single Circuit	230	790	7	1282	8874	Yellow (3)
OC15SFS	15m Steel Pole, Self Support, Single Circuit	230	830	7	1429	8898	Green (3)

Table 2
Applications of Standard Octagonal Steel Poles For Single Circuit Lines

Pole Type	Pole Structure	Angle of Deviation (Degrees)	No. of Stays/Location From Top (mm)	Buried Depth (mm)	Crossarm Location From Top (mm)
OC10	Intermediate, LV	0 - 15	N/A	1500	N/A
	Medium Angle, LV	16 - 60	1 @ 150	1500	N/A
	Heavy Angle, LV	61 - 90	1 @ 150	1500	N/A
	Terminal, LV	-	1 @ 150	1500	N/A
OC13S OC14S OC15S/D	Intermediate, MV	0 – 5	N/A	2000	50
	Light Angle, MV	6 – 15	1 @ 250	2000	50
	Medium Angle, MV	16 –60	1 @ 250 & 1 @ 350	2000	50
	Heavy Angle, MV	61 – 90	1 @ 250 & 1 @ 350	2000	50
	Section, MV	-	2 @ 250 along the line	2000	50
	Terminal, MV	-	1 @ 250 & 1 @ 350	2000	50
OC10SFS *	Self-Support, LV	16 - 90	N/A	1500	N/A
OC13SFS * OC14SFS * OC15SFS *	Self-Support, MV	6 - 90	N/A	2000	50

* For the installation of the above specified angles without guy support.

Table 3
Applications of Standard Octagonal Steel Poles For Double Circuit Lines

Pole Type	Pole Structure	Angle of Deviation (Degrees)	No. of Stays/Location From Top (mm)	Buried Depth (mm)	Crossarm Location From Top (mm)
OC14D	Intermediate, MV	0 – 5	N/A	2000	50, 1250 & 2450
	Light Angle, MV	6 – 15	1 @ 250 & 1 @ 350	2000	50, 1250 & 2450
	Medium Angle, MV	16 –60	1 @ 250, 1 @ 350, 1 @ 2650 & 1 @ 2750	2000	50, 1250 & 2450
	Heavy Angle, MV	61 – 90	1 @ 250, 1 @ 350, 1 @ 2650 & 1 @ 2750	2000	50, 1250 & 2450
	Section, MV	-	2 @ 250 & 2 @ 2650 along the line	2000	50, 1250 & 2450
	Terminal, MV	-	1 @ 250, 1 @ 350, 1 @ 2650 & 1 @ 2750	2000	50, 1250 & 2450
OC15S/D	Intermediate, MV	0	N/A	2000	50, 1250 & 2450
	Light Angle, MV	1 – 15	1 @ 250 & 1 @ 350	2000	50, 1250 & 2450
	Medium Angle, MV	16 –60	1 @ 250, 1 @ 350, 1 @ 2650 & 1 @ 2750	2000	50, 1250 & 2450
	Heavy Angle, MV	61 – 90	1 @ 250, 1 @ 350, 1 @ 2650 & 1 @ 2750	2000	50, 1250 & 2450
	Section, MV	-	2 @ 250 & 2 @ 2650 along the line	2000	50, 1250 & 2450
	Terminal, MV	-	1 @ 250, 1 @ 350, 1 @ 2650 & 1 @ 2750	2000	50, 1250 & 2450

Table 4
Design Parameters for Single Circuit LV and MV (with Earth Wire) Line

Description		10m	12m, 13m, 14m and 15m
Span (m)	Basic Wind Weight	50 55 75	100 110 150
Wind Pressure (N/m²)	On Pole On Conductors at 10ºC	1200 600	1200 600
Factor of Safety	Vertical Loads Transverse Loads Longitudinal Loads Ultimate Load Conductor Minimum Breaking Strength	1.5 1.5 1.5 1.5 3.0	1.5 1.5 1.5 1.5 3.0
Planting Depth (m)		1.5	2.0
Type of Structure	Unstayed Stayed Stayed Stayed Stayed Unstayed	Intermediate (0-15º) - Med. Angle (16-60º) Heavy Angle (61-90º) - Terminal Self-Support (90º)	Intermediate (0-5º) Light Angle (6-15º) Med. Angle (16-60º) Heavy Angle (61-90º) Section Terminal Self-Support (90º)
Allowable Deflection at Pole Top		5% of exposed length	5% of exposed length
Conductors	Phase Earth Wire	120 mm² Quadruplex Cable (3 – Insulated AAC for Phase & 1 – Bare ACSR/AW Messenger-Neutral) N/A	170 mm² ACSR/AW (Merlin) in horizontal configuration 70 mm² ACSR/AW (Quail) for Branch 70 mm² ACSR/AW (Quail) below crossarm
Stay Wires	Minimum Breaking Load Max. Tension Minimum Angle to the Pole	65 kN 90 % of Min. Breaking Load 37º	101 kN 90 % of Min. Breaking Load 37º
Temperature	Minimum Maximum	-2ºC +80ºC	-2ºC +80ºC

Table 5
Design Parameters for Double Circuit MV (with Earth Wire) Line

Description		14m	15m
Span (m)	Basic	100	100
	Wind	110	110
	Weight	150	150
Wind Pressure (N/m^2)	On Pole	1200	1200
	On Conductors at 10ºC	600	600
Factor of Safety	Vertical Loads	1.5	1.5
	Transverse Loads	1.5	1.5
	Longitudinal Loads	1.5	1.5
	Ultimate Load	1.5	1.5
	Conductor Minimum Breaking Strength	3.0	3.0
Planting Depth (m)		2.0	2.0
Type of Structure	Unstayed	Intermediate (0-5º)	Intermediate (0º)
	Stayed	Light Angle (6-15º)	Light Angle (1-15º)
	Stayed	Med. Angle (16-60º)	Med. Angle (16-60º)
	Stayed	Heavy Angle (61-90º)	Heavy Angle (61-90º)
	Stayed	Section	Section
	Stayed	Terminal	Terminal
Allowable Deflection at Pole Top		5% of exposed length	5% of exposed length
Conductors	Phase	170 mm^2 ACSR/AW (Merlin) in vertical configuration	170 mm^2 ACSR/AW (Merlin) in vertical configuration
	Earth Wire	70 mm^2 ACSR/AW (Quail) below crossarm	70 mm^2 ACSR/AW (Quail) below crossarm
Stay Wires	Minimum Breaking Load	101 kN	101 kN
	Max. Tension	90 % of Min. Breaking Load	90 % of Min. Breaking Load
	Minimum Angle to the Pole	37º	37º
Temperature	Minimum	-2ºC	-2ºC
	Maximum	+80ºC	+80ºC

5.3 Materials

5.3.1 Structural steel for pole shaft shall comply with the applicable requirements of ASTM A572 or equivalent with mechanical properties as given below:

- Minimum yield strength - 355 N/mm²
- Minimum ultimate tensile strength - 490 N/mm²
- Max. ultimate tensile strength - 620 N/mm²

5.3.2 Structural steel for bearing plate and top cap shall comply with the applicable requirements of ASTM A36 or equivalent with minimum yield strength of 250 N/mm².

5.3.3 Pole shaft, bearing plate and top cap shall be hot-dipped galvanized after fabrication, including all drilling, cutting and welding. Galvanizing shall be done in accordance with the requirement of 01-SDMS-01 and the minimum average thickness of coating shall be 0.086 mm, equivalent to 610 g/m².

5.3.4 Bolts, nuts and locknuts for top cap, bearing plate and earthing nut shall be steel Grade 4.6 and shall comply with the applicable requirements of ASTM A307 and ASTM A 563 or equivalent and hot-dipped galvanized in accordance with the requirement of 01-SDMS-01 with minimum average coating thickness of 0.053 mm, equivalent to 381 g/m².

5.3.5 Weld material shall be compatible with the material of the pole as defined by American Welding Society.

5.4 Fabrication

5.4.1 Shearing and cutting shall be performed carefully and all portions of the work shall be finished neatly. Copes and re-entrant cuts shall be filleted before cutting.

5.4.2 All forming and bending during fabrication shall be done by method that will prevent embrittlement or loss of strength in the material being worked.

5.4.3 All welding operations shall be done in accordance with the American Welding Society, AWS D1.1.

5.4.4 Bolt holes as specified in the applicable drawings shall be punched or drilled. Holes may be punched when the material thickness does not exceed the diameter of the hole. Holes of any diameter may be drilled. Holes shall be cylindrical, perpendicular to the pole shaft, free of burrs, and clean cut without torn or ragged edges. The use of burning torch for cutting holes will not be permitted.

5.4.5 Extra holes for the purpose of lifting or other than those specified in the drawings shall not be permitted.

5.4.6 All pre-drilled holes shall be provided with durable ultra-violet resistant, plastic plugs.

5.4.7 Steel pole shall be provided with M12 earthing nut at the location specified in applicable drawing. Hot-dipped galvanized M12 x 30 mm long hexagonal bolt with washer shall be screwed on to the earthing nut.

5.4.8 Steel poles shall be provided with detachable top cap and base bearing plate. Flat bar with drilled and tapped hole to suit M12 bolt shall be welded to the top and bottom of the pole for attaching the top cap and base bearing plate, respectively. Hot-dipped galvanized M12 x 30 hexagonal bolts and washers shall be provided for attaching the top cap and base plate.

5.4.9 The following tolerances shall apply:

- +/-0.5 % for overall length
- +/- 5 mm for A/F diameter
- +/- 2 mm for center-to-center distance between holes
- +/- 0.5 mm for diameter of pre-drilled holes

5.4.10 Straightness of the pole shaft shall be within 1 mm/m and without any twist.

5.5 Marking

5.5.1 Each pole shall be provided with 80 mm x 80 mm nameplate riveted to the shaft at the location specified in applicable drawing. All markings shall be legible and so applied to remain legible under normal handling and installation practices. Nameplate shall include, but not limited to the following information:

- SEC Monogram
- Pole Type
- Pole Ultimate Load
- Pole Dimension (A/F Top/Bottom/Thickness)
- Pole Weight
- SEC Purchase Order Number
- SEC Stock Number
- Manufacturer's Name or trademark, place and year of manufacturing.

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Pole Type:
Pole Ultimate Load:
Pole Dimensions:
Shaft Weight:
SEC P.O. No.
SEC Stock No.
Manufacturer:
Year of Manufacture:
Made in:

5.5.2 Each pole shall be provided with color coding consisting of 50 mm wide band with the following color painted to the pole at the location specified in applicable drawing:

- 10 m Single Circuit - White
- 13 m Single Circuit - Red

- 14 m Single Circuit - Yellow
- 15 m Single Circuit - Green
- Double Circuit – Same color as the above except double band 50 mm apart.
- Self-Support – Same color as the above except triple band 50 mm apart.

6.0 INSPECTION AND TESTING

In addition to the requirements specified in 01-SDMS-01, the following shall be fulfilled:

6.1 The Supplier shall make adequate tests and inspections to determine the conformity of material furnished under this Specification with the requirements invoked. SEC or its designated representative will conduct acceptance inspection and witness testing at the manufacturer's plant.

6.2 Inspection/Routine Test Requirements

6.2.1 Inspection / routine tests shall be in accordance with NEMA Standard TT-1 for Tapered Tubular Steel Structure.

6.2.2 Visual inspection shall include checks for satisfactory workmanship, materials, freedom from surface defects and for compliance with the Purchase Order and the General Specifications.

6.2.3 SEC designated representative shall have free access at all times while work is being carried on, to all areas of the Supplier's plant which concern the work.

6.2.4 Inspection/routine tests may be made during all stages of manufacturing, testing and shipping. Inspection may be at the point of shipment or delivery site at SEC option. However, inspection and acceptance shall not relieve the Supplier of his responsibility for conformance with this specification.

6.2.5 Proof Load Test (Horizontal Testing)

The tubular steel poles shall be proof tested in accordance with applicable standards. One pole of each design for every consignment shall be tested as per the manufacturer's testing procedure approved by SEC.

Manual application of load during testing shall not be allowed. Digital dynamometer shall be used to obtain accurate readings.

The proof test will verify the adequacy of steel pole to withstand the static design loads specified for that structure as an individual entity under controlled conditions.

In the event of any one pole not fulfilling the test requirements, further two shall be tested. Should either of these fail, the whole order of the particular type of pole shall be deemed to have failed to comply with this specification.

6.3 Type Testing Requirements

All materials shall be type tested in accordance with the latest standards in this specification.

Following the completion of all tests, two certified copies of the test reports shall be submitted to SEC for review and approval.

6.3.1 Full-scale Loading Test (Vertical Testing)

When SEC desires full scale loading tests, it shall be as stated in the Data Schedule. The Supplier shall then include in his proposal, as a separate item, the cost of the tests.

Full scale loading test shall be in accordance with the applicable standards. The Supplier shall submit for approval by SEC diagrams showing the proposed scheme for applying and measuring loads and determining deflections of critical points.

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6.3.2 Deflections (During Pole Test)

Pole deflections under load shall be measured and recorded. Deflection readings shall be recorded for the "before-load", "load-on" and "load-off" conditions as well as at all intermediate holds during loading. All

deflections shall be performed to common base readings, such as the initial positions, taken before any test loads are applied.
A no-load deflection reading shall be taken five minutes after the removal of the maximum test load, the reading shall not exceed the allowable deflection (5% of the exposed length).

6.3.3 Test Reports

The Supplier shall furnish a full and comprehensive report of each pole test and shall include detailed diagrams and tabulation showing values and methods of load application and deflection records of each load test, photographs of test set up and description (with photographs) of all failures, if any.
Include mill test reports of the material used and the results of any tensile tests of specimens cut from any members, which failed during the testing program. Particular emphasis shall be placed on the determination of the mechanical properties of the material.

6.3.4 Test Acceptance

The Supplier, upon receipt of written acceptance from SEC for the satisfactory performance of the pole loading tests, may start fabrication of the steel poles.

7.0 PACKING AND SHIPMENT

In addition to the packing and shipping requirements specified in 01-SDMS-01, the following shall be fulfilled:

7.1 The poles shall be stacked with spacers and blocks in order to avoid damages of zinc coating during the loading and transportation.

7.2 Poles shall be delivered in bundles of 6 poles with the arrangement of 2 layers, with 3 poles per layer, and strapped at four (4) locations of equal distances with the use of steel straps size 31 mm x 0.8 mm (min.) and necessary wood separators, padding or cushion material underneath the steel straps.

7.3 Wooden separators shall be provided between the horizontal and vertical layers of poles to avoid scratches and to facilitate slinging.

7.4 Bundled poles shall be so arranged such that the earthing hardwares are not disturbed during normal handling.

7.5 Reasonable care shall be exercised in the handling and shipment of steel poles. Any expense incurred due to the careless handling and shipment of steel poles shall be considered as a legitimate back charge against the Supplier.

8.0 GUARANTEE

8.1 The vendor shall guarantee the steel pole against all defects arising out of faulty design or workmanship or defective material for a period of one year from the date of installation or two years from date of delivery. SEC certificates for date of commissioning shall be accepted.

8.2 If no exceptions to this specification is taken and no list of deviations is submitted, it shall be deemed that, in every respect, steel pole offered shall conform to this Specification. SEC interpretation of this Specification shall be accepted.

9.0 SUBMITTALS

9.1 In addition to documentations specified in 01-SDMS-01, the following shall be submitted by the vendor/manufacturer:

9.1.1 Design information and drawings to be supplied with the proposals:

a) Detailed drawings of steel pole showing the complete dimensions identification marks, number and location of pre-drilled bolt holes, details of pole top cap, bearing plate, hole plastic plug, earthing nut and marking plate.

b) Detailed drawing/procedure for bundling of poles.

c) Details of anti-corrosion coating

9.1.2 Submittals required following award of contract:

a. Drawings for final SEC approval shall be submitted prior to start of manufacturing. Supplier shall furnish all final drawings in original or Mylar tracings as well as on digital format.

b. Manufacturing schedule, progress report and test schedules.

c. Test reports including, but not limited to, the following:

- Certified mill test reports for all material.
- Certified welding reports.
- Impact property test reports showing that the materials used in the structures meet the impact properties.
- Test reports on coating thickness, nuts & bolts and reports on dimensional checks.
- Report of all structure testing, when required, including photos, diagrams, loading trees, etc.

10.0 DATA SCHEDULE
OCTAGONAL STEEL POLE
(Sheet 1 of 10)

SEC Inquiry No. _____ SEC Stock No. _____

REF. SEC-TION	DESCRIPTION	SEC VALUES	VENDOR PROPOSED VALUES
5.2.1	Pole type	OC10	
5.2.1	Length, m	10	
5.2.1	Top A/F diameter, mm	100	
5.2.1	Bottom A/F diameter, mm	345	
5.2.1	Shaft thickness, mm	4	
5.2.1	Pole ultimate load, kg	803	
	Total weight (after galvanization), kg	*	
5.3.1	Standard designation/grade of steel for pole shaft	*	
5.3.1	Minimum yield stress of steel material for pole shaft, N/mm^2	355	
5.3.3	Minimum coating weight of hot-dip galvanizing of pole shaft, g/m^2	610	
5.3.4	Hot-dipped galvanized steel Grade 4.6 for bolts, nuts & locknuts of top cap, bearing plate and earthing nuts	As specified	
5.4.6	All pre-drilled holes provided with U.V. resistant, plastic plugs	As specified	
5.4.7	M12 x 30 mm bolt and washer for earthing nut	As specified	
5.4.8	M12 x 30 mm bolt with washer for attaching top cap and bearing plate	As specified	
5.4.9	Tolerances	As specified	
5.4.10	Straightness of the pole	As specified	
5.5.1	Name plate with complete information	As specified	
5.5.1	Name plate affixed to the pole by rivets	As specified	
5.5.2	Color Code (Number of bands)	White (1)	
9.0	Submittals as per this specification enclosed	As specified	

* Values to be provided/proposed by Vendor

10.0 DATA SCHEDULE
OCTAGONAL STEEL POLE
(Sheet 2 of 10)

SEC Inquiry No. _____ SEC Stock No. _____

REF. SEC-TION	DESCRIPTION	SEC VALUES	VENDOR PROPOSED VALUES
5.2.1	Pole type	OC13S	
5.2.1	Length, m	13	
5.2.1	Top A/F diameter, mm	155	
5.2.1	Bottom A/F diameter, mm	410	
5.2.1	Shaft thickness, mm	4	
5.2.1	Pole ultimate load, kg	1530	
	Total weight (after galvanization), kg	*	
5.3.1	Standard designation/grade of steel for pole shaft	*	
5.3.1	Minimum yield stress of steel material for pole shaft, N/mm^2	355	
5.3.3	Minimum coating weight of hot-dip galvanizing of pole shaft, g/m^2	610	
5.3.4	Hot-dipped galvanized steel Grade 4.6 for bolts, nuts & locknuts of top cap, bearing plate and earthing nuts	As specified	
5.4.6	All pre-drilled holes provided with U.V. resistant, plastic plugs	As specified	
5.4.7	M12 x 30 mm bolt and washer for earthing nut	As specified	
5.4.8	M12 x 30 mm bolt with washer for attaching top cap and bearing plate	As specified	
5.4.9	Tolerances	As specified	
5.4.10	Straightness of the pole	As specified	
5.5.1	Name plate with complete information	As specified	
5.5.1	Name plate affixed to the pole by rivets	As specified	
5.5.2	Color Code (Number of bands)	Red (1)	
9.0	Submittals as per this specification enclosed	As specified	

* Values to be provided/proposed by Vendor

10.0 DATA SCHEDULE
OCTAGONAL STEEL POLE
(Sheet 3 of 10)

SEC Inquiry No. _____ SEC Stock No. _____

REF. SEC-TION	DESCRIPTION	SEC VALUES	VENDOR PROPOSED VALUES
5.2.1	Pole type	OC14S	
5.2.1	Length, m	14	
5.2.1	Top A/F diameter, mm	155	
5.2.1	Bottom A/F diameter, mm	430	
5.2.1	Shaft thickness, mm	4	
5.2.1	Pole ultimate load, kg	1564	
	Total weight (after galvanization), kg	*	
5.3.1	Standard designation/grade of steel for pole shaft	*	
5.3.1	Minimum yield stress of steel material for pole shaft, N/mm^2	355	
5.3.3	Minimum coating weight of hot-dip galvanizing of pole shaft, g/m^2	610	
5.3.4	Hot-dipped galvanized steel Grade 4.6 for bolts, nuts & locknuts of top cap, bearing plate and earthing nuts	As specified	
5.4.6	All pre-drilled holes provided with U.V. resistant, plastic plugs	As specified	
5.4.7	M12 x 30 mm bolt and washer for earthing nut	As specified	
5.4.8	M12 x 30 mm bolt with washer for attaching top cap and bearing plate	As specified	
5.4.9	Tolerances	As specified	
5.4.10	Straightness of the pole	As specified	
5.5.1	Name plate with complete information	As specified	
5.5.1	Name plate affixed to the pole by rivets	As specified	
5.5.2	Color Code (Number of bands)	Yellow (1)	
9.0	Submittals as per this specification enclosed	As specified	

* Values to be provided/proposed by Vendor

10.0 DATA SCHEDULE
OCTAGONAL STEEL POLE
(Sheet 4 of 10)

SEC Inquiry No. _____ SEC Stock No. _____

REF. SEC-TION	DESCRIPTION	SEC VALUES	VENDOR PROPOSED VALUES
5.2.1	Pole type	OC14D	
5.2.1	Length, m	14	
5.2.1	Top A/F diameter, mm	155	
5.2.1	Bottom A/F diameter, mm	600	
5.2.1	Shaft thickness, mm	4	
5.2.1	Pole ultimate load, kg	2431	
	Total weight (after galvanization), kg	*	
5.3.1	Standard designation/grade of steel for pole shaft	*	
5.3.1	Minimum yield stress of steel material for pole shaft, N/mm^2	355	
5.3.3	Minimum coating weight of hot-dip galvanizing of pole shaft, g/m^2	610	
5.3.4	Hot-dipped galvanized steel Grade 4.6 for bolts, nuts & locknuts of top cap, bearing plate and earthing nuts	As specified	
5.4.6	All pre-drilled holes provided with U.V. resistant, plastic plugs	As specified	
5.4.7	M12 x 30 mm bolt and washer for earthing nut	As specified	
5.4.8	M12 x 30 mm bolt with washer for attaching top cap and bearing plate	As specified	
5.4.9	Tolerances	As specified	
5.4.10	Straightness of the pole	As specified	
5.5.1	Name plate with complete information	As specified	
5.5.1	Name plate affixed to the pole by rivets	As specified	
5.5.2	Color Code (Number of bands)	Yellow (2)	
9.0	Submittals as per this specification enclosed	As specified	

* Values to be provided/proposed by Vendor

10.0 DATA SCHEDULE
OCTAGONAL STEEL POLE
(Sheet 5 of 12)

SEC Inquiry No. _____ SEC Stock No. _____

REF. SEC-TION	DESCRIPTION	SEC VALUES	VENDOR PROPOSED VALUES
5.2.1	Pole type	OC15S/D	
5.2.1	Length, m	15	
5.2.1	Top A/F diameter, mm	155	
5.2.1	Bottom A/F diameter, mm	450	
5.2.1	Shaft thickness, mm	4	
5.2.1	Pole ultimate load, kg	1545	
	Total weight (after galvanization), kg	*	
5.3.1	Standard designation/grade of steel for pole shaft	*	
5.3.1	Minimum yield stress of steel material for pole shaft, N/mm^2	355	
5.3.3	Minimum coating weight of hot-dip galvanizing of pole shaft, g/m^2	610	
5.3.4	Hot-dipped galvanized steel Grade 4.6 for bolts, nuts & locknuts of top cap, bearing plate and earthing nuts	As specified	
5.4.6	All pre-drilled holes provided with U.V. resistant, plastic plugs	As specified	
5.4.7	M12 x 30 mm bolt and washer for earthing nut	As specified	
5.4.8	M12 x 30 mm bolt with washer for attaching top cap and bearing plate	As specified	
5.4.9	Tolerances	As specified	
5.4.10	Straightness of the pole	As specified	
5.5.1	Name plate with complete information	As specified	
5.5.1	Name plate affixed to the pole by rivets	As specified	
5.5.2	Color Code (Number of bands)	Green (1)	
9.0	Submittals as per this specification enclosed	As specified	

* Values to be provided/proposed by Vendor

10.0 DATA SCHEDULE
OCTAGONAL STEEL POLE
(Sheet 6 of 12)

SEC Inquiry No. _____ SEC Stock No. _____

REF. SEC-TION	DESCRIPTION	SEC VALUES	VENDOR PROPOSED VALUES
5.2.1	Pole type	OC10SFS	
5.2.1	Length, m	10	
5.2.1	Top A/F diameter, mm	230	
5.2.1	Bottom A/F diameter, mm	590	
5.2.1	Shaft thickness, mm	5	
5.2.1	Pole ultimate load, kg	4968	
	Total weight (after galvanization), kg	*	
5.3.1	Standard designation/grade of steel for pole shaft	*	
5.3.1	Minimum yield stress of steel material for pole shaft, N/mm^2	355	
5.3.3	Minimum coating weight of hot-dip galvanizing of pole shaft, g/m^2	610	
5.3.4	Hot-dipped galvanized steel Grade 4.6 for bolts, nuts & locknuts of top cap, bearing plate and earthing nuts	As specified	
5.4.6	All pre-drilled holes provided with U.V. resistant, plastic plugs	As specified	
5.4.7	M12 x 30 mm bolt and washer for earthing nut	As specified	
5.4.8	M12 x 30 mm bolt with washer for attaching top cap and bearing plate	As specified	
5.4.9	Tolerances	As specified	
5.4.10	Straightness of the pole	As specified	
5.5.1	Name plate with complete information	As specified	
5.5.1	Name plate affixed to the pole by rivets	As specified	
5.5.2	Color Code (Number of bands)	White (3)	
9.0	Submittals as per this specification enclosed	As specified	

* Values to be provided/proposed by Vendor

10.0 DATA SCHEDULE
OCTAGONAL STEEL POLE
(Sheet 7 of 10)

SEC Inquiry No. _____ SEC Stock No. _____

REF. SEC-TION	DESCRIPTION	SEC VALUES	VENDOR PROPOSED VALUES
5.2.1	Pole type	OC13SFS	
5.2.1	Length, m	13	
5.2.1	Top A/F diameter, mm	230	
5.2.1	Bottom A/F diameter, mm	750	
5.2.1	Shaft thickness, mm	7	
5.2.1	Pole ultimate load, kg	8781	
	Total weight (after galvanization), kg	*	
5.3.1	Standard designation/grade of steel for pole shaft	*	
5.3.1	Minimum yield stress of steel material for pole shaft, N/mm^2	355	
5.3.3	Minimum coating weight of hot-dip galvanizing of pole shaft, g/m^2	610	
5.3.4	Hot-dipped galvanized steel Grade 4.6 for bolts, nuts & locknuts of top cap, bearing plate and earthing nuts	As specified	
5.4.6	All pre-drilled holes provided with U.V. resistant, plastic plugs	As specified	
5.4.7	M12 x 30 mm bolt and washer for earthing nut	As specified	
5.4.8	M12 x 30 mm bolt with washer for attaching top cap and bearing plate	As specified	
5.4.9	Tolerances	As specified	
5.4.10	Straightness of the pole	As specified	
5.5.1	Name plate with complete information	As specified	
5.5.1	Name plate affixed to the pole by rivets	As specified	
5.5.2	Color Code (Number of bands)	Red (3)	
9.0	Submittals as per this specification enclosed	As specified	

* Values to be provided/proposed by Vendor

10.0 DATA SCHEDULE
OCTAGONAL STEEL POLE
(Sheet 8 of 10)

SEC Inquiry No. _____ SEC Stock No. _____

REF. SEC-TION	DESCRIPTION	SEC VALUES	VENDOR PROPOSED VALUES
5.2.1	Pole type	OC14SFS	
5.2.1	Length, m	14	
5.2.1	Top A/F diameter, mm	230	
5.2.1	Bottom A/F diameter, mm	790	
5.2.1	Shaft thickness, mm	7	
5.2.1	Pole ultimate load, kg	8874	
	Total weight (after galvanization), kg	*	
5.3.1	Standard designation/grade of steel for pole shaft	*	
5.3.1	Minimum yield stress of steel material for pole shaft, N/mm^2	355	
5.3.3	Minimum coating weight of hot-dip galvanizing of pole shaft, g/m^2	610	
5.3.4	Hot-dipped galvanized steel Grade 4.6 for bolts, nuts & locknuts of top cap, bearing plate and earthing nuts	As specified	
5.4.6	All pre-drilled holes provided with U.V. resistant, plastic plugs	As specified	
5.4.7	M12 x 30 mm bolt and washer for earthing nut	As specified	
5.4.8	M12 x 30 mm bolt with washer for attaching top cap and bearing plate	As specified	
5.4.9	Tolerances	As specified	
5.4.10	Straightness of the pole	As specified	
5.5.1	Name plate with complete information	As specified	
5.5.1	Name plate affixed to the pole by rivets	As specified	
5.5.2	Color Code (Number of bands)	Yellow (3)	
9.0	Submittals as per this specification enclosed	As specified	

* Values to be provided/proposed by Vendor

10.0 DATA SCHEDULE
OCTAGONAL STEEL POLE
(Sheet 9 of 10)

SEC Inquiry No. _____ SEC Stock No. _____

REF. SEC-TION	DESCRIPTION	SEC VALUES	VENDOR PROPOSED VALUES
5.2.1	Pole type	OC15SFS	
5.2.1	Length, m	15	
5.2.1	Top A/F diameter, mm	230	
5.2.1	Bottom A/F diameter, mm	830	
5.2.1	Shaft thickness, mm	7	
5.2.1	Pole ultimate load, kg	8898	
	Total weight (after galvanization), kg	*	
5.3.1	Standard designation/grade of steel for pole shaft	*	
5.3.1	Minimum yield stress of steel material for pole shaft, N/mm^2	355	
5.3.3	Minimum coating weight of hot-dip galvanizing of pole shaft, g/m^2	610	
5.3.4	Hot-dipped galvanized steel Grade 4.6 for bolts, nuts & locknuts of top cap, bearing plate and earthing nuts	As specified	
5.4.6	All pre-drilled holes provided with U.V. resistant, plastic plugs	As specified	
5.4.7	M12 x 30 mm bolt and washer for earthing nut	As specified	
5.4.8	M12 x 30 mm bolt with washer for attaching top cap and bearing plate	As specified	
5.4.9	Tolerances	As specified	
5.4.10	Straightness of the pole	As specified	
5.5.1	Name plate with complete information	As specified	
5.5.1	Name plate affixed to the pole by rivets	As specified	
5.5.2	Color Code (Number of bands)	Green (3)	
9.0	Submittals as per this specification enclosed	As specified	

* Values to be provided/proposed by Vendor

10.0 DATA SCHEDULE
OCTAGONAL STEEL POLE
(Sheet 10 of 10)

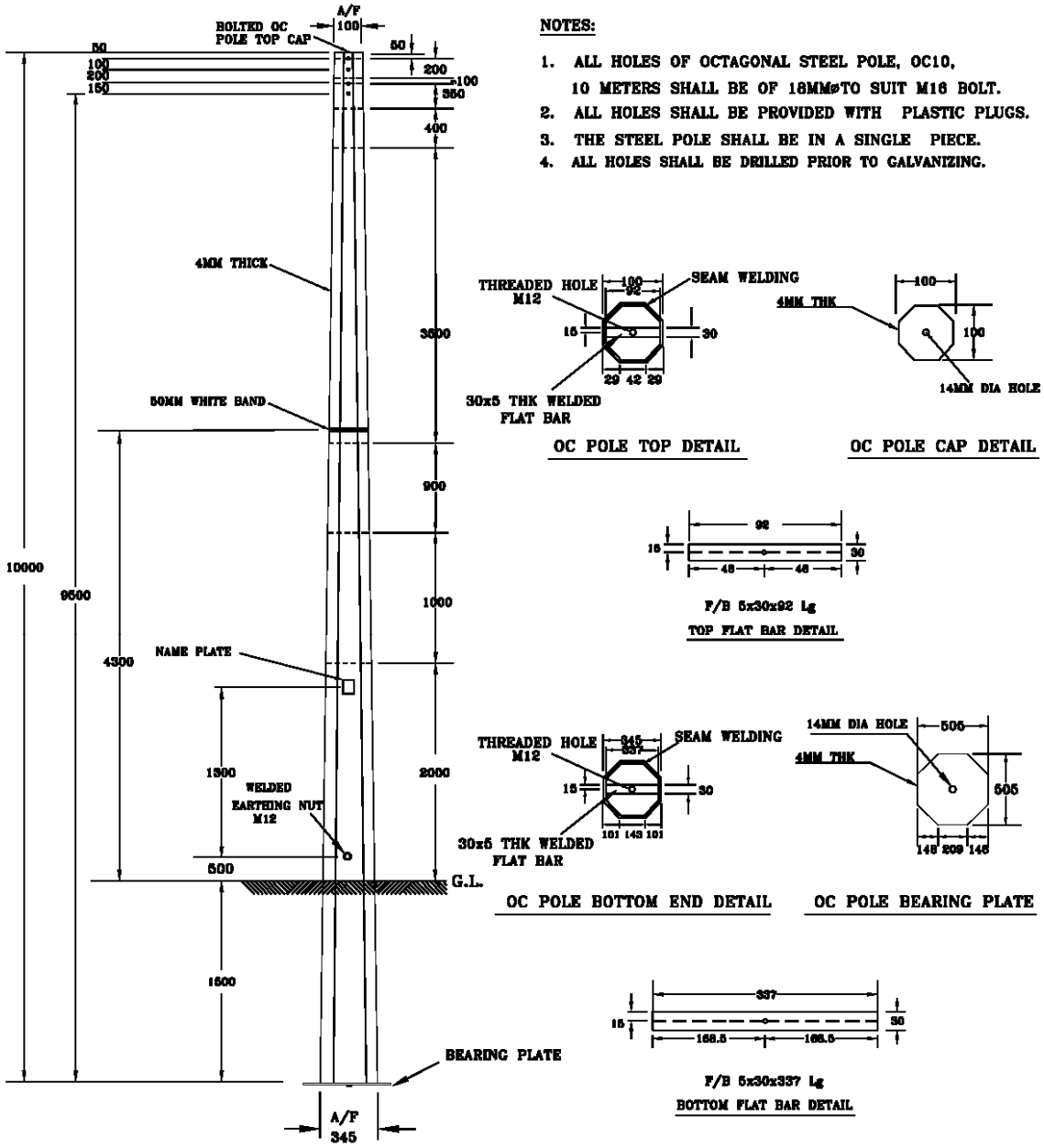
A. ADDITIONAL TECHNICAL INFORMATION OR FEATURES SPECIFIED BY SEC:

B. ADDITIONAL SUPPLEMENTARY DATA OR FEATURES PROPOSED BY BIDDER/VENDOR/SUPPLIER:

C. OTHER PARTICULARS TO BE FILLED UP BY BIDDER/VENDOR/ SUPPLIER:

D. LIST OF DEVIATIONS & CLAUSES TO WHICH EXCEPTIONS ARE TAKEN BY THE BIDDER/VENDOR/SUPPLIER: (USE SEPARATE SHEET IF NECESSARY)

	MANUFACTURER	VENDOR / SUPPLIER
Name of Company		
Location and Office Address		
Name and Signature of Authorized Representative		
Official Seal / Stamp		

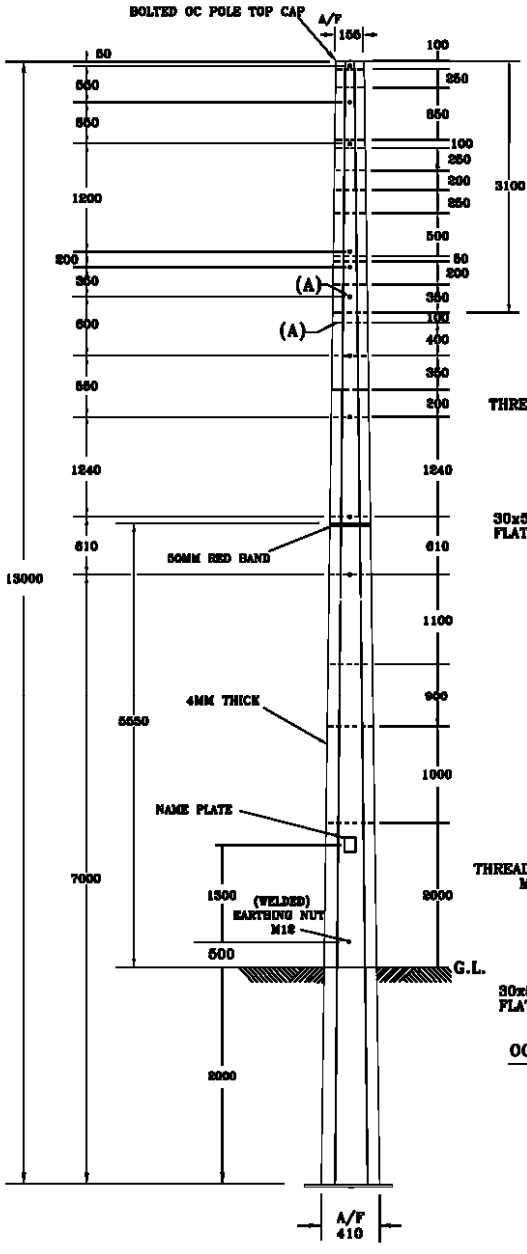


NOTES:

1. ALL HOLES OF OCTAGONAL STEEL POLE, OC10, 10 METERS SHALL BE OF 18MMøTO SUIT M16 BOLT.
2. ALL HOLES SHALL BE PROVIDED WITH PLASTIC PLUGS.
3. THE STEEL POLE SHALL BE IN A SINGLE PIECE.
4. ALL HOLES SHALL BE DRILLED PRIOR TO GALVANIZING.

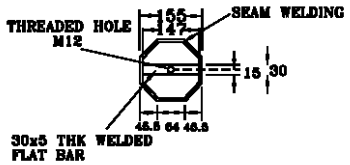
DRW.P01–OCTAGONAL STEEL POLE, 10M, LOW VOLTAGE (OC10)

ALL DIMENSIONS ARE IN MILLIMETER

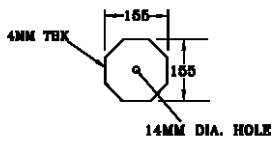


NOTES:

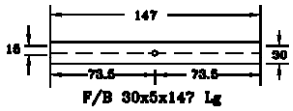
1. ALL HOLES OF OCTAGONAL STEEL POLE,OC13S, 13 METERS SHALL BE OF 22mmø TO SUIT M20 BOLT EXCEPT INDICATED BY 'A'.
2. HOLES INDICATED BY (A) ARE 18mmø (2 NOS ONLY.)
3. ALL HOLE SHALL BE PROVIDED WITH PLASTIC PLUGS.
4. THE STEEL POLE SHALL BE IN A SINGLE PIECES.
5. THE HOLE AT 3100mm (----) FROM POLE TOP IS DESIGNED FOR BRACING OF FUSE CUTOUT CHANNEL OF SINGLE POLE MOUNTED TRANSFORMER.
6. ALL HOLES SHALL BE DRILLED PRIOR TO GALVANIZING.



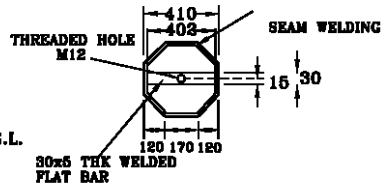
OC POLE TOP DETAIL



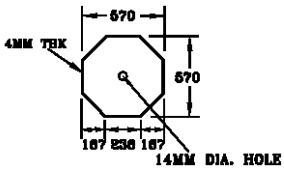
OC POLE CAP DETAIL



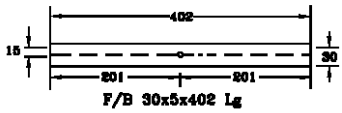
TOP FLAT BAR DETAIL



OC POLE BOTTOM END DETAIL



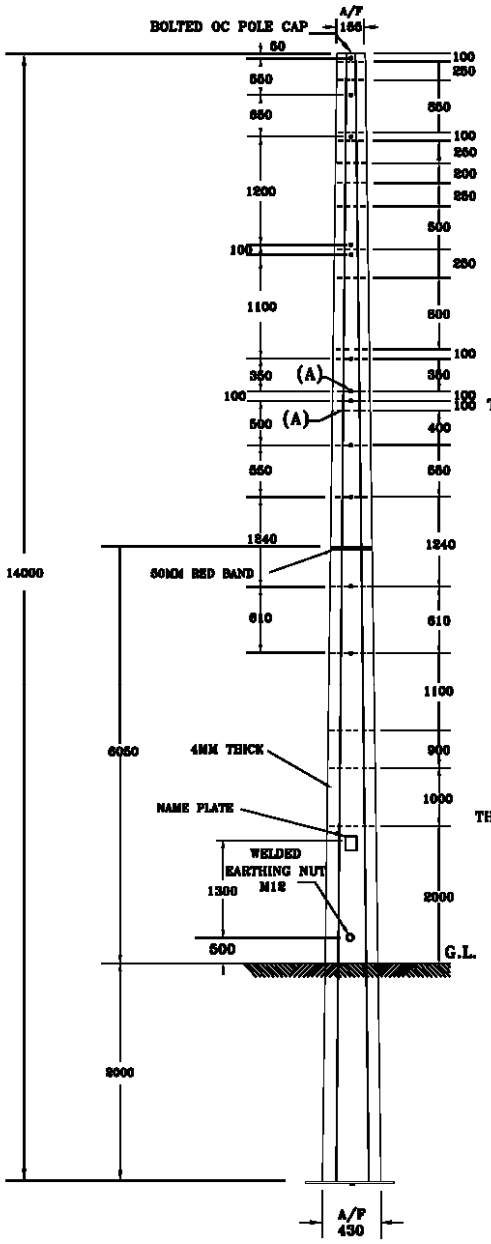
OC POLE BEARING PLATE



BOTTOM FLAT BAR DETAIL

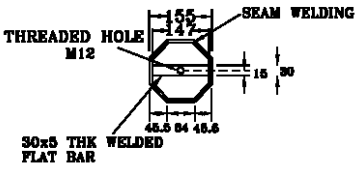
DRW.P02 – OCTAGONAL STEEL POLE, 13M, MEDIUM VOLTAGE S.C. (OC13S)

ALL DIMENSIONS ARE IN MILLIMETER

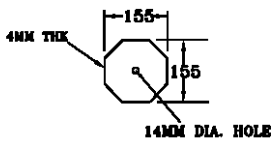


NOTES:

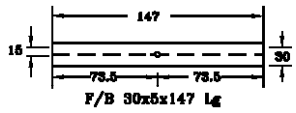
1. ALL HOLES OF OCTAGONAL STEEL POLE, OC14S, 14 METERS SHALL BE OF 22mm ØTO SUIT M20 BOLT EXCEPT INDICATED BY 'A'.
2. HOLES INDICATED BY (A) ARE 18mmø(2 NOS ONLY.)
3. ALL HOLE SHALL BE PROVIDED WITH PLASTIC PLUGS.
4. THE STEEL POLE SHALL BE IN A SINGLE PIECE.
5. THE HOLE AT 3100mm (----) FROM POLE TOP IS DESIGNED FOR BRACING OF FUSE CUTOUT CHANNEL OF SINGLE POLE MOUNTED TRANSFORMER.
6. ALL HOLES SHALL BE DRILLED PRIOR TO GALVANIZING.



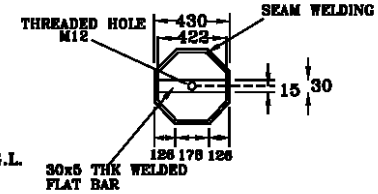
OC POLE TOP DETAIL



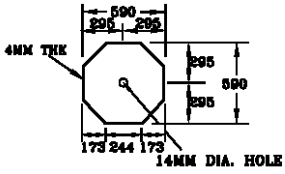
OC POLE CAP DETAIL



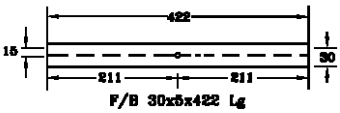
TOP FLAT BAR DETAIL



OC POLE BOTTOM END DETAIL



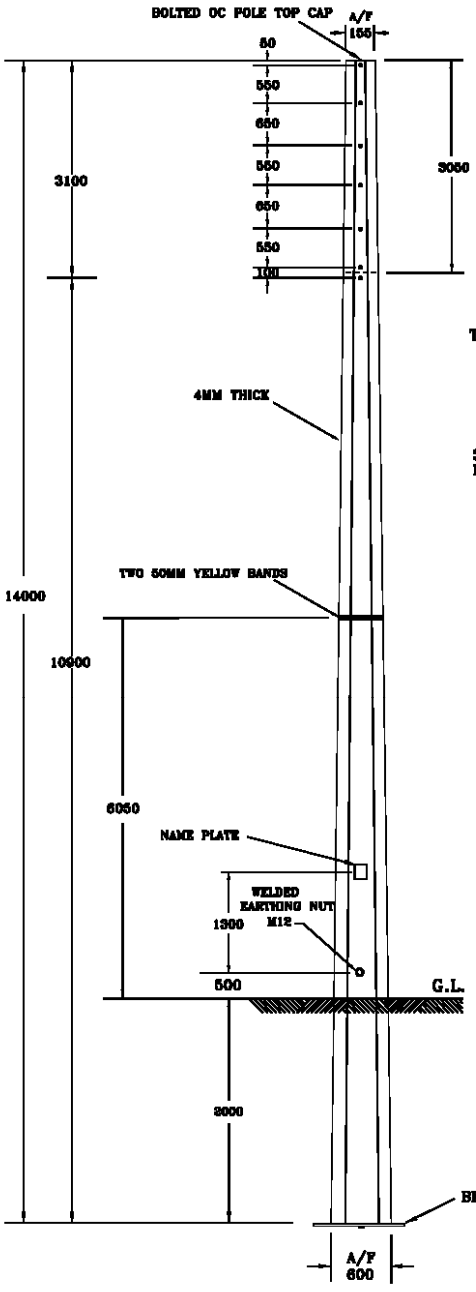
OC POLE BEARING PLATE



BOTTOM FLAT BAR DETAILS

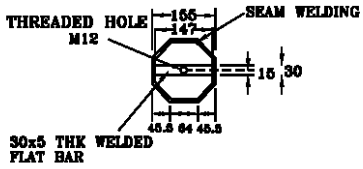
DRW.P03 – OCTAGONAL STEEL POLE, 14M, MEDIUM VOLTAGE S.C. (OC14S)

ALL DIMENSIONS ARE IN MILLIMETER

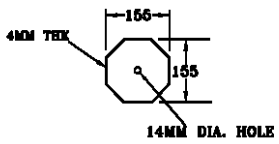


NOTES:

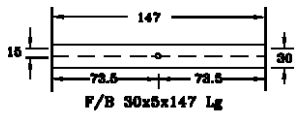
1. ALL HOLES OF OCTAGONAL STEEL POLE,OC14D, 14 METERS SHALL BE OF 22mmø TO SUIT M20 BOLT.
2. ALL HOLE SHALL BE PROVIDED WITH PLASTIC PLUGS.
3. THE STEEL POLE SHALL BE IN A SINGLE PIECE.
4. ALL HOLES SHALL BE DRILLED PRIOR TO GALVANIZING.



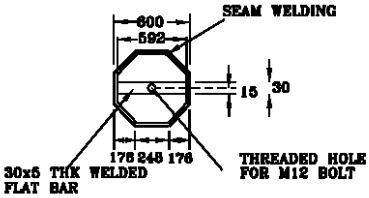
OC POLE TOP DETAIL



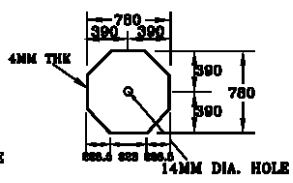
OC POLE CAP DETAIL



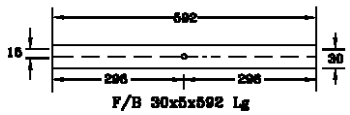
TOP FLAT BAR DETAIL



OC POLE BOTTOM END DETAIL



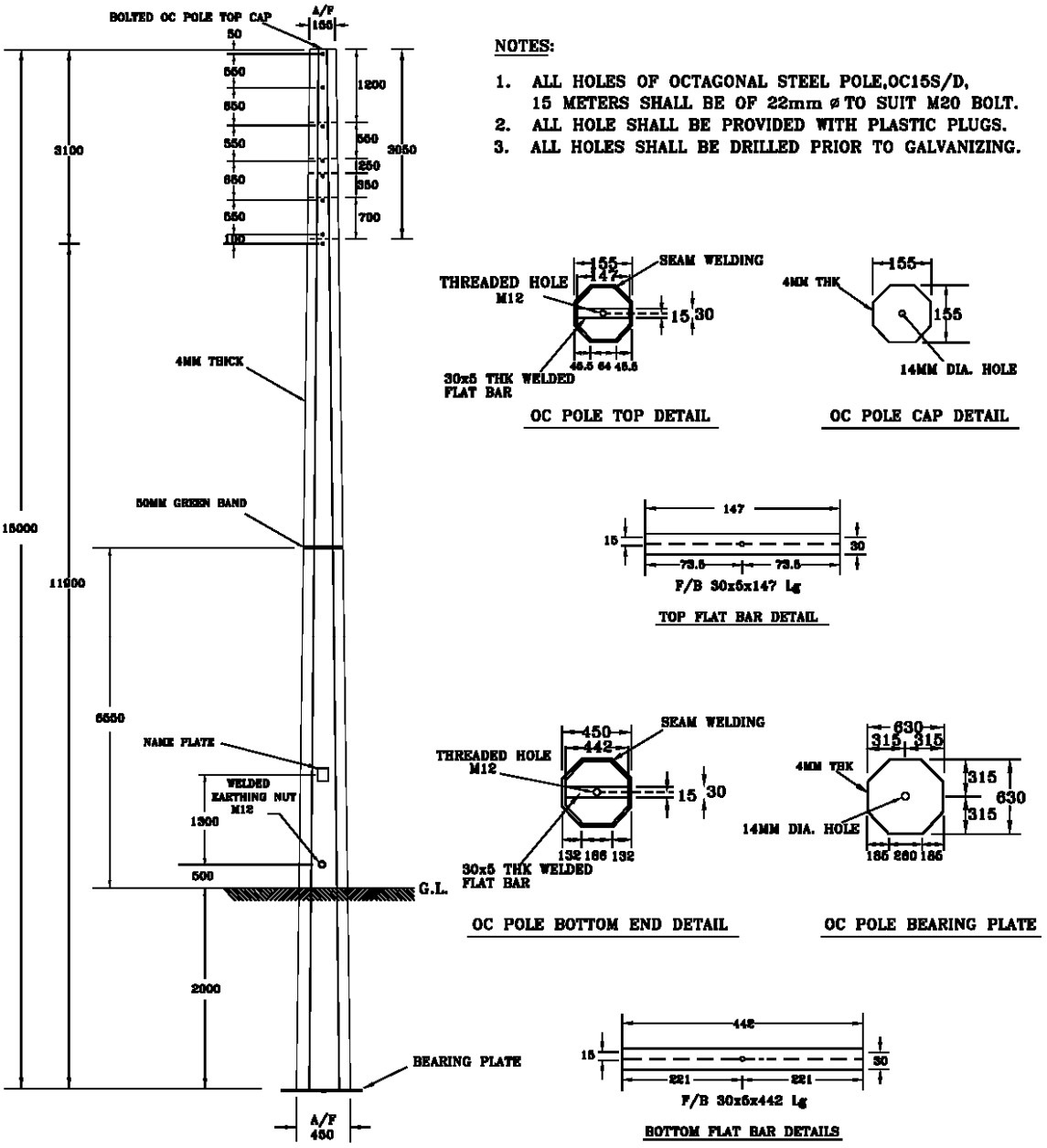
OC POLE BEARING PLATE



BOTTOM FLAT BAR DETAILS

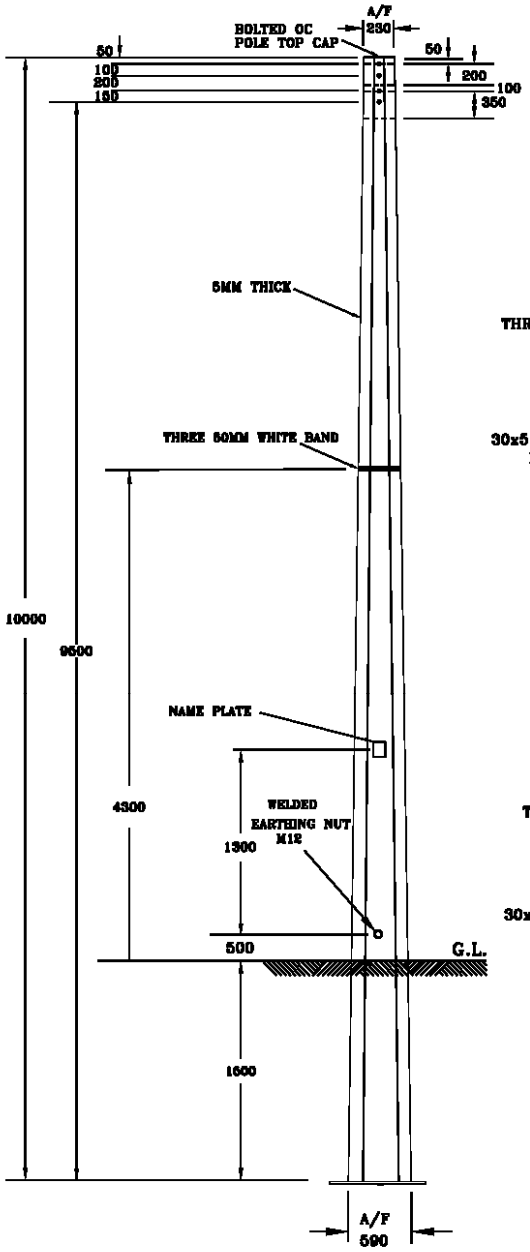
DRW.P04 – OCTAGONAL STEEL POLE, 14M, MEDIUM VOLTAGE D.C. (OC14D)

ALL DIMENSIONS ARE IN MILLIMETER



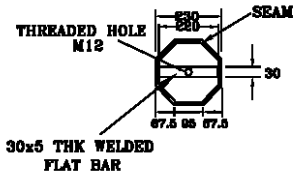
DRW.P05 – OCTAGONAL STEEL POLE, 15M, MEDIUM VOLTAGE S.C/D.C(OC15S/D)

ALL DIMENSIONS ARE IN MILLIMETER

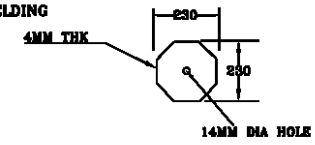


NOTES:

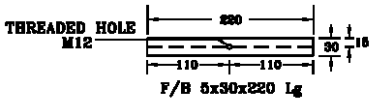
1. ALL HOLES OF OCTAGONAL STEEL POLE,OC10,10 METERS SHALL BE OF 18MM ϕ TO SUIT M16 BOLT.
2. ALL HOLES SHALL BE PROVIDED WITH PLASTIC PLUGS.
3. THE STEEL POLE SHALL BE IN A SINGLE PIECES.
4. ALL HOLES SHALL BE DRILLED PRIOR TO GALVANIZING.



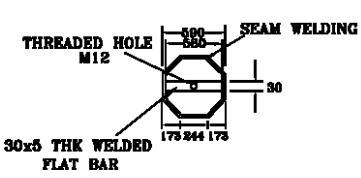
OC POLE TOP DETAIL



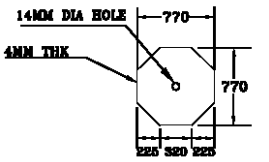
OC POLE CAP DETAIL



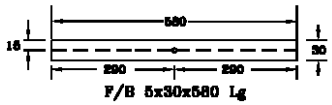
TOP FLAT BAR DETAIL



OC POLE BOTTOM END DETAIL



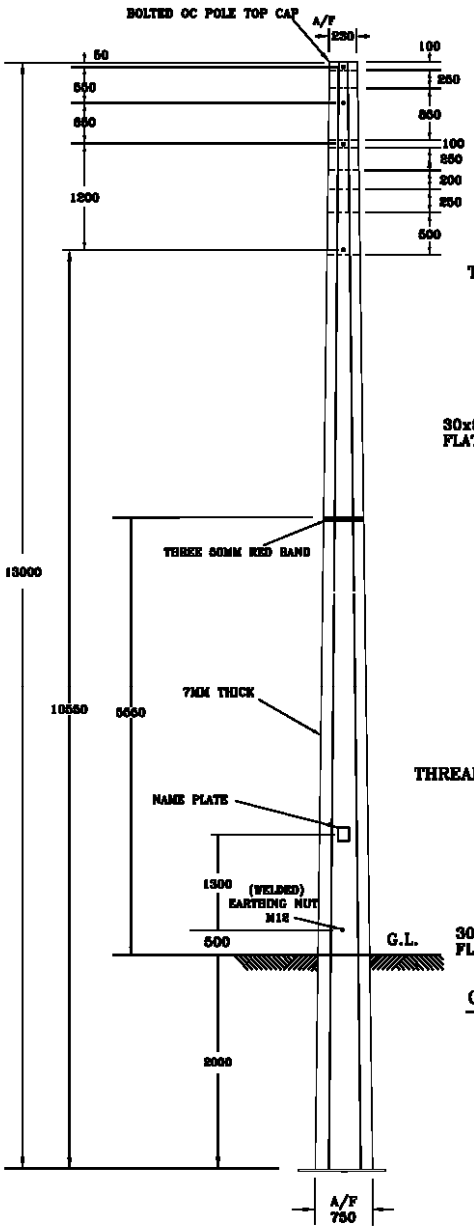
OC POLE BEARING PLATE



BOTTOM FLAT BAR DETAIL

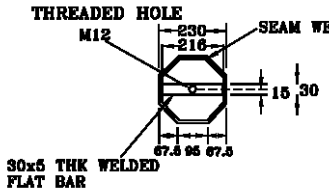
ORW.P06 – OCTAGONAL STEEL POLE, SELF SUPPORT 10M, LOW VOLTAGE (OC10SFS)

ALL DIMENSIONS ARE IN MILLIMETERS

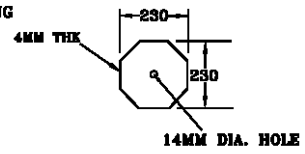


NOTES:

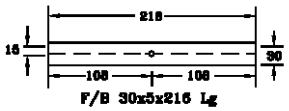
1. ALL HOLES OF OCTAGONAL STEEL POLE,OC13SFS, 13 METERS SHALL BE OF 22mm ø TO SUIT M20 BOLT.
2. ALL HOLES SHALL BE PROVIDED WITH PLASTIC PLUGS.
3. THE STEEL POLE SHALL BE IN A SINGLE PIECES.
4. ALL HOLES SHALL BE DRILLED PRIOR TO GALVANIZING.



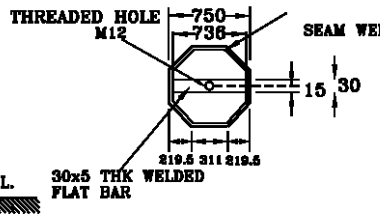
OC POLE TOP DETAIL



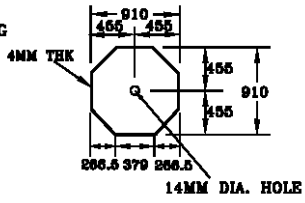
OC POLE CAP DETAIL



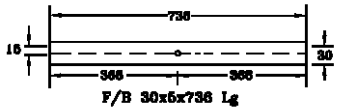
TOP FLAT BAR DETAIL



OC POLE BOTTOM END DETAIL



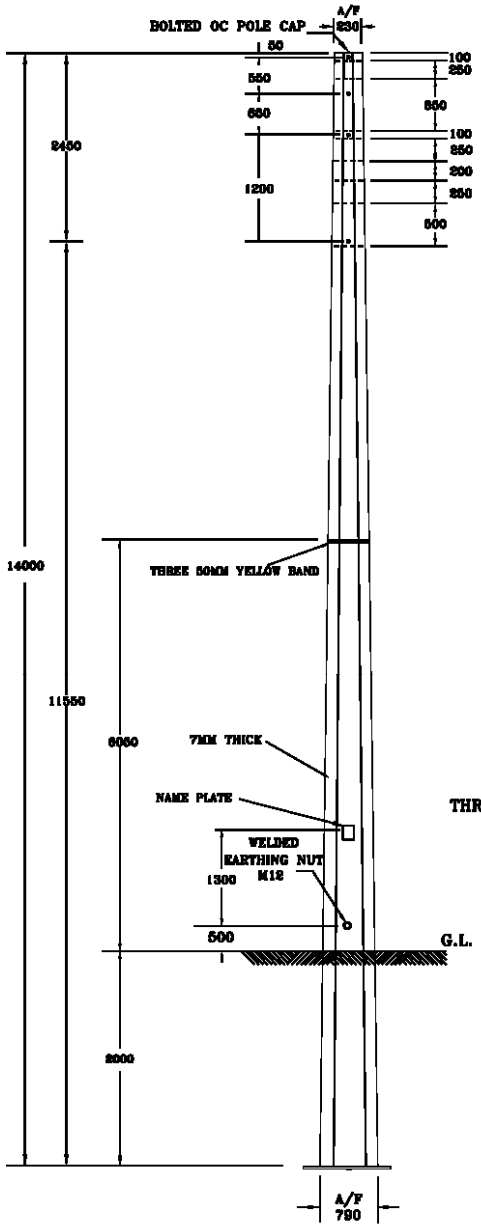
OC POLE BEARING PLATE



BOTTOM FLAT BAR DETAIL

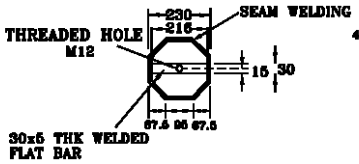
DRW.P07 – OCTAGONAL STEEL POLE, SELF SUPPORT 13M, MEDIUM VOLTAGE S.C. (OC13SFS)

ALL DIMENSIONS ARE IN MILLIMETER

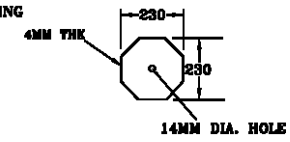


NOTES:

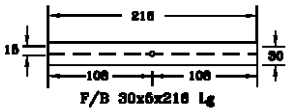
1. ALL HOLES OF OCTAGONAL STEEL POLE,OC14SFS, 14 METERS SHALL BE OF 22mm ø TO SUIT M20 BOLT.
2. ALL HOLES SHALL BE PROVIDED WITH PLASTIC PLUGS.
3. THE STEEL POLE SHALL BE IN A SINGLE PIECE.
4. ALL HOLES SHALL BE DRILLED PRIOR TO GALVANIZING.



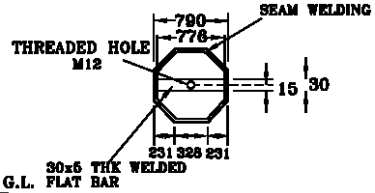
OC POLE TOP DETAIL



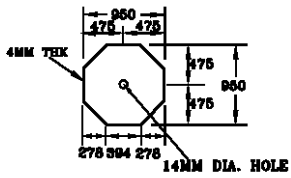
OC POLE CAP DETAIL



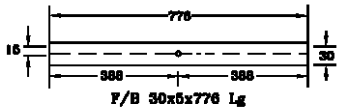
TOP FLAT BAR DETAIL



OC POLE BOTTOM END DETAIL



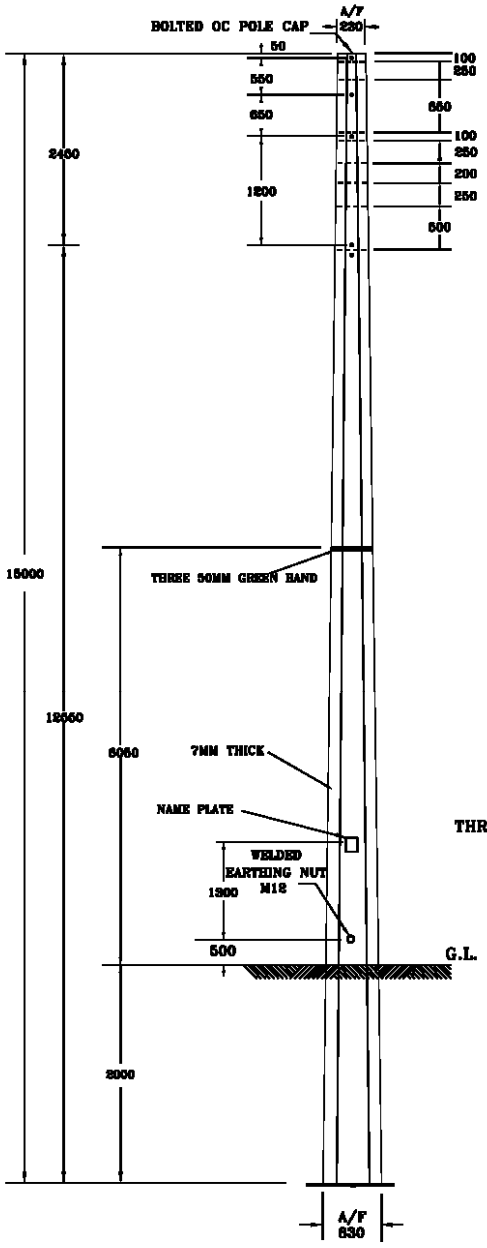
OC POLE BEARING PLATE



BOTTOM FLAT BAR DETAILS

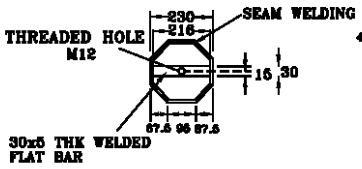
DRW.P08 – OCTAGONAL STEEL POLE, SELF SUPPORT 14M, MEDIUM VOLTAGE S.C.(OC14SFS)

ALL DIMENSIONS ARE IN MILLIMETER

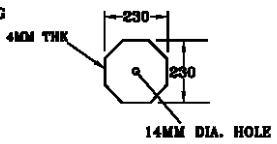


NOTES:

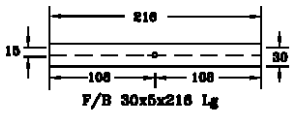
1. ALL HOLES OF OCTAGONAL STEEL POLE,OC15SFS, 15 METERS SHALL BE OF 22mm ø TO SUIT M20 BOLT.
2. ALL HOLES SHALL BE PROVIDED WITH PLASTIC PLUGS.
3. ALL HOLES SHALL BE DRILLED PRIOR TO GALVANIZING.



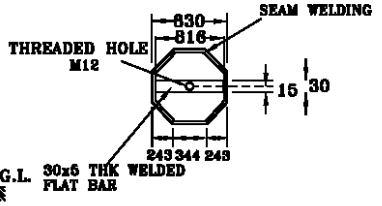
OC POLE TOP DETAIL



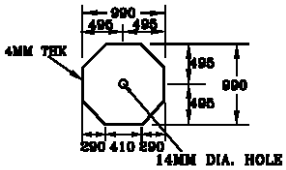
OC POLE CAP DETAIL



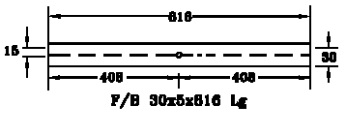
TOP FLAT BAR DETAIL



OC POLE BOTTOM END DETAIL



OC POLE BEARING PLATE



BOTTOM FLAT BAR DETAILS

DRW.P09 – OCTAGONAL STEEL POLE, SELF SUPPORT 15M, MEDIUM VOLTAGE S.C. (OC15SFS)

ALL DIMENSIONS ARE IN MILLIMETER