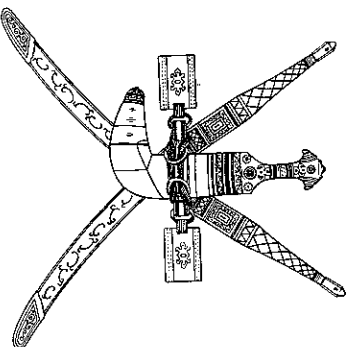


SULTANATE OF OMAN

MINISTRY OF ELECTRICITY & WATER



STANDARD - OES 11

GENERAL SPECIFICATIONS FOR ELECTRICAL MATERIALS AND EQUIPMENT

BRIEF SPECIFICATIONS AND STANDARD DRAWINGS

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SULTANATE OF OMAN
MINISTRY OF ELECTRICITY & WATER

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GENERAL SPECIFICATIONS FOR ELECTRICAL MATERIALS AND EQUIPMENT

TABLE OF CONTENTS

Clause No.	Description	Page
01	Main electrical systems and climatic conditions	1
02	Design and construction	2
03	Materials and workmanship	
04	Cleaning, painting and finishing	3
05	Standards	4
06	Tender drawings and descriptive literature	
07	Drawings	
08	Units of measurement	5
09	Labels, rating and name plates	
010	Locks	
011	Identification of materials	6
012	Packing	
013	Completeness of tender	
014	Compliance with specification	
015	Installation, operation and maintenance instruction	
016	Tropicalisation	
017	Nuts, bolts, studs and washers	
018	Valves	
019	Instruments	
020	Small wiring	8
021	Terminal boards	9
022	Fuses, links and miniature circuit breakers	
023	Control switches and push buttons	10
024	Indicating lamps and fittings	
025	Auxiliary switches	11
026	Current and voltage transformers	
027	Electrical motors	12
028	Anti condensation heaters and ventilators	
029	Pressure gauges	
030	Insulating oil and compound	
	Drawing PL/GDI/56	13

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0.01 MAIN ELECTRICAL SYSTEMS AND CLIMATIC CONDITIONS

These general specifications are applicable, where relevant and appropriate, to all electrical materials and/or equipment supplied to the Ministry of Electricity & Water and/or installed on the Ministry's electrical system.

Materials and equipment shall be suitable in all respects for operation on electrical systems in the Sultanate of Oman for operation in the climatic conditions obtaining at sites, which are as follows :

	132 KV	33 KV	11 KV	415 V	
Rated service voltage	KV	132	33	11	415/240
Highest voltage	KV	145	36	12.5	—
Number of phases		3	3	3	3
Frequency	Hz	50	50	50	50
Design fault level	KA	31.5/2 sec.	25/3 sec.	18.4 sec.	40/1 sec.
Earthing system		solidly earthed	earthed through resistor	solidly earthed	solidly earthed

CLIMATIC CONDITIONS

Maximum ambient temperature	50°C
Maximum temperature of metal surface in direct sunlight	80°C
Altitude	sea level - 30 mtres
Maximum wind velocity	125 km/hr
Average annual rainfall	100 mm
Maximum relative humidity	100%

02 DESIGN AND CONSTRUCTION

The material, equipment and accessories shall be designed to give satisfactory and continuous service under the conditions obtaining at the sites.

The design shall ensure satisfactory operation, repairs and maintenance. All corresponding parts shall be made to gauge and shall wherever applicable be interchangeable.

All equipment shall have provision to minimise entry of dust. Further, outdoor equipment shall be so designed that water cannot collect at any point.

In complying with the requirements of the Ministry's standard specifications, both with respect to arrangement and detail, design is to conform to the best current engineering practice. Each of the several parts of the plant is to be of the maker's standard design provided that this design is in general accordance with the specifications.

The essence of design should be simplicity and reliability in order to give long continuous service with high economy and low maintenance cost. Particular attention should be paid to internal and external access in order to facilitate inspection, cleaning and maintenance.

The design, dimensions and materials of all parts are to be such that they will not suffer damage as a result of stress under the most severe service conditions.

Fully detailed specifications of the several parts of the plant are to be submitted describing particularly the materials to be used.

The materials used in the manufacture of the plant are to be of the highest quality and selected particularly to meet the duties required of them. Mechanisms are to be constructed to avoid sucking due to rust or corrosion.

Workmanship and general finish are to be of the highest class throughout.

All equipment is to operate without undue vibration and with the least possible amount of noise.

All equipment is to be designed to minimise the risk of fire and any damage which may be caused in the event of fire.

The equipment is also to be designed to prevent ingress of vermin and accidental contact with live parts. The use of materials which may be liable to attack by termites or other insects is to be avoided.

0.03 MATERIALS AND WORKMANSHIP

The materials of all parts shall be the best of their kind. The workmanship of all parts shall be of the highest order. No welding, plugging or filling of defective parts shall be carried out without the prior approval in writing of the Ministry.

0.04 CLEANING, PAINTING AND FINISHING

It is to be borne in mind that the atmosphere at the site is highly corrosive. Therefore special attention should be given for protection of all iron work. The methods proposed and the means adopted for rustproofing should be fully described in the Tender.

The following would indicate in general the minimum requirements which the Tenderer shall take into account while submitting his own proposals.

a. CLEANING

All surfaces shall be thoroughly cleaned and freed from rust, scale, grease, dirt and other foreign matter. Sharp points, weldspatters, flux or other imperfections shall be removed. The interior of all tanks and other oil filled chamber shall be cleaned of all scale and rust by sandblasting or other approved methods.

b. PAINTING

Immediately after cleaning, a primary coat of red lead or other approved primer shall be applied. After the application of the first primary coat all rough surfaces shall be rubbed down and filled and a second coat of red or other approved primer applied. This shall be followed for outdoor equipment by the application of two coats of an approved oil-based aluminium paint.

For indoor equipment, after the application of the two primary coats, two coats of high class paint shall be applied. The final coat shall be of glossy finish of colour No. : 692 to BSS 381 C.

The interior of all tanks and other oil filled chambers, after necessary preparation and cleaning as described in 'a' above, shall be painted with an oil resisting varnish or enamel.

All paint and/or enamel shall be applied by brush or sprayer. Dipping shall not be permitted. A first class blemish free pleasing finish shall be obtained. Sufficient paint shall be provided for all necessary touching up on site after erection.

Damage to paint work incurred during transport up to delivery to stores/site shall be made good by thoroughly cleaning the damaged portion and applying the full number of coats that had been applied before the damage was caused. A matching finish shall be obtained to the satisfaction of the Ministry.

c. PLATING

Parts which are normally plated shall be plated in hard chromium finish.

d. GALVANISING

Materials to be galvanised shall be of the full dimensions shown or specified, and all punching, cutting, drilling, screw tapping and the removal of burrs is to be completed before the galvanising process commences.

Galvanising shall be done by the hot dip process with spelter not less than 98% of which must be pure zinc. No alternative process may be used without the approval of the Ministry. NO components may be galvanised which are likely to come into subsequent contact with oil.

Bolts shall be completely galvanised including the threads. The zinc coating shall be uniform, clean, smooth and as free from spangle as possible.

In the case of component parts, galvanising shall be in accordance with BS 729 and the minimum zinc coating shall be 915 gm/m² (127 micron).

Galvanised wire for general purpose shall comply with the requirements of BS 183, galvanised wire for cable armouring shall comply with BS 1442. The weight of zinc coating on wires shall be in accordance with BS 443.

Nuts and bolts shall be galvanised to comply with the requirements of BS 729. Galvanised parts shall be protected from injury to the zinc coating due to differential aeration and abrasion during periods of transit, storage and erection. Damaged areas of the coating shall be brushed up with an approved metallic zinc rich priming paint complying with BS 4652.

0.05 STANDARDS

All materials and equipment shall comply as a minimum :

- a. With the latest relevant recommendation of the International Electro Technical Commission (I.E.C.), or International Standards Organisation (I.S.O.).
- b. If (a) is not available, with the latest relevant British Standard Specification (BSS).
- c. If (a) and (b) are not available, with the latest relevant A.S.T.M.

This applies to quality of materials, testing etc. If standards as mentioned above contradict with the Ministry's specification, then the requirements of the Ministry's specification shall apply.

0.06 TENDER DRAWINGS AND DESCRIPTIVE LITERATURE

With each tender shall be submitted dimensional drawings showing the general arrangement of each item including foundation details where applicable; also drawings showing the proposed methods to be adopted for dust and vibration proofing, its design, materials of construction and methods of operation, shall be submitted, together with pamphlets and complete characteristics and performance data to enable the Ministry to assess the merits of the material offered.

All drawings and descriptive literature, data, etc. submitted with the tender will be binding. Drawings and literature shall be in English. Dimensions shall be given in metric units.

0.07 DRAWINGS

Before the work is put in hand, dimensioned drawing and diagrams showing all details of the plant and materials to be used shall be submitted to the Ministry for approval. No wiring or connection diagrams shall be submitted for approval unless prior approval has been obtained for schematic diagrams, showing the facilities being provided and the working of the schemes. The drawing shall be submitted in triplicate as soon as possible after order placement and in any case in sufficient time to permit modifications to be made if such are deemed necessary by the Ministry without delaying delivery. The drawings submitted shall be modified as necessary if requested by the Ministry and re-submitted for final approval. Final working drawings will be required to be submitted in quadruplicate.

The submission of drawings shall be included in the programme and after the dates have been agreed with the Ministry they must be strictly adhered to.

After all items of Plant have been manufactured and delivered, transparency of each drawing previously approved is to be provided, two prints on heavy gauge white paper from such drawing as may be required to show the detail and arrangement of the Plant as made and supplied.

All drawings submitted by the Contractor or by any sub-Contractor shall have the following particulars in the lower right hand corner as per drawing no: PL/GDL/56.

0.08 UNITS OF MEASUREMENT

In all correspondence, in all technical schedules and on all drawings metric units of measurement shall be used.

0.09 LABELS, RATING AND NAME PLATES

All labels, rating and name plates unless specifically called for in both English and Arabic, shall be in English language and should be non-deteriorating and non-wrapping. Size and text shall be to the Ministry's approval.

Labels for mounting outdoors, shall be of chromium plated bronze with black filled letters.

Labels for mounting indoor shall be made of suitable engraving material 2 mm thick white surface with black engraving.

0.10 LOCKS

All locks and padlocks shall be of brass. Three keys shall be supplied for each lock and all locks shall be non-interchangeable.

Where a set of lock is provided under any particular section of plant or apparatus, a group master key shall be supplied in addition.

Locks shall be designed, constructed and located on the equipment so that they remain serviceable in the climatic conditions specified without operation or maintenance for continuous periods of upto two years and, with suitable maintenance, will operate satisfactorily for indefinite periods.

Where a group of locks are supplied for any section of plant, a rack or cabinet of approved design shall be supplied for the accommodation of padlocks and/or keys while not in use. The padlocks and keys shall be engraved with a suitable identifying code or inscription and this shall be repeated on the racks or cabinets on engraved labels attached thereto.

Where locks and keys are required for equipment forming an extension to the existing installation, shall be provided, where possible, locks and keys of the same type, grouping, and master key suits as are already existing.

0.11 IDENTIFICATION OF MATERIALS

Before leaving the manufacturer's works, all apparatus, fitting, etc. shall be painted or stamped in two places at least, with a marking number and/or letter on approved drawing and materials list.

The erection marks on galvanised or other plated parts shall be stamped on before galvanising or plating and shall be clearly legible after galvanising or plating. Spares and maintenance tools shall be packed separately and identified as such.

0.12 PACKING

Each item shall be packed properly or protected for shipment and transport from the place of manufacture to the site/stores. The cases to be lined with water proof materials to safeguard the equipment during the sea voyage.

Tenderers are warned that packages are liable to very rough handling enroute from the factory to the site/stores and it is essential that the packing is efficient and strong with extra reinforcement where necessary to ensure safe delivery to the site/stores.

All equipment and components shall be packed where necessary in non-returnable cases or in non returnable drums or otherwise prepared for overseas shipment to a tropical country without sustaining damage. All packing shall become the property of the Ministry.

0.13 COMPLETENESS OF TENDER

The tender is to include in his offer the whole of equipment which are described or implied in the tender documents and which may be inferred to be obviously necessary for the efficiency and completeness of the equipment. The same shall be deemed to be included in the tender prices.

0.14 COMPLIANCE WITH SPECIFICATION

Notwithstanding any description, drawings or illustrations which may have been submitted with the tender, all details other than those shown in the Schedule of Departures will be deemed to be in accordance with the Ministry's Specification and the standards referred to therein.

No departure from the Specification, except those shown in the Schedule of Departures and approved by the Ministry, shall be made without the written approval of the Ministry.

0.15 INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

Within two months of placing order, six copies of operation and maintenance instruction for all equipment shall be submitted to the Ministry.

The instructions shall include full details and procedure for installation of the equipment, and all necessary adjustment during service and operation, together with parts lists to enable spare parts or replacements to be ordered.

0.16 TROPICALISATION

In choosing materials and their finishes, due regard shall be given to the humid tropical conditions under which equipment is to work, and the recommendations of British Standard Code of practice 1014 or equivalent should be observed unless otherwise approved.

0.17 NUTS, BOLTS, STUDS AND WASHERS

Nuts and bolts for incorporation in the plant shall preferably conform to ISO Metric Coarse or to BS 3692 and BS 4190. Other sizes of threads are permitted for threaded parts not to be disturbed in normal use or maintenance. Bolt heads and nuts must be hexagon head and in no case must bolt heads be welded to the shanks.

Nuts and bolts for pressure parts shall be of the best quality high tensile steel, machined on the shank and under the head and nut.

All washers, locking devices and antivibration arrangements shall be included.

0.18 VALVES

Valves shall be arranged so that the hand wheel moves in clockwise direction to close the valve. The face of each hand wheel shall be clearly marked with the words "Open" and "Close" and be provided with an arrow to indicate direction for opening and closing. As far as possible valves shall not be fitted in an inverted position.

0.19 INSTRUMENTS

Unless otherwise specified, all indicating and recording instruments shall be of the flush mounted pattern with dust and moisture proof covers.

Instrument dials in general should be white with black markings and should be reversible where double scale instruments are specified.

Scales shall be of such materials that no peeling or discolouration will take place with age under humid tropical conditions.

The movements of all electrically actuated instruments shall be of the dead beat type.

Wherever necessary, instruments shall be provided with a readily accessible zero adjustment.

All electrical instruments and meters shall comply with IEC 51 and IEC 43 respectively and, unless otherwise specified, shall be of industrial grade accuracy.

Meters shall be calibrated to the appropriate grade in IEC 43 and due allowance and shall be made in such calibration for the errors in the instrument transformers to be used in service.

0.20 SMALL WIRING

All control panel wiring, secondary control wiring in circuit breakers, motor starters, control gear and the like shall be carried out in a neat and systematic manner with cable supports clear of the panels and other surfaces at all points to obtain free circulation of air.

In all cases, the sequence of the wiring terminals, shall be such that the junction between multicore cables and the terminals is effected without crossover. Claw washers or crimped connectors of approved type shall be used to terminate all small wiring. Insulating bushes shall be provided where necessary to prevent the chafing of wiring.

All panel wiring shall conform to the requirements of IEC 228 and BS 6231. The conductors shall have a minimum cross section equivalent to 50/0.25 mm (2.5 mm²) or 7/0.67 mm (2.5 mm).

Wire colours shall be as follows :

Colour of wire	Circuit Particulars
Red	Red-phase connections in current and voltage transformer circuits only
Yellow	Yellow-phase connections in current and voltage transformer circuits only
Blue	Blue-phase connection in current and voltage transformer circuits only

Green-Yellow	Connections to earth
Black	A.C. neutral connections, earthed or unearthed, connected to the secondary circuits of current and voltage transformer. A.C. connections other than those above and connections in a.c/d.c circuits
Grey	Connections in d.c. circuits

Wiring diagrams shall indicate wire colours. All diagrams shall be drawn as viewed from the back of the panel and shall state the highest number in any group.

All wires shall be fitted with numbered ferrules of approved type at each termination. The same ferrule number should not be used on wires forming connections not directly in series or parallel in the same panel. At points of interconnection between wiring, where a change of numbering cannot be avoided, double ferrules shall be provided. Such points shall be clearly indicated on the wiring diagram.

The ferrules on all wiring directly connected to circuit breaker trip coils, tripping switches, etc. shall be of a colour, preferably red, different from that of the remainder and marked "trip"

No wires may be teed or jointed between terminal points.

Electrical wiring and instruments shall be so located that leakage of oil or water cannot affect them.

Bus wiring between control panels, etc. shall be fully insulated and be completely segregated from the main panel wiring.

All metallic cases of instruments, switches, relays etc. mounted on control panels or in cubicles steel or otherwise, shall be connected by means of bare copper conductors of not less than 2.5 mm² section to the nearest earth bar.

All wiring when made up completely is to be capable of withstanding a minimum HV test of 2000 Volt RMS for one minute applied between each core and earth.

0.21 **TERMINAL BOARDS**

All terminal boards shall be mounted in accessible positions and when in enclosed cubicles shall be inclined towards the door.

Spacing between adjacent terminal boards shall be not less than 100 mm and the bottom of each board shall be not less than 200 mm above the incoming cable gland plate. Separate studs shall be provided on each terminal strip for the cores of incoming and outgoing cables including all spare cores.

Brass bolts and studs shall be of not less than 6 mm but stainless steel and bronze down to 5 mm may be used provided that the current carrying capacity is adequate. All studs shall be provided with nuts, washers and lock nuts or lock washers. They shall have adequate current carrying capacity and shall be provided with locking devices. Insulated barriers shall be fitted between adjacent terminals.

415/240 Volt circuit terminals shall be segregated from other terminals and shall be fitted with non-inflammable transparent plastic covers to prevent contact with any live parts. They shall have warning labels, with red lettering, mounted thereon in a conspicuous position.

All connections shall be made at the front of the terminal boards and no live metal shall be exposed at the back.

0.22 FUSES, LINKS AND MINIATURE CIRCUIT BREAKERS

a. FUSES AND LINKS :

All fuses and links associated with electrical instrument, protection and control circuits shall be of approved type and grouped, as far as possible, according to their functions. They shall be clearly labelled, both on the panels and the associated wiring diagrams.

Fuses and links shall be connected to enable the control circuits to be individually isolated for maintenance purposes.

Fuses and links associated with control and tripping circuits shall preferably be mounted on the outside of control panels in approved positions, whilst the remainder shall be mounted internally.

All fuses shall incorporate H.R.C. cartridges to IEC 269. Rewireable fuses will not be accepted.

Carriers and bases for 16 amp fuses shall be coloured green and those for 6 amps fuses shall be black. Link carriers and bases shall be white.

The fuses, links and carriers are to be designed to prevent the link carrier being interchanged with fuse carriers.

b. MINIATURE CIRCUIT BREAKERS :

Miniature circuit breakers shall comply with BS 3871 Part 1.

0.23 CONTROL SWITCHES AND PUSH BUTTONS

Control switches shall have handles of the spade type, the pistol grip type being reserved for local circuit breaker operation only. Push buttons shall be shrouded. Control, selector and test switches shall be mounted, constructed and wired so as to facilitate the maintenance of contracts without the necessity for disconnecting the wiring.

Control switches for circuit breakers shall be of the non-locking type with spring return to the "neutral" position. Such switches shall be controlled by independent springs, the use of contact springs alone for restoring not being acceptable.

Remote control switches for circuit breakers shall preferably be of the discrepancy indication type.

All push buttons shall be of the non-retaining type made of non-hygroscopic material, non-swelling and fitted to avoid any possibility of sticking.

The contacts of all switches and push buttons shall be robust and shall have a positive wiping action when operated.

Control switches for use in direct current control schemes shall be rated for the substation battery voltage.

All control switches shall be provided with labels complying with clause 0.08 in addition to clear indication as to the direction of each operation, for example "open," "raise," "lower," etc.

0.24 **INDICATING LAMPS AND FITTINGS**

Indicating lamps fitted into the fascias of switch and instrument cubicles or panels shall be adequately ventilated.

Lamps shall be easily removed and replaced from the front of the panel by manual means not requiring the use of extractors.

The bezel of metal or other approved material holding the lamp glass shall be of an approved finish and be easily removable from the body of the fitting so as to permit access to the lamp and lamp glass.

The lamps shall be clear and shall fit into an accepted form of lamps holder. The rated lamp voltage should be 10% in excess of the auxiliary supply voltage, a.c. or d.c.

Indicating lamps glasses, shall unless otherwise specified or approved, conform to the following standard colour code :

Colour	Type of indication	Status
Red	Circuit breaker or contactor	Closed
Green	Circuit breaker or contactor	Open
Amber	Alarm indication on which action is necessary	
Blue	Indication of operation of equipment which operates intermittently	

The colour shall be in the glass and not an applied coating and the different coloured glasses shall be interchangeable. Transparent synthetic materials may be used instead of glass, provided it can be shown that such materials have fast colours and are completely suitable for operating in tropical climates.

0.25 **AUXILIARY SWITCHES**

Where appropriate, each item of plant shall be equipped with all necessary auxiliary switches, contactors and mechanisms for indication, protection, metering, control interlocking, supervisory and other services. All auxiliary switches shall be wired up to a terminal board on the fixed portion of the plant, whether they are in use or not in the first instance.

All auxiliary switches and mechanisms shall be mounted in approved accessible positions clear of the operating mechanisms and shall be protected in an approved manner. The contacts of all auxiliary switches shall be robust and shall have a positive wiping action when closing.

Banks of auxiliary switches and associated terminal boards shall be arranged to facilitate extension when required.

0.26 CURRENT AND VOLTAGE TRANSFORMERS

Current and voltage transformers shall comply with IEC 185 or BS 3938 and IEC 186 or BS 3941 as appropriate and shall have the required ratings and ratios and be suitable for the duties specified.

Secondary windings shall be wired to suitable terminal boards and earthed at one point in the circuit.

All transformer shall be provided with an identifying label giving type, ratio, class output and serial number.

0.27 ELECTRIC MOTORS

All motors shall be in accordance with IEC 34-1 and, unless otherwise specified, shall be of the totally enclosed fan cooled type, suitable for continuous operation and direct on-line starting.

They shall be suitable in all respects for service in a damp tropical climate. Main conductor and slot insulation shall be non-hygroscopic and in accordance with IEC 85.

Motors shall be capable of operating continuously at rated output at any frequency between 48 and 51 Hz at any voltage within 6 percent of the nominal value. Motors shall be designed to operate for a period of not less than 5 minutes at a voltage of 25 percent below the nominal value and at normal frequency without injurious overheating.

The starting current at full voltage shall not exceed six times the rated full load current.

0.28 ANTI-CONDENSATION HEATERS AND VENTILATORS

Any major items of electrical equipment which are liable to suffer from internal condensation due to atmospheric or load variations shall be fitted with heating devices suitable for electrical operation at 240 volts a.c. 50 Hz single phase of sufficient capacity of raise the internal ambient temperature by 5°C. The electrical apparatus so protected shall be designed so that the maximum permitted rise in temperature is not exceeded if the heaters are energised while the apparatus is in operation. Where fitted, a suitable terminal box and control switch shall be mounted in an accessible position. Where heaters are controlled by push buttons, an indicating lamp shall be provided. All such equipment, whether fitted with a heating device or not, shall be provided with suitable drainage and shall be free from pockets in which moisture can collect.

0.29 PRESSURE GAUGES

Pressure gauges shall comply with the requirements of BS 1780.

All pressure gauges shall be fitted with stop cocks and all pressure gauge piping shall be fitted with isolating valves at each point of connection to the main system. Where pressure gauges are mounted on panel, the stop cocks shall be suitable for the connection of a test gauge.

Where a difference in level exists between the situation of the gauge and the point at which pressure is to be measured, appropriate compensation shall be made in the dial reading and the dial must be marked with the amount compensation applied.

All pressure gauges where practicable shall be mounted on panels in location approved by the Employer/Engineer. Stop cocks shall be clearly identified by means of separate labels of approved type and lettering.

All high pressure gauge piping shall be of rustless steel but other pressure gauge piping may be of copper tube or other material approved by the Employer/Engineer.

An approved pattern shall be fitted in such positions as may be determined to suit the operation and testing of the plant to the approval of the Employer/Engineer. A thermometer pocket shall be fitted adjacent to each point of connection for distant remote temperature indication, unless specifically stated to the contrary. Where necessary, the pocket shall be of approved alloy materials suitable for the required service.

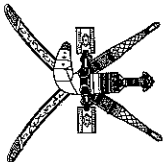
All thermometer pockets shall comply with the requirements of BS 2765 or equivalent.

0.30 INSULATING OIL AND COMPOUND

Oil and/or compound required for all apparatus shall be provided.

Oil and compound shall comply with IEC 296 or BS 1858 as appropriate and shall be delivered in strong hermetically sealed drums.

Where drums are stored on site in the open, they shall be kept in a horizontal position.

REV	DATE	DESCRIPTION	BY
SULTANATE OF OMAN Ministry of Electricity & Water Directorate General of Electricity  مديرية العامة للكهرباء وزارة الكهرباء والمياه سلطنة عمان			
JOB:			
CONSULTANTS:			
CONTRACTOR:			
<i>AREA FOR CONTRACTOR'S OWN USE</i>			
DRAWING TITLE:			
DRAWN		EXAMINED	
DATE		*APPROVED	
SCALE			
DRG. NO.		REV:	