

6.1 Type

Three phase, oil immersed naturally cooled, **step lap core** type distribution transformer. The transformer shall be in accordance with the IEC/BSEN Publication No. 60076 or equivalent except where stated otherwise.

6.2 Installation

The pole mounted transformer will be installed outdoor and will be exposed to direct sun rays and thus they shall be capable of carrying their full rated current under Kuwait's worst temperature conditions. Outdoor type pole mounted transformers shall be suitable for fixing on two cross-arm which will be mounted to a 2 -pole structure. The two pole structure shall be at 1830mm centre to centre. The offered transformers shall be suitable to fix on this cross arm, due care being taken for working clearance of the transformer from the wood pole support. Cross arm details are given on drawing (No. MC/1/113 A) attached with this specification. Two channels of adequate section shall be fixed to the transformer under base in such a way that these channels will be perpendicular to the cross-arms. All transformers shall be fully suitable for the specified site condition.

6.3 Normal Rating

The normal rating shall be the maximum continuous rating under the worst temperature conditions encountered in Kuwait. (see clause 5.5 of section 5 : climatic condition).

Tenderers shall state in the schedule, the equivalent British Standard Specification or the International Electro- Technical Commission rating for the transformers offered.

The Kuwait continuous rating shall not be more than 80% of British Standard Specification continuous rating.

6.4 Voltage Ratio

The normal voltage ratio of the transformers on normal tapping and no-load shall be as stated in the schedules.

6.5 Duty Under Fault Conditions

The transformer shall be capable of sustaining a three phase symmetrical short circuits current on the L.V. side with the fault power being maintained on the H.V. side and without damages to the transformers for three seconds.

6.6 Impedance Voltage

The impedance voltage at normal rating, tapping & frequency and at 75 degree centigrade shall be as stated in the schedules.

6.7 Temperature Rise

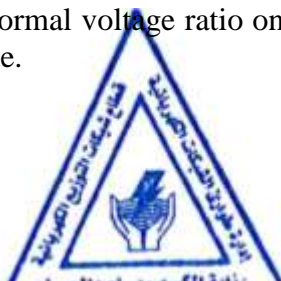
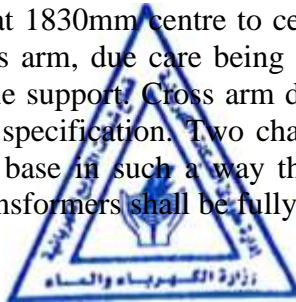
The transformers shall be capable of carrying its full normal rated current continuously under the worst temperature conditions encountered in Kuwait and at any tapping, without the temperature rise of oil in the hottest region exceeding **35** degree centigrade as measured by the thermometer and that of the winding 45 degree centigrade as measured by resistance.

Any transformer exceeding the above temperature rise limits will be rejected.

6.8 Connection and Ratio

The transformers are to be wound to IEC/BSEN Publication No. 60076, vector symbol Dyn 11 in accordance with normal voltage ratio on normal tapping at no-load and neutral point brought out on L.T. Side.

6.9 Cooling



Cooling of the transformers shall be natural circulation's of oil through the banks of plain external cooling tubes or radiators suitably arranged, due note being taken of the site conditions. The radiators shall physically be separated from the tank and shall not form integral part of the tank. However, transformers with corrugated tanks or cooling fins will also be considered.

6.10 Cores

The core shall be constructed of the best quality low loss cold rolled, grain oriented electrical steel lamination.

All core should be in step lap core type design construction. Wound core design construction is not acceptable.

The flux density in any part of the core shall not exceed 1.6 TESLA at normal voltage and frequency.

All core plates shall be insulated from one another to reduce the loss to a minimum, and the core shall be held together by bolts and clamping plates, all of which shall be adequately insulated. The completed core shall be provided with lifting eyes to facilitate its removal from the tank. A suitable fixing arrangement of the core to the tank at the top and bottom to be provided to prevent movement of the core during transit service. Such fixing arrangement of the transformer core must be adequate and strong enough to withstand the forces due to external short circuits. Detailed drawings of this arrangement to be submitted for approval to the purchaser. All steel sections used for supporting the core are to be thoroughly sand blasted after cutting, drilling and welding and painted with oil and acid resisting paint.

Design of supporting frames shall take into consideration complete emptying of tank through a drain valve, the avoidance of movement of the core relative to the tank during transport, installation and operation.

6.11 Winding & insulation level

The maximum current density in both H.V. and L.V. Winding shall not exceed 265 amperes per square centimeter.

All windings shall be made of high conductivity electrolytic copper conductors of best quality and shall be fully insulated to IEC/BSEN Publication No. 60076 and for a system's highest voltage 12 KV. The insulation shall be class "A" to IEC/BSEN Publication No. 60085. The insulation class shall be verified by the purchaser's representative.

All winding shall be easily removable by removing top yoke, wound core design construction is not acceptable.

6.12 Off circuit tapping

Off circuit tapping shall be provided on the center (both electrical and mechanical) of the H.V. Windings. These shall be arranged as follows :

Six tapping + 5%, + 2.5%, normal voltage, - 2.5%, - 5% and - 7.5%.

The transformer shall be capable of operation at its rated KVA without injury on any tapping and any applied voltage which does not vary from the voltage for which the tapping is rated by more than + 5%. Tapping shall be connected to an externally operated off-circuit tapping switch provided with clearly marked position indicator. Padlocking facility and pad locks shall be supplied for the switch and so arranged that the lock can only be inserted when the switch is on a definite tapping. The location of the tap-changer switch shall be in an accessible position and shall be subject to purchaser's approval. Special attention should be paid to the oil seal around the tap-changer rod. Each tender shall be accompanied by detailed drawing showing the sealing arrangement and any additional measures taken, if any, to cope with Kuwait's conditions shall be indicated. The location of tap-changer switch shall be arranged on the side of the transformer tank. A stainless steel caution plate 2.5 mm thick with adequate dimensions with engraved writing in red color to 0.5 mm depth, stating that the tap switch to be operated only when the transformer is disconnected from both the H.V. and L.V. sides shall be fitted near the tap switch handle.

6.13 Tank

The tank's top and bottom plates shall be constructed of mild steel of suitable thickness with the necessary reinforcing section, and the whole shall be welded and fitted with bilateral rails. The thickness of the sidewalls of the tank shall not be less than 5 mm. The top and the bottom of the tank shall not be less than 4.5 mm.

Suitable lifting lugs must be provided to enable the transformer to be lifted by means of an overhead crane and slings. Suitable lugs shall be provided on the tank cover to facilitate its removal.

The tank shall be fitted with an oil drain valve which shall be designed to be suitable for oil sampling too. Alternatively, a separate valve for oil sampling shall be provided. Two suitably located earthing studs shall be provided and this point shall be colored with green and yellow color. The earth point must be clearly visible.

The whole of the tank and fittings shall be sand blasted inside and outside, to remove all scales and rust before painting (please refer clause 5.7 of section 5).

The construction of the tank particularly the cover should be such to prevent oil leakage under various load conditions. Construction drawings shall be submitted with the offer clearly showing the construction details to achieve this purpose.

6.14 Conservator

A conservator vessel shall be provided for mounting on the top of the tank. The conservator shall be of ample capacity for containing sufficient oil to allow for the transformer working over the maximum permissible temperature range.

Connection will be between the highest point of the main tank and the conservator and shall project four centimeters above the bottom of the conservator in order to allow a sump of collection of moisture or sludge, vent pipes shall be provided as required to prevent the trapping of air or gas in sealing ends, bushing or other pockets. The conservator tank shall be provided with a filling cap and drain valve.

6.15 Breather

A silica gel breather with replaceable elements shall be provided. If the breather is connected to the conservator body by pipe, this shall be of galvanized iron pipe. Oil or ball valve seals shall be provided to prevent the circulation of air except under correct working conditions. A suitable observation window to be provided in the breather. Breathers having glass or plexi-glass covers shall be provided with wire mesh or cages for protection and which can be easily removed.

6.16 Oil valve

High grade gun metal valves should be flanged type with indication to show whether in the open or closed position and with padlocking devices to prevent an inadvertent operation shall be fitted as an integral part of the valve as follows:

- A) Main tank drain valve (see clause 6.13 of section 6).
- B) Conservator to main tank valve.
- C) Conservator drain valve.

All drain valves to be fitted with plugs or cover plates and having oil tight joints.
All valves shall comply with BS. 5154, series "B".

6.17 Oil level gauge

An oil level gauge of an approved type shall be mounted on the end of the conservator vessel, particular care being taken that the oil level is easily observed when partially obscured by dust as may be expected, under operating conditions.

The gauge shall have three markings to indicate the level at 20 degree centigrade and lower and upper markings corresponding to the lower and the higher temperature for which the transformer is required to operate on site.

6.18 Gaskets

All gaskets used for making oil tight joints shall conform to BS. Au. 120 & BSS. 3063 as applicable, taking into account Kuwait's temperature conditions. A sample of gasket material together with test report should be submitted to the purchaser for approval. The material used for gasket shall be cork rubber and have very good resistance to transformer oil.

6.19 Rating & Terminal Marking Plates

Substantial brass or stainless steel diagram and rating plates in accordance with international electro-technical commission no. 76 and British Standard Specification no. 171 shall be fixed to each transformer giving full detailed information as follows :-

- Type of cooling :
- Kuwait rating KVA :
- BSS/IEC rating KVA :
- Volts at no-load & normal tapping : HV side
: LV side
- Short circuit current/duration : K Amps/sec.
- Impedance voltage : Percentage.
- Current at rated load & normal tapping : H.V. Side
: L.V. Side
- Type of winding : H.V. Side
: L.V. Side
- Number of phases :
- Diagram of connection :

- Position of tapping switch corresponding to different voltages :
- Manufacturer's name and transformer serial no. :
- Temperature rise of :
- A) Oil :
- B) Winding :
- Frequency :
- Vector group reference :
- Weight of oil :
- Weight of core and winding in tons :
- Total weight in tons :
- Quantity of oil in liters :
- Year of manufacture :



The plates shall not be less than 2.5 mm thickness and the marking shall be engraved to 0.5 mm therein, the writing being filled in black.

Full details of rating plates shall be submitted for approval.

6.20 Nuts and Bolts

All nuts and pins shall be locked in position in an approved manner with the exception of those external to the transformer where locking may be omitted on receipt of the purchasers approval.

Where possible, it shall be arranged that in the event of nut working loose and falling off, the bolts shall remain in position.

Where bolts and studs are so placed to be inaccessible by means of ordinary spanners, the contractor shall provide such special tools as are necessary.

6.21 Construction details

The overall construction and assembly of the transformers shall be robust and shall be rendered suitable for the arduous weather and local conditions under which these transformers will operate.

The contractor's attention is particularly drawn to the following requirements

- A) The coil's bracing and tightening shall be such that the hum and vibration is kept to a minimum and shall be sufficiently strong to withstand the short circuit forces.
- B) There shall be complete **step lap type** inter-leaving of lamination in joints between cores and yokes.
- C) Only copper conductors are acceptable for transformer winding.
- D) Adequate ducts for oil circulation to avoid hot spots and heat pockets in the following manner :-
 - I Axial ducts between HT. and LT. windings.
 - II Axial ducts between LT. winding and cores.
 - III Radial ducts in HT winding.
- E) Adequate insulation shall be provided at the end of the windings. Special care is to be taken for insulation at the end of the winding, which will lead for connection to the bushings.
- F) The transformer coils shall be vertically mounted and easily removed from limb by removing top yoke.
- G) The sound power level shall be measured in accordance with **IEC/BSEN 60076-10** and the value shall comply as specified.

- H) Location of tap changer switch shall be arranged on the **front** side of the transformer tank.
- I) The H.V. terminal bushing and the L.V. terminal bushings shall be on the top of the tank
- J) The manufacturer has to clearly state in his offer the type of winding offered (foil/sheet or wire conductor type winding) and this has also to be clearly engraved on the rating plate.

6.22 Termination on pole-mounted transformer

Pole mounted transformers shall be provided with outdoors type H.V. and L.V. Bushings generally as specified in latest relevant IEC/BS Specification No. 60076. The bushings shall be fully suitable for the site conditions specified and the number and minimum creepage distance of these shall be as follows:

- 3 nos. H.V. bushings 406 mm
- 4 nos. L.V. bushings 127 mm

The bushing shall be tested according to the latest relevant IEC/BS Specification. The high voltage bushing shall be provided with arcing horns of an approved type. (the arcing horns shall be in two parts and subject to approval by MEW Engineer. Drawing indicating the arrangement shall be submitted with the offer)

The gap of the arcing horns shall be fixed to withstand the surge due to switching or atmospheric surges. As already mentioned earlier in the specification there may be heavy surge due to the lightning. The arcing horns must be able to protect the transformers from the lightning.

Necessary gauge for the measurement of fixed gap of the arcing horn must be supplied with the transformers. Minimum six (6) NOS. Gauge must be supplied. This will be used for verifying the gap of the arcing horn during installation and commissioning of the transformer.

The cap of the bushing shall be colored as follows:

For the phase on H.V. & L.V. it shall be colored red, yellow and blue and neutral on L.V. Side with white color.

H.V bushings shall be coated with silicone coating this shall be subjected to approval of MEW Engineer.

6.23 Oil

The transformers shall be dispatched with tanks filled with an approved make of insulating oil. The oil shall be in accordance with IEC. 60269

6.24 Test

The contractor shall carry out the tests specified in any applicable British Standard Specification, unless otherwise agreed upon, and such additional tests in the contractor's works as in the opinion of the purchaser or his representative are necessary to determine that the works comply with the conditions of the specification.

All tests shall be carried out in the presence of and to the satisfaction of the purchaser or his representative and at such times as he may reasonably requires.

Type and routine tests shall be carried out in accordance with relevant IEC/BSEN 60076 Specification, on each type of transformer fitted with all accessories.

In addition to the routine tests, the following tests also shall be applied in the presence of the purchaser or his representative.

- A) Ability to withstand short circuit test as per IEC 60076-5 in an internationally recognized independent laboratory (ASTA / **KEMA / CESI / CPRI**)

- B) Temperature rise tests on one transformer in accordance with British Standard IEC/ BSEN 60076 – 2 :-
I Continuous maximum rating under Kuwait conditions.
II Equivalent to BSS, continuous maximum rating.
- C) Impulse voltage withstand test on one transformer. The test shall be applied on each H.V. winding and shall be in accordance with IEC/ BSEN 60076 – 3. The test shall be carried out using a 95 KV impulse withstand voltage 1.2/50 wave of positive and negative polarity. Also, bushings shall be tested for impulse voltage withstand as required in the relevant IEC/BS specification.
- D) All transformers shall be tested, completely assembled with conservator tank ... Etc., for oil leakage. The oil pressure shall be equivalent to a head of four meters of oil above the normal oil level and shall be applied for a period not less than six hours.



N.B. The cost of the above tests shall be included in the contract price and shall not be quoted for separately.

- TYPE TEST CERTIFICATE FROM INTERNATIONALLY APPROVED LABORARARIES (ASTA/KEMA/CESI/CPRI) FOR THE OFFERED TRANSFORMER FROM SAME MANUFACTURER.**
- TYPE TEST CERTIFICATE SHALL BE LATEST ONE, NOT MORE THAN (FIVE) YEARS.**
- OFFER WILL BE REJECTED IF ABOVE IS NOT FULFILLED.**

