



Joint Ergon Energy/Energex

Technical Specification for Ground Mounted Distribution Transformers

JTS02-03-01

Technical Specification for Ground Mounted Distribution Transformers

Contents

1. Purpose and Scope	1
2. References	2
2.1 Applicable Standards	2
3. Drawings	3
3.1 Drawings by the Purchaser.....	3
4. Service Conditions	3
4.1 Environmental Conditions	3
4.2 Electrical Power Supply System Characteristics.....	4
5. Design and Construction	4
5.1 General	4
5.2 Loading	5
5.3 Oil Preservation System - Type	5
5.4 Tanks and Lids.....	5
5.5 Joints and Gaskets	5
5.6 Core and Windings	5
5.7 Tappings	6
5.8 Impedance Voltage	6
5.9 Cooling.....	6
5.10 Insulating Oil	6
5.11 Bushings and Terminals	7
5.12 HV Cable Box	7
5.13 LV Cable Box.....	10
5.14 Parallel Operation of Transformers	11
5.15 Sound Power Level.....	11
5.16 Radio and Television Interference	11
5.17 Fittings	11
5.18 Protective Coatings.....	13
5.19 Minimum Power Efficiency (MEPS)	13
5.20 Comparison of Tenders	13



Technical Specification for Ground Mounted Distribution Transformers

5.21	Additional Requirements	14
6.	Performance and Testing	15
6.1	Type Test Compliance	15
6.2	Routine Tests	15
6.3	Acceptance Tests	16
6.4	Witnessing of Tests	16
6.5	Routine Test Certificates	16
7.	Risk Assessment	16
7.1	Compliance	16
7.2	Formal Risk Assessment	16
7.3	Hazards	17
8.	Quality Assurance	17
8.1	Purchasers Policy	17
8.2	Documentary Evidence	17
9.	Samples	17
9.1	Production Samples	17
10.	Packaging and Marking	17
10.1	Packaging and Dispatch	17
10.2	Making of Goods for Delivery	18
10.3	Pallets	18
10.4	Unloading (Where Applicable)	18
10.5	Workplace Health and Safety	18
10.6	Transportation	19
11.	Service Performance	19
12.	Reliability	19
12.1	Service Life	19
12.2	Evidence in Support of Reliability	19
13.	Environmental Considerations	20
14.	Information to be Provided	20
14.1	Drawings and Information to be Submitted with the Tender	20
14.2	Drawings and Information to be Provided by the Supplier	20



Technical Specification for Ground Mounted Distribution Transformers

14.3	Purchaser Comments	20
14.4	Responsibility.....	20
14.5	Supplier Proceeding Work	20
15.	Quality of Drawings	21
15.1	Drawing Title Block	21
15.2	Drawing Revisions	21
15.3	Drawings in Electronic Format	22
16.	Attachment 1 – Specific Requirements / Guaranteed Particulars for Standard Offer	24
17.	Attachment 2 - Additional Requirements.....	37
18.	Attachment 3 - Risk Assessment.....	38
19.	Attachment 4 - Rating Plate Details for Transformer	40

Technical Specification for Ground Mounted Distribution Transformers



1. Purpose and Scope

This specification sets out the technical requirements for the design, manufacture, testing at works and supply of ground mounted distribution transformers complying with the latest current version of AS 60076 Power transformers – all parts and amendments as current, AS 2374 Power transformers – all parts and amendments as current, and as detailed in this specification. The following items are required:

Item	Description
1	11 kV/ 433-250 V;100 kV.A;3 Phase;50Hz;Ground Mtg;Air HV 180 LV Bsh;Mineral Oil Insulated;ONAN;Outdoor;Dyn11;Low Impedance Type;4.0% Impedance;7 Tap Positions;Tapping Range +10% To -5% At 2.5% Step;HV & LV Cable Boxes Fitted;Local Supply For Substations
2	11 kV/ 433-250 V;315 kV.A;3 Phase;50Hz;Ground Mtg;Air HV 180 LV Bsh;Mineral Oil Insulated;ONAN;Outdoor;Dyn11;Low Impedance Type;4.0% Impedance;7 Tap Positions;Tapping Range +10% To -5% At 2.5% Step;HV & LV Cable Boxes Fitted;Local Supply For Substations
3	11kV/ 433-250 V;500 kV.A;3 Phase;50Hz;Ground Mtg;Cable Box HV 180 LV Bushings;Mineral Oil Insulated;ONAN;Outdoor;Dyn11;Low Impedance Type;4.0% Impedance;7 Tap Positions;Tapping Range +10% to -5% At 2.5 % Step HV Cable Box Fitted
4	11 kV/ 433-250 V;750 kV.A;3 Phase;50Hz;Ground Mtg;Air HV 180 LV Bushings;Mineral Oil Insulated;ONAN;Outdoor;Dyn11;Low Impedance Type;5.0% Impedance;7 Tap Positions;Tapping Range +10% To -5% At 2.5% Step. HV Cable Box Fitted
5	11 kV/ 433-250 V;1000 kV.A;3 Phase;50Hz;Ground Mtg;Air HV 180 LV Bushings;Mineral Oil Insulated;ONAN;Outdoor;Dyn11;Low impedance Type;5.0% Impedance;7 Tap Positions;Tapping Range +10% To -5% At 2.5% Step. HV Cable Box Fitted
6	11 kV/ 433-250 V;1500 kV.A;3 Phase;50Hz;Ground Mtg;Air HV 180 LV Bushings;Mineral Oil Insulated;ONAN;Outdoor;Dyn11;Low Impedance Type;6.25% Impedance;7 Tap Positions;Tapping Range +10% To -5% At 2.5% Step. HV Cable Box Fitted
7	11 kV/ 433-250 V;1500 kV.A;3 Phase;50Hz;Ground Mtg;Air HV 180 LV Bushings;Mineral Oil Insulated;ONAN;Outdoor;Dyn11;HIGH IMPEDANCE Type;9.75% Impedance;7 Tap Positions;Tapping Range +10% To -5% At 2.5% Step; HV Cable Box Fitted
8	33 kV/ 433-250 V;315 kV.A;3 Phase;50Hz;Ground Mtg;Air HV 180 LV Bushings;Mineral Oil Insulated;ONAN;Outdoor;Dzn0;Low Impedance Type;4.0% Impedance;7 Tap Positions;Tapping Range +10% To -5% AT 2.5% Step;HV & LV Cable Boxes Fitted;Local Supply For Substations
9	33 kV/ 433-250 V;750 kV.A;3 Phase;50Hz;Ground Mtg;Air HV 180 LV Bushings;Mineral Oil Insulated;ONAN;Outdoor;Dzn0;Low Impedance Type;5.0% Impedance;5 Tap Position;Tapping Range +10% To -5% At 5% Step;HV & LV Cable Boxes Fitted;Local Supply For Substations
10	LV cable box with accessories to suit Item 3, 11kV 500 kVA transformer
11	LV cable box with accessories to suit Item 4, 11kV 750 kVA transformer
12	LV cable box with accessories to suit Item 5, 11kV 1000 kVA transformer
13	LV cable box with accessories to suit Item 6, 11kV 1500 kVA transformer

Technical Specification for Ground Mounted Distribution Transformers

2. References

2.1 Applicable Standards

Unless specified otherwise, all equipment must comply with the latest current version of all relevant Queensland Health & Safety Acts/ Regulations, Australian/ International Standards, (and where directly relevant to the equipment in it's own right, and any considerations of normal Energy Industry Sector application) the National Electricity Law, National Electricity Regulations, and National Electricity Rules, including all current amendments and parts, in particular:

Standard	Title
AS 1100	Technical Drawings
AS 1319	Safety signs for the occupational environment
AS/NZS 1580	Paints and related materials – Methods of Test
AS 1767	Insulating liquids - Specification for unused mineral insulating oils for transformers and switchgear
AS 2067	Substations and high voltage installations exceeding 1 kV a.c.
AS 2129	Flanges for pipes, valves and fittings
AS/NZS 2312	Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings
AS 2374	Power Transformers (including all parts and normative references as current)
AS/NZS 4680	Hot-dip galvanized (zinc) coatings on fabricated ferrous articles
AS 2700	Colour Standards for general purposes
AS 3000	Electrical installations (known as the Australian/New Zealand Wiring Rules)AS/NZS 4360 Risk Management
AS 4436	Guide for the selection of insulators in respect of polluted conditions
AS/NZS 4680	Hot-dip galvanized (zinc) coatings on fabricated ferrous articles
AS/NZS ISO 9001	Quality Management Systems
AS/NZS ISO 14000	Environmental Management Standards <i>Set</i> , including,
AS/NZS ISO 14042	Environmental management - Life cycle assessment - Life cycle impact assessment
AS 60038	Standard voltages
AS 60044.1	Instrument transformers - Current transformers
AS 60044.2	Instrument transformers - Inductive voltage transformers
AS 60076	Power transformers (including all parts and normative references as current)
AS/NZS 60137	Insulated bushings for alternating voltages above 1000 V
AS 60214	Tap-changers (including all parts and normative references as current)
AS 60270	High voltage testing techniques – Partial discharge measurements
IEC 60721	Classification of environmental conditions (including all parts and normative references and all other as relevant to this technical specification)
IEC 61619	Insulating liquids - Contamination by polychlorinated biphenyls (PCBs) - Method of determination by capillary column gas chromatography
AS 62271.200	High-voltage switchgear and controlgear - A.C. metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV
AS 62271.301	High voltage switchgear and controlgear - Dimensional standardization of terminals

Technical Specification for Ground Mounted Distribution Transformers

If the equipment offered does not comply with Australian Standards, but complies with International Standards, eg IEC, then detailed descriptions will be given in English of the differences between the apparatus offered and the Australian Standards specified requirements. Note: The Purchaser will not accept equipment that does not comply in full with all relevant Queensland Health & Safety Acts/ Regulations.

3. Drawings

3.1 Drawings by the Purchaser

The following drawings are included and form part of this specification:

Drawing	Revision	Title
02-03-01	A	11 kV Cable Box - Removable Gland Plate and Termination Adaptor Details
02-03-03	A	General Arrangement for Attaching LV Current Transformers on Cable Box Distribution Transformers
02-03-04	A	General Arrangement for Insulated Earth Stud and Bar in HV Cable Termination Box for 11 kV / 433 V Distribution Transformers
5267-A3	F	Underground Hardware Connector, Copper Tube Type Long Barrel For Stranded Copper Conductors

4. Service Conditions

4.1 Environmental Conditions

The items will be installed outdoors/ indoors and will be exposed to and must be able to withstand the following environmental conditions:

Humidity	Extended periods of relative humidity, ranging from 10% to 90% (IEC60721-2-1 Figure 6)
Solar radiation Level	1 100 Wm ⁻² with high ultra violet content (IEC60721-2-4 Table 1)
Ambient temperature range	+ 45°C summer daytime (maximum) - 5°C winter night time (minimum)
Precipitation	Annual rainfall in excess of 1500mm (Bureau of Meteorology)
Wind speed	Tropical summer storms with gust wind speeds above 160 km/h
Isokeraunic Level	35-40 (Bureau of Meteorology)
Pollution	Level IV – very heavy (for installation in polluted ambient air with areas of coastal salt spray and industrial pollution refer AS4436 Table 1)

Technical Specification for Ground Mounted Distribution Transformers



4.2 Electrical Power Supply System Characteristics

Particulars	System Voltages		
	230/400 V phase to neutral/ phase to phase	11 kV	33 kV
Nominal system voltage	230/400 V	11 kV	33 kV
Highest system voltage	253/440 V	12 kV	36 kV
Number of phases	1/3	3	3
Frequency	50 Hz	50 Hz	50 Hz
Insulation level (BIL/flashover voltage)	AC 10 kV rms	95 kV peak / 28 kV rms	200 kV peak / 70 kV rms
Rated short-time withstand current / Duration	38 kA / 1 sec minimum, ≥50 kA / 1 sec preferred	20 kA / 3 sec	31.5 kA / 3 sec

The Purchaser's 11 & 33kV systems are 3 phase, 3 wire, 50 Hz. The substations may be installed in effectively earthed and non-effectively earthed situations. When installed in non-effectively earthed situations, significant voltage variations (up to line to neutral voltage) may be produced at the neutral terminal during an earth fault.

The transformers will be suitable for indoor and outdoor use.

The service conditions will be in accordance with Clause 1.2 of AS 60076.1, with the following exception that the maximum air temperature will be 45°C and the average daily and annual air temperature will not exceed 35°C and 25°C respectively and consequently the allowable reduced temperature rise limits to those specified in AS 2374.2 shall be limited to 55° C and 60° C for top oil temperature rise and average winding temperature rise respectively. The mean relative humidity can vary between 40% and 90%.

5. Design and Construction

Design and construction performance parameters are detailed in this section and supplemented by **Attachment 1**.

5.1 General

Generally, all design and construction of the items and their components and parts must be Fit for Purpose and Fit for Duty, including for Normal Cyclic and Emergency Cyclic Duty as described in this specification and applicable documents to prevent distortion or damage under service conditions and during handling and transport.

The transformers will be suitably stiffened and braced to prevent distortion or damage under service conditions or during handling and transport.

All sharp points on transformer exterior will be removed to prevent injury.

All bolts nuts and washers (fasteners, studs, lifting lugs etc.) will be to Australian Metric Standards and be stainless steel Grade 316 or 304. Compatibility, with regard to corrosion

Technical Specification for Ground Mounted Distribution Transformers

prevention, between the fasteners will be observed. To prevent binding, different grade stainless steel nuts and bolts¹ will be used together with anti-seizing lubricant on all bolt threads.

The overall dimensions of the transformers will not exceed the limits detailed in **Attachment 1**.

5.2 Loading

The transformers will be suitable for loading in accordance with AS 2374, Part 7. No part of the transformer (for example; bushings or tapping switch) will impose restrictions on the loading capabilities.

5.3 Oil Preservation System - Type

Sealed tank type construction will be used; however, the transformers will not be pressurised or incorporate gases other than air. Diaphragm sealing is not acceptable.

5.4 Tanks and Lids

All surfaces will be designed to prevent the accumulation of water.

All seams will be electrically welded and oil tight.

On the external areas of the tank, welding of horizontal and vertical joints will be on both sides of the joint. Welding in all cases will be continuous.

All metal work will be electrically bonded to the tank to permit earthing by the Purchaser. If a part cannot be adequately bonded it will be constructed from a suitable insulating material instead of metal.

The tanks will be so designed that with a top oil temperature of 105°C, the oil level in the tank will be below the tank lid flange.

The lid of the transformer will be capable of being removed without having to take off other components first (eg. cable box) and will be capable of supporting up to 100 kg of a person's weight without permanent deformation.

The tank will incorporate all mounting studs necessary for the fitment of an LV cable box. It will also incorporate two mounting lugs located approx. 450mm above ground level for attachment of the LV cable support bracket. (Refer clause 5.13.3).

5.5 Joints and Gaskets

All joints will be oil tight. All gaskets/seals will be designed to last the intended life of the transformer. Joints in gaskets will not occur at bolt holes.

5.6 Core and Windings

All transformers will have electrically separate high and low voltage windings connected to comply with vector group Dyn11, or Dzn0 as relevant to the items as stated in Attachment 1, of AS 60076.

The core and winding assembly will be supported by the main tank and not by the cover.

¹ For example, 316 grade bolts and washers fitted with 304 grade nuts.

Technical Specification for Ground Mounted Distribution Transformers

Means will be provided at both the top and bottom of the core and coil assembly for locating the transformer core centrally in the tank and securing it in position to prevent movement, particularly during transport.

The core and all metalwork will be electrically bonded to the tank. The bonding will be brought to one point only.

The insulation between the core and the frame will have a resistance no lower than 50 M Ω after assembly, and will withstand 2.5 kV for one minute. The core and frame will then be electrically connected together at one point only.

5.7 Tappings

Seven tappings will be provided on the high voltage winding. The tapping range for each unit will be +10% to -5% of rated voltage with a tapping step of $\pm 2.5\%$. Tap position 1 will correspond to the full winding in circuit.

Each transformer will be capable of off-circuit tap changing by means of an externally operated seven position tapping switch.

The tapping switch will have a permanent overload capability of 50% i.e. 150% of nameplate full load current of transformer.

The tapping switch will be located near the top of the transformer for ease of access and to readily facilitate unloading of the transformer.

The tapping switch will be capable of being locked in each position. The locking arrangements will be such that it is not possible to lock the switch between taps.

Each tapping selector switch position will be identified by a number clearly and indelibly stamped onto either the switch operating handle or the transformer tank.

A sealing gland will be provided on the tapping selector switch operating shaft where it passes through the transformer tank to prevent any breathing or leaking along the shaft.

5.8 Impedance Voltage

The impedance voltage at rated current on principal tapping will be as specified in **Attachment 1**.

5.9 Cooling

The method of cooling each transformer will be ONAN.

5.10 Insulating Oil

The transformers will be delivered filled (to cold oil level) with mineral insulating oil complying with: AS 1767.1 - 1999, and be proven to be non-corrosive by Method B of ASTM D1275-06 Standard Test Method for Corrosive Sulfur in Electrical Insulating Oils and, IEC 62535 Ed. 1.0: Insulating liquids – Test method for detection of potentially corrosive sulphur in used and unused insulating oil. The quality of Mineral Insulating oil at time of filling (i.e. on release from supplier) must have a moisture content of less than 20 ppm and greater than or equal to 50 kV Breakdown Voltage.

Any and each insulating oil offered will be certified as polychlorinated biphenyl-free (PCB-free) in accordance with the definition of PCB-free in the Environmental Protection (Waste

Technical Specification for Ground Mounted Distribution Transformers

Management) Regulations 2000 (Qld). Analysis shall be conducted in a laboratory certified by NATA for the appropriate analyses. The Tenderer will supply full specifications and test results for any and each oil offered.

5.11 Bushings and Terminals

5.11.1 General

All bushings will comply with AS/NZS 60137, AS 4436 and the Service and Environmental Conditions as specified in this technical specification. All porcelain components will be glazed and fully vitrified.

All terminal palms will be arranged vertically and comply with AS 62271.301. They will be copper with their contact surfaces tinned or silver plated. Both surfaces will be used as contact surfaces.

5.11.2 LV Bushings

The LV bushings will be mounted horizontally on the side of the transformer opposite the HV cable box and spaced to allow a bushing mounted current transformer to be fitted by the Purchaser to each phase as shown in drawing 02-03-03.

The part of each LV bushing within the tank will be completely covered with oil when the transformer is cold (with an outside temperature of 15°C), and will be readily accessible with the tank cover removed.

The distance between centre lines of the LV bushings will not be less than 200 mm for all ratings. The taut string metal to metal clearances of the bushing terminals will be not less than 100 mm, phase to phase, and 60 mm phase to earth.

The terminal palms will allow for current transformers to be fitted over them (clear of the contact area).

The neutral connection to the star point on the secondary winding will be brought out of the tank unearthed and insulated in the same manner as the phase terminals.

5.11.3 Marking of Terminals

The terminals will be marked in accordance with AS 2374. The use of adhesives to attach marking plates will not be accepted.

5.12 HV Cable Box

5.12.1 Designed to Conform to AS 62271.200

The cable box will be designed to conform with the internal arc withstand requirements of AS 62271.200 : High-voltage switchgear and controlgear - A.C. metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV, Annex A, A.2 Types of accessibility, Accessibility Type A, A.6 Acceptance criteria, Criterion No. 1 to Criterion No. 5 inclusive, for an IAC classification test current for each voltage level to the Purchaser's satisfaction, generally being preferred by the Purchaser as; the Rated short-time withstand current for each voltage level as noted under Clause 4.2 Electrical Power Supply System Characteristics with an IAC Fault duration of 1 second.

Technical Specification for Ground Mounted Distribution Transformers

5.12.2 General Requirements for 33 kV Cable Boxes

The access cover of the cable box shall be capable of being removed/installed by two persons without mechanical aids. A brushed aluminium cover fitted with suitable lifting handles is preferred by the Purchaser. As a minimum, the top edge of the access cover shall have a return to ensure the ingress of moisture through the gasket is prevented. It is preferred that both side edges also include a return.

Cable lugs as shown on Drawing Number 5267 – A3 will be supplied by ENERGEX.

The minimum clearances between exposed live parts shall generally be in accordance with the requirements of AS 2067 for the required impulse withstand voltages of 200 kVp. When determining minimum clearances, due consideration shall be taken of the flexible cable connections. Where manufacturers use clearances that are less than those shown in AS 2067, type test results are to be provided by the Supplier indicating that the clearances selected are capable of meeting the above test voltages.

The design of the cable box shall be such that the cable termination connections can be left bare without the need for further insulation. The provision of easily removable phase-barriers is acceptable.

Lightning impulse withstand voltage tests shall be carried out with the cable lugs suitable for the applicable cable fitted within the box (to remain fitted to transformer during test including cover) to prove compliance with the specified impulse withstand voltage level.

The cable box shall be completely weather and vermin proof and shall be adequately ventilated to eliminate the possibility of build up of moisture internally.

The cable box shall be fitted with a removable gland plate made of aluminium, brass, or other corrosive-resistant material to the Purchaser's satisfaction, bolted to the underside of the cable box to allow the cables to be laid into and removed from the box without the need to thread the cables through the entry holes. This feature provides ease of jointing and facilitates the changing of transformers.

An earth bar for cable sheath earths, insulated from the transformer steelwork, shall be provided in the cable box. The earth bar shall have sufficient holes provided to allow for individual connection of each cable sheath. Provision shall be made for external connection to the earth grid.

The minimum distance from the gland plate to ground level shall be 460 mm.

The cable box front cover shall be fastened using galvanised bolts, nuts and washers.

The cable openings shall be located directly below the corresponding phase cable connection points.

5.12.3 33 kV Cable Requirements

33 kV cable boxes provided for distribution transformers shall be suitable for terminating all industry standard 33 kV cables used for power supply distribution.

Allowance shall be made in the gland plates to accommodate these cables.

Consideration shall be given to the provision of support insulators for connection busbars and/or the use of flexible connectors to alleviate excessive forces being applied to the tank bushings by the expansion and contraction of connected cables under different load and temperature conditions. Flexible connectors, if used, shall be capable of carrying the specified overload current of the transformer. Support insulators and flexible connectors

Technical Specification for Ground Mounted Distribution Transformers



where required shall be provided to each phase and neutral connection. The design of these flexible connectors shall be approved by the Purchaser prior to use.

5.12.4 General Requirements for 11 kV Cable Boxes

The transformers will be fitted with an air insulated HV cable box (refer to drawing 02-03-01) suitable for the termination of 11 kV PLYHDPE or XLPE/HDPE 3 core cables with Cu. or Al. conductors ranging in size from 35 mm² to 95 mm² and 11kV XLPE/HDPE Triplex (3x1 core) cables with Al. conductors ranging in size from 35 mm² to 185 mm².

The HV cable box will be fitted on a side of the transformer tank parallel to the plane of the core and will be opposite the LV bushings. The centre of the HV cable box will be located within 100 mm of the centre of the overall transformer including radiators.

Clearances within the cable box will be in accordance with the air clearances specified in Clause 9.1 of AS 2067 for a 12 kV system with a 95 kV BIL and a 36 kV system with a 200 kV BIL. When determining these clearances, due consideration will be given to the cable termination lugs. (The largest lug used is Utilux Type H15135 or equivalent for 95 mm² stranded aluminium conductor and Utilux Type H15327 or equivalent for 185 mm² stranded aluminium conductor). The horizontal distance between the centre line of each phase termination will be 260 mm ± 5mm.

The vertical distance between the centre of the terminal palms and the cable gland plate will be 600 mm ± 5 mm. The terminal palms will be supplied fitted with 'angle adaptors' as shown on drawing 02-03-01. Note: Drawing 02-03-01 shows the details of the 'angle adaptor' to suit the three core cables. The 'angle adaptor' details to suit the triplex cables (if required) will be finalised in consultation with the successful tenderer. For the HV Cable Box; triplex / 3 x 1 Core cables (Ergon Energy requires allowance for; 51mm diameter holes to suit heat-shrinkable cable glands) are to be spaced at 120mm centres and bushing angle adaptors provided to suit.

Three earth stud arrangements similar to typical drawing QESI 02-03-04 will be required for the earthing of the individual cable screens. ENERGEX requires allowance for; 1 off 89mm diameter hole to suit a heat-shrinkable cable gland and bushing angle adaptors provided to suit. An earth stud arrangement similar to typical drawing QESI 02-03-04 will be required for the earthing of the individual cable screens.

With the wheels fitted to the transformer, the top of the cable gland plate will be a minimum of 850mm above floor level and it is preferred that the gland height be the same for all ratings.

The cable box will have a removable gland plate made of aluminium, brass or other non-corrosive material to the Purchaser's satisfaction that is not subject to inductive heating and meets the IAC design requirements for the cable box manufactured with reference to typical drawing 02-03-01 however the design will be modified such that the gland plate, and as fitted in the design of the HV cable box, overall dimensions will be suitable to accommodate the range of cables previously identified.

The overall dimensions of the removable gland plate will accommodate either a 3 core cable or triplex 3 x 1 core cable terminations at 120mm centres, all gland plates will come fitted with three earth stud arrangements beside each possible triplex 1 core possible entry with reference to typical drawing QESI 02-03-04. (**Note:** Drawing 02-03-01 shows the gland plate details for the 3 core cables only. Gland plate and cable box cut-out details to suit the triplex cables will be finalised in consultation with the successful tenderer).

Technical Specification for Ground Mounted Distribution Transformers

The removable gland plate will be blank regarding pre-drilled holes for cables entry/ glands and any other related to the glands. No cable glands or cut-outs for the actual cable gland entries are required, however, clearance for the glands and nuts, and the cable earthing arrangements must be allowed.

Three off insulated earth stud and bridging bar arrangements (one off next to each possible individual triplex cable entry similar to typical drawing 02-03-04) for earthing the screen of the XLPE cables will be provided.

Lightning impulse withstand voltage tests will be carried out with the angle adaptors and cable lugs fitted within the enclosed cable box to prove compliance with the specified LIWV level.

All transformers will be delivered with the cable box positioned for bottom entry of cables unless otherwise advised during the placement of order. The cable box will be designed so that it can be easily inverted for top entry.

The cable box will provide a degree of protection IP46 with the cable box in the bottom entry position, and IP42 in the top entry position.

The cable box front cover will be removable and have lifting handles. The gasket between the cable box and the front cover will be glued to the cable box.

The cable box will be able to breathe and will be so designed that condensation is avoided and the trapping of water on the bottom of the cable box (top or bottom entry positions) is avoided.

5.13 LV Cable Box

The Purchaser requires an air insulated cable box as standard for the LV bushings utilising the mounting studs described in Clause 5.4.7 for all items except for items 3, 4, 5, 6 & 7. The LV Cable box additional item will be required for items 3, 4, 5, & 6 as outlined in clause 5.21.2

The cable box will maintain the clearances given in Clause 5.11.2 and have a detachable un-drilled gland plate made of aluminium, brass, stainless steel or other non-corrosive material that is not subject to inductive heating and fit for purpose, to the Purchaser's satisfaction.

The cable box shall be supplied complete with all necessary accessories, supports and flexible connections suitable for termination of single or multiple 300mm² Copper or Aluminium cables as required. Additionally a 'unistrut' or equivalent type cable support bracket to accommodate up to 4 x 300mm² cables per phases and 2 x 300mm² cables for the neutral shall be provided. The bracket shall be suitable for attachment to the mounting lugs provided on the tank (clause 5.4.7) and shall be clear of the transformer cooling fins. All necessary nuts, bolts, etc for the mounting of the bracket shall be provided. The bracket design and attachment shall be to the Purchaser's satisfaction.

The Purchaser prefers that Low-voltage cable box dimensions/ designs be equivalent and interchangeable, while meeting all minimum statutory clearance requirements, for any designs of ground mounted distribution transformers where the Tenderer produces ranges of 11 kV, 22 kV (although 22 kV items not included in this technical specification but included in the total tender pack) and 33 kV ground mounted distribution transformers.

The mounting arrangement of the CT support brackets may need to be varied, depending upon the cable box supplied.

Technical Specification for Ground Mounted Distribution Transformers

Detail drawings of the cable boxes offered, including a list of accessories such as supports and flexible connections (expansion joints), shall be submitted with the Tender.

The LV extension palms/ flexible connectors (expansion joints)/ cable support boards must suit installation on all the Tenderer's kVA ratings listed above.

5.14 Parallel Operation of Transformers

The transformers shall be capable of operating in parallel with one or more transformers built to the same specification requirements.

5.15 Sound Power Level

The design and construction of each transformer will be such that the sound power level will be no greater than the applicable 'reduced limit' as per Appendix AA of AS2374.6.

5.16 Radio and Television Interference

The design and construction of each transformer will be such that it must not cause any perceptible radio or television interference.

5.17 Fittings

5.17.1 Rating and Designation Plates

Each unit will be supplied with a rating plate complying with AS 2374 and AS 60076. In addition, the Purchaser's contract number and transformer number will be included. The rating plate will also include a statement of compliance with AS 2374.1.2

The rating plate will be made from stainless steel (or non-ferrous metal) and be clearly marked.

Note: The transformer number is designated as the structured plant number (SPN) in Ergon Energy. The SPN will be nominated in the purchase orders to the successful Tenderer and it will be an eight digit number prefixed by two alphas (e.g. TD 12345678 for the distribution transformers).

5.17.2 Lifting and Transport Facilities

Fully rated lifting and hold down points will be provided on the transformers to facilitate the hoisting and holding down during transport and these shall be clearly marked with a permanent label or stencilled. .

Two lifting lugs marked "Transformer Lifting Point" with a minimum hole diameter of 28 mm will be provided suitable for lifting the transformer. These lugs will be positioned to allow centre lifting and cater for a maximum included angle for slings of 120°. They will be arranged so that any slings attached do not foul any part of the transformer and when suspended by them, the transformer will hang without tilting.

All parts of the transformer weighing in excess of 15 kg that will be removed for inspection or repair will be fitted with lifting points suitable for use with shackles and slings. For the main tank cover, at least two lifting lugs with M24 holes (minimum) will be provided.

Technical Specification for Ground Mounted Distribution Transformers

5.17.3 Wheels

Transformers will be fitted with wheels that enable them to be moved forwards, backwards and sideways. Jacking points will be provided to facilitate changing the direction of the wheels. The wheelbase and wheel height will be such that the transformer may be rolled from one level surface to another 530 mm higher, using a ramp 4 m long, without any portion of the transformer fouling. Towing holes will be located on the frame such that it is possible to connect a cable to winch the transformer along. The wheels will be suitable for running in 152 mm x 76 mm channels.

5.17.4 Current Transformer Support Brackets

Current transformer support brackets will be designed and provided by the Supplier in the positions indicated (refer drawing 02-03-03), fully welded to the tank. The inside and outside diameters and depth of each current transformer are 112mm and 170mm and 65mm respectively.

5.17.5 Earthing Terminal

A stainless steel flag of at least 50 x 40 x 5 mm with an M14 hole will be provided near the bottom of the tank (as close as practicable to vertically below the secondary neutral terminal) in an easily accessible position. The earth flag will be welded directly to the tank.

An M12 x 40 mm Grade 304 stainless steel bolt and stainless steel nut, locknut and two flat washers will be supplied fitted to the flag.

5.17.6 Oil Level Indicator

Oil level indication will be provided by a permanent marking on the inside of the tank.

A flush type external oil level indicator will also be provided. It will indicate the oil level over the designed operating temperature range of the transformer. The cold oil level will be clearly and indelibly marked on the indicator.

5.17.7 Oil Draining

An oil drain valve is required for transformers with ratings of 1000kVA and above – items 5, 6 & 7.

The drain valve will have a 25 mm BSP internal thread fitted with a flanged plug and shall be of the metallic sealing gate type. The valve will be positioned so that all sludge and thick oil can be drained from the bottom of the tank and that clear access is provided to operate the valve.

5.17.8 Thermometer Pocket

Thermometer pockets are not required.

5.17.9 Filler Cap

Transformers shall be fitted with a filler cap. It will be positioned on the lid as near as possible to one corner, such that if moisture did enter it would drop to the bottom of the tank and that if required, a pipe for draining oil can be inserted to the bottom of the tank.

5.17.10 Tank Markings

The transformer capacity, the Purchaser's identification number and the structured plant number will be stencilled in black on the tank where it can be easily seen. Each character will be 75 mm high and have a body width of not less than 12 mm. The words 'LOW

Technical Specification for Ground Mounted Distribution Transformers

IMPEDANCE' will also be stencilled in black capital letters on the tank 50 mm high with a body width of not less than 10 mm where the items are Low Impedance.

5.18 Protective Coatings

The Purchaser requires that all internal and external surfaces be protected against corrosion.

Exterior coatings shall be suitable for use in a very severe coastal/ marine environment as described in AS 2312.

As the estimated life of the transformer is 35 years, the life requirements for the coating system to first maintenance shall be classified as long term protection system designation "L" per AS 2312.

Exterior coatings, where coloured, will be storm grey, N42 to AS 2700.

The surface coating inside the tank will not react with the insulating oil.

5.19 Minimum Power Efficiency (MEPS)

All transformers must meet or exceed the minimum power efficiency levels specified in Table 1 of AS 2374.1.2 - 2003 Minimum Energy Performance Standard (MEPS). Transformers with efficiencies not meeting or improving performance upon these MEPS levels are unacceptable.

During the term of the Contract, the Purchaser reserves the right to negotiate with the Supplier to enhance the transformer power efficiency levels to meet any future amendments to the MEPS requirement of AS2374.1.2.

5.20 Comparison of Tenders

Guaranteed load and no-load loss figures are to be specified in Attachment "1" for all items. Load losses are to be corrected to a reference temperature of 75°C.

In evaluating the tenders, the Purchaser will capitalise the guaranteed losses and so determine the economic advantages of the transformers offered. Capitalisation of losses will be based on the guaranteed losses at the required power rating for each item as stated in Attachment "1" items. Load losses will be those specified on the principal tapping. For this contract, the following values will be used for the purpose of making a fair economic comparison:

F (No-load loss) = \$ 6 300 / kW

C (Load loss) = \$ 1 800 / kW

F and C are the \$/kW capitalisation figures for the no-load and load losses respectively.

As specified in AS 60076.1, the maximum allowable tolerance for the total losses for all transformers to be supplied under this contract is +10%. For any transformer, the maximum allowable tolerance for either the no-load loss or load loss is +15%, provided that the total loss meets the above requirement of +10%. Where the total loss exceeds the +10 % tolerance or either the no-load loss or load loss exceeds the +15 % tolerance, the Purchaser reserves the right to reject the unit. As an alternative, the unit may be accepted with the application of Liquidated Damages as described in the Liquidated Damages portion of the Standing Order.

Technical Specification for Ground Mounted Distribution Transformers



5.21 Additional Requirements

Tenderers will advise full details in **Attachment 2** for each of the following Additional Requirements:

5.21.1 Low-Voltage Current Transformers (CTs) for Future (Remote) LV Monitoring - Requirement

The Purchaser requires all Items in Attachment 1 to come fitted with

- CTs,
- voltage reference take-offs - one per phase for all and each three phases, LV Neutral and LV Earth,
- CT & VT wiring cabled to a junction/ marshalling box, all being ultraviolet stabilised and fit for outdoor, all-weather use.

The CTs must be pre-wired short-circuited in the junction/ marshalling box via a shorting plug; ready for future connection to a possible future LV Monitoring/ LV Meter system*. The CT items and arrangements as required must be correlated to the transformer size and Emergency Cyclic Duty as per AS 2374.7 and as per CT items specifications and requirements as noted in TS481 LV Transformer Monitoring Capability Requirements for Pole Top and Ground Type Transformers. The position of the junction box must be to the Purchaser's requirements.

The Tenderer to provide full details and information for each item so fitted.

5.21.2 The Purchaser may require LV cable box fitted to the base items 3, 4, 5, & 6. The Tenderer shall provide as separate items for fitting either during the manufacturing process or as individual items.

Item No	Description
12	LV cable box with accessories to suit Item 3, 11kV 500 kVA transformer
13	LV cable box with accessories to suit Item 4, 11kV 750 kVA transformer
14	LV cable box with accessories to suit Item 5, 11kV 1000 kVA transformer
15	LV cable box with accessories to suit Item 6, 11kV 1500 kVA transformer

5.21.3 Maximum Demand Indicator

Accuracy class 3 Maximum Demand Indicators (MDIs) connected to the CT wiring of the junction box in clause 5.21.1

The indicators will be scaled in primary values to 120% of the transformer's full load rating and have dual pointers (one driving pointer & one driven/resetable pointer). Each MDI will be labelled (A, B or C phase as appropriate) with an additional label "TRANSFORMER LOADING" identifying the origin of the readings.

The wiring between the current transformers and maximum demand indicators will be through a terminal block with facilities to allow the insertion of 4 mm banana plug test leads and the shorting of the current transformers, such terminal block facility and arrangements will be provided in the one enclosure, also catering for specification requirements in TS481 LV Transformer Monitoring Capability Requirements for Pole Top and Ground Type

Technical Specification for Ground Mounted Distribution Transformers

Transformers to allow future LV Monitoring system connection . The CT ratio will be clearly marked near the terminals.

The MDIs will be mounted on the transformer in a suitable outdoor enclosure in a readily accessible position. The position must be to the Purchaser's requirements. The associated current transformers will be fitted around the LV bushings and attached to the support brackets (refer to drawing 02-03-03).

6. Performance and Testing

6.1 Type Test Compliance

The following type tests, as specified in AS 2374, will be conducted on each design:

- Temperature Rise Test
- Impulse Voltage Withstand Test
- Impulse Voltage Withstand Test Including Chopped Wave Test
- Sound Level Tests
- Short Circuit Tests

All units of the same design will be identical in all respects relating to materials, design and manufacture.

A copy of the type test certificates will be provided, free of charge, to the Purchaser for each item purchased against this specification and prior to the first delivery of each item. If an item has not been previously tested, the Purchaser will allow the tests to be performed on purchased units at the Suppliers expense.

Where units are offered of a similar design to those previously tested, consideration may be given (in accordance with AS 2374.1, Clause 3.11.2) to accepting previous type test reports. Tenderers will state if such tests exist. Tenderers may be requested (during the tender evaluation period) to substantiate their claims with written engineering evaluation. Such evaluation will provide all relevant details so that the Purchaser can establish the validity of existing type tests.

A list of all options and accessories that have been satisfactorily tested with the transformer offered, giving details of the manufacturer and product identification, is to be provided with the tender.

6.2 Routine Tests

The following routine tests, as specified in AS 2374, will be carried out on every transformer supplied:

- Measurement of winding resistance
- Measurement of voltage ratio and check of voltage vector relationship
- Measurement of impedance voltage, short circuit impedance and load loss
- Measurement of no-load loss and current
- Calculated MEPS efficiency;
- Separate-source voltage withstand
- Induced over-voltage withstand
- Insulation resistance

To prove that transformers have been adequately sealed, a routine pressure test will also be performed. Each transformer will be pressurised to not less than 30 kPa with dry air. If

Technical Specification for Ground Mounted Distribution Transformers

after 30 minutes, the pressure has not dropped more than 2 kPa, the transformer is considered to have passed the test.

6.3 Acceptance Tests

Subsequent to delivery and before approval is given for full payment, the equipment may be tested by the Purchaser to prove that it conforms with the requirements of this specification.

Any equipment showing evidence of failure to comply with the requirements of this specification will be liable to rejection.

6.4 Witnessing of Tests

The Purchaser reserves the right to witness all type tests and randomly witness routine testing.

The supplier will give the Purchaser reasonable notice of when each and every type test will be carried out.

6.5 Routine Test Certificates

One copy of the routine test results will accompany each unit delivered. A second soft copy will be forwarded to the Supervising Officer for the contract or Purchaser's nominated representative for the contract by electronic mail. (For Ergon Energy : inventory.nameplatedata@ergon.com.au)

All test certificates will include the manufacturer's serial number. On allocation, the Purchaser's structured plant number, the order number, contract/item number, specification number and guaranteed losses/efficiency will be added to the certificate, or attachment to the test report.

The soft copy of the test certificates will also be accompanied with the completed Attachment 4 returned as a MS Excel document.

7. Risk Assessment

7.1 Compliance

The Tenderer warrants (without limiting any other warranties or conditions implied by law) that all Goods have been produced, sold and delivered to the Principal in compliance with all applicable laws (including all workplace health and safety and electrical safety legislation, codes of conduct and the Principal's Workplace Health & Safety and Electrical Safety Conditions).

7.2 Formal Risk Assessment

Tendered items will be subjected to a formal risk assessment prior to acceptance. The Queensland Plant Code of Practice requires the Tenderer to perform a risk assessment and provide the resultant documentation to the Purchaser with their tender. Where risk assessment documentation is not provided with the tenders, or does not meet the required standard, such tenders may be rejected or will have their price loaded with the estimated costs associated with the Purchaser conducting the assessments. Any documented risk assessment which accompanies the tender will meet the requirements of AS/NZS 4360:1995 Risk Management as a minimum standard and address the five main steps of the process. It is preferred that the risk assessment methodology uses an energy model to identify hazards.

Technical Specification for Ground Mounted Distribution Transformers

7.3 Hazards

The risk assessment/s will identify hazards to the corporation's personnel, public and property associated with:

- a) The installation of the equipment
- b) The operation and maintenance of the equipment during life expectancy
- c) Dismantling/ disposal of equipment at end of life.
- d) The 'Risk Assessment' schedule included with this specification is to be completed by the Tenderer.

Note: The schedule contains a generic set of questions designed to cover all of the Purchaser's plant and materials and the tenderer is only required to complete those items applicable to the product offered. Where required by some questions, full details to support answers will be furnished.

8. Quality Assurance

8.1 Purchasers Policy

It is expected that suppliers will have a quality system certified to AS/NZS ISO 9001 in operation.

8.2 Documentary Evidence

Documentary evidence shall be provided concerning the level of Quality System Certification associated with the supplier and or manufacturer. This documentation shall include the Capability Statement associated with the Quality System Certification.

9. Samples

9.1 Production Samples

Samples of typical units may be required during the tender assessment period. Samples would normally only be required from tenderers who have previously not supplied transformers to the Purchaser.

When samples are required, production samples will be delivered freight free, suitably packaged and labelled including the Contract Number and delivered to the Purchaser's nominated location marked Attention: <the Purchaser's nominated contract representative – contact details as per noted in the Tender documentation> after liaison with the same Purchaser's nominated contract representative.

The Purchaser may at its discretion either buy the samples at the tendered price or return the samples to the respective tenderer after the contract has been awarded.

10. Packaging and Marking

10.1 Packaging and Dispatch

- a) The packaging of items by the Contractor must ensure that they are capable of being delivered undamaged giving due consideration to the quantity, distance of transportation and the preferred method of handling at each location.

Technical Specification for Ground Mounted Distribution Transformers



- b) The Contractor shall take all necessary precautions to ensure safe handling of all products supplied.

10.2 Making of Goods for Delivery

- a) Delivery documents accompanying items shall contain the following information:
 - Ergon Energy Contract Number
 - The Purchase Order number against which the item(s) is being supplied;
 - Item description; and
 - Quantity

The information will be provided to the Contractor on each Purchase Order issued by Ergon Energy under the Materials Contract.

10.3 Pallets

- a) The Contractor(s) shall take all necessary precautions to ensure safe handling of all products supplied, in particular:
 - Palletised goods are to be secured and stabilised with no overhang to facilitate safe unloading
 - Individual packs shall not have any sharp edges or protrusions, which can cause injury.
 - Pallets are to be labelled with the following information:

Item Description
ENERGEX Stores Stock Code
Manufacturers Name
Pack Size

- Palletised goods shall be supplied on standard pallets, 1165mm x 1165mm to AS 4068 with 150mm bottom entry boards and in good condition. Specially designed pallets may be accepted where additional stability is required.
- The overall height of palletised goods shall not exceed 1.4 metres.

10.4 Unloading (Where Applicable)

Ergon Energy will arrange unloading of goods at the delivery point between the hours 8:00am and 3:30pm on any normal working day.

For deliveries outside these hours, the Contractor shall make arrangements at no cost to Ergon Energy and if necessary, accept any charges representing expenses incurred by Ergon Energy because of that delivery.

10.5 Workplace Health and Safety

The Contractor must:

- a) Wear footwear, which completely covers the feet and protects them from injury in accordance with the provisions of the Queensland Workplace Health and Safety Regulation 1995. These provisions apply to all drivers delivering goods to any Ergon Energy site.
- b) If the nature of the goods being delivered/unloaded presents a high risk of injury to the feet during the operation, safety footwear manufactured to AS 2210 must be worn.

Technical Specification for Ground Mounted Distribution Transformers



- c) Drivers must wear high visibility vests at all Ergon Energy delivery sites. Failure to comply with these requirements may result in refusal to unload the vehicle.

10.6 Transportation

The Contractor must:

- a) Ensure that delivery of Materials to sites does not breach Queensland Transports requirements for the operation of B Doubles. The Contractor acknowledges that most Ergon Energy sites are not located on approved B Double routes.
- b) Ensure that all goods and loads on the Contractors vehicles must be restrained in such a manner as to comply with Part 4 (Loading) of the Queensland Transport and Traffic Amendment Regulation (No 1) 1995, with specific reference to Performance Standards outlined in the Load Restraint Guide Second Edition 2004 (published by the Australian Government Publishing Service and available for purchase from the Commonwealth Government Bookshop).
- c) Ergon Energy accepts no responsibility for any penalties incurred by the Contractors for a breach of these loading obligations.

11. Service Performance

Tenderers will state:

(a)	The period of service achieved by the items offered within Australian service conditions
(b)	Australian electricity supply authorities who have a service history of the items offered
(c)	Contact names and phone numbers of relevant employees of those supply authorities who can verify the service performance claimed.

In the absence of relevant Australian Service performance, the information required in (a), (b) and (c) above will be stated for service history in overseas countries. Priority will be given to performance in environments similar to those described above.

12. Reliability

12.1 Service Life

Tenderers are required to comment on the reliability of the equipment and the performance of the materials offered for a service life of 35 years under the specified system and environmental conditions.

12.2 Evidence in Support of Reliability

Such comments will include evidence in support of the reliability and performance claimed including information on Failure Mode and Effect Analysis.

Technical Specification for Ground Mounted Distribution Transformers

13. Environmental Considerations

Tenderers are required to comment on the environmental soundness of the design and material used in the manufacture of the items offered. In particular, comments should address such issues as recyclability and disposal at end of service life.

Tenderers are required to provide with the tender, EMF levels at transformer normal (balanced) maximum load. Such EMF levels are required at a point midway along each side, and diagonally out from each corner, at a distance of 1m above and beyond the base.

14. Information to be Provided

14.1 Drawings and Information to be Submitted with the Tender

14.1.1 To enable the Purchaser to properly evaluate the equipment being offered, (in addition to the completed attachments) Tenderers will submit the following information with their tender:

- a) A list showing similar equipment supplied to or on order from other Australian Electricity Supply Authorities.
- b) General arrangement drawings of the transformers offered including details of the HV cable boxes and LV terminal palms.
- c) Type test certificates for the transformers offered, or transformers of similar design and rating (if available).
- d) Typical loading curves (for loading transformers in accordance with AS 2374, Part 7)
- e) Short circuit test details for equipment of similar design and rating.
- f) Typical installation and maintenance manuals.
- g) Full details of the protective coatings offered.
- h) A list of all departures of the tender from this specification.

14.2 Drawings and Information to be Provided by the Supplier

Within three months from the signing of the agreement document with the Successful Tenderer, the Supplier will provide three copies of drawings and information necessary to enable the Purchaser to examine the general design and arrangement.

14.3 Purchaser Comments

The Purchaser will comment on drawings supplied under this contract in relation to how the equipment interfaces with the Purchaser's design, construction, operation, maintenance and other requirements.

14.4 Responsibility

Comments about drawings by the Purchaser will not in any way absolve the Supplier of responsibility for the safety and reliability aspects of the plant or equipment supplied. The Supplier will amend the drawings as directed and resubmit them to the Purchaser within one week.

14.5 Supplier Proceeding Work

In the event of the Supplier proceeding with work before such comment has been given in writing, any necessary alterations and modifications will be carried out at the Supplier's own expense. These drawings and information will include the following:

Technical Specification for Ground Mounted Distribution Transformers

- (a) A fully dimensioned general arrangement drawing for each transformer rating with the location of all fittings, enclosure panels showing:
- centre-lines and centre of gravity
 - electrical clearances
 - jacking, lifting (with maximum sling angle identified), towing and tie down points
 - maximum safe slope identified which the transformer can ascend/descend
 - mass
 - wheel mounting/storage positions
 - terminal/bushing heights
 - cable gland plate and gland details
 - CT support bracket details
 - terminal palm details
- (b) A drawing showing the rating and terminal marking plates for each transformer rating.
- (c) Erection, testing and maintenance information - the following information with particular reference to the equipment being supplied to this specification shall be provided:
- A comprehensive description of the plant, its construction, operation and performance capabilities.
 - A tabulation of the guaranteed electrical and mechanical performance characteristics of the equipment.
 - Detailed procedure for receiving, handling and storage
 - Pre-energisation checks on components and assemblies
 - Repair procedures for surface coatings
 - Special precautions during disassembly and reassembly (including bushings)
 - Relevant special requirements for reassembly (eg. nut/bolt tensions, crimp connections, welding, etc.)
 - Routine maintenance recommendations
 - Disposal at end of service life

Note: Each erection and testing procedure will be illustrated by clearly identifiable and labelled photographs, drawings or similar, acceptable to the Purchaser.

15. Quality of Drawings

15.1 Drawing Title Block

The drawing title will be a concise description of the contents of the drawing; it will contain a sufficient number of distinct lines each describing an aspect of the drawing so that all lines together represent an accurate and complete description.

The title will be designed so that it reads from the general to the particular, top to bottom, as indicated in the following example:

CONTRACT NO. ...
PLANT SPECIFIC eg GROUND TYPE DISTRIBUTION TRANSFORMER
MANUFACTURE TYPE eg 11000/433V 1500 kV.A
DRAWING FUNCTION eg GENERAL ARRANGEMENT

15.2 Drawing Revisions

A revision space will be provided on each drawing sheet. The original issue of the drawing is usually indicated as an 'A'; the first revision is therefore 'B'.

Technical Specification for Ground Mounted Distribution Transformers

Revision descriptions should be as brief and concise, as possible and where appropriate should indicate the previously existing situation, eg "Section 'B' dimension 1028 mm was 1044 mm".

It is preferred that standard industry practice, for example, such as on circuitry drawing revisions, where there are numerous revisions on the same drawing it will be necessary to highlight the revision note with a 'cloud effect' or similar highlighting, and similarly each correspondingly revised area of the drawing.

The revision block for each revision will preferably contain:

- (a) The revision letter in prominent display.
- (b) A brief description of the revision.
- (c) The draftsman's initials.
- (d) An approval signature and date.

15.3 Drawings in Electronic Format

Tenderers will also provide drawings in electronic format to AS 1102 and AS 1103. The Purchaser has a preference for MICROSTATION format however AutoCAD format is also acceptable.

JOINT ENERGEX/ERGON ENERGY

TECHNICAL SPECIFICATION

SPECIFIC REQUIREMENTS & TECHNICAL DETAILS TO BE PROVIDED BY TENDERER

THE FOLLOWING TABLES DETAIL SPECIFIC DESIGN AND PERFORMANCE CRITERIA FOR ITEMS COVERED BY THIS SPECIFICATION AND PARAMETERS TO BE PROVIDED BY THE TENDERER FOR ITEMS COVERED BY THIS SPECIFICATION.

Technical Specification for Ground Mounted Distribution Transformers



16. Attachment 1 – Specific Requirements / Guaranteed Particulars for Standard Offer

The Tenderer will complete this attachment and guarantee the particulars provided. Attach additional sheets as necessary.

Ref.	Particulars	Unit	Specified Value/ Response	Guaranteed Performance
				All Items * except where specifically noted
(A) Transformer (Common requirements for all components)				
1.	Manufacturer of complete transformer and country of manufacture	-		
2.	Oil Preservation System - Type	-		
3.	Service	-		
4.	Rated frequency	Hz		
5.	Number of phases	-		
6.1.1	Vector Reference Group * Items 1 to 7 and 10 & 11	-		
6.1.2	Vector Reference Group * Items 8 and 9	-		
6.1.3	Rated voltage			
6.1.4	• Primary Voltage * Items 1 to 7	V		
6.1.5	• Primary Voltage * Items 8 to 11	V		
6.2	• Secondary Voltage (No Load)	V		
7.	Method of cooling			
8.	Loading Suitable for loading in accordance with AS 2374, Part 7.	Yes/No		
9.	Normal Loading Curves Supplied with Tender (corrected for maximum ambient temperature)	Yes/No		
10.	Maximum Ambient Temperature	° C		
11.	Tappings 7 HV winding tappings, rated +10% to -5% of rated voltage, 2.5% steps, off-circuit.	Yes/No		
12.	Insulation Level:			
12.1.1	• HV winding impulse voltage withstand * Items 1 to 7	kV peak		

Technical Specification for Ground Mounted Distribution Transformers

Ref.	Particulars	Unit	Specified Value/ Response	Guaranteed Performance
				All Items * except where specifically noted
12.1.2	<ul style="list-style-type: none"> HV winding impulse voltage withstand * Items 8 to 11 	kV peak		
12.2.1	<ul style="list-style-type: none"> Power frequency voltage withstand of HV winding * Items 1 to 7 	kV rms		
12.2.1	<ul style="list-style-type: none"> Power frequency voltage withstand of HV winding * Items 8 to 11 	kV rms		
12.3	<ul style="list-style-type: none"> Power frequency voltage withstand of LV winding 	kV rms		
13.	All external bolts (fasteners, studs, etc.) nuts and washers 316 or 304 only grade stainless steel applied with a non-hazardous anti-seizing grease.	Yes/No		
14.	Top and bottom cable entry	Yes/No		
15.	Degree of Protection - HV and LV cable box			
15.1	Bottom entry position	-		
15.2	Top entry position	-		
16.	Cable box – Does the HV cable box meet the internal arc withstand requirements of AS 62271.200 as per Clause 5.12.1 of this specification?	Yes/No		
17.	Protective Coating	-		
17.1	Are full details of protective coating included with tender documents?	Yes/No		
17.2	Time to first maintenance	Years		
18.	Lifting & Transport Facilities			
18.1	Clearly Marked with Label or Stencil	Yes/No		
18.2	Fully Rated	Yes/No		
19.	Base mounting arrangement			
19.1	Bi-Directional Wheels	Yes/No		
19.2	Jacking Points	Yes/No		
20.	Minimum space required for installation, operation or maintenance:			

Technical Specification for Ground Mounted Distribution Transformers

Ref.	Particulars	Unit	Specified Value/ Response	Guaranteed Performance
				All Items * except where specifically noted
20.1	• in front of the transformer	mm		
20.2	• behind the transformer	mm		
20.3	• at sides of the transformer	mm		
21.	Clearances in air (minimum)			
21.1	• HV phase-to-phase * Items 1 to 7	mm		
21.1	• HV phase-to-phase * Items 8 to 11	mm		
21.2	• HV phase-to-earth * Items 1 to 7	mm		
	• HV phase-to-earth * Items 8 to 11	mm		
21.3	• LV phase-to-phase	mm		
21.4	• LV phase-to-earth (and neutrals)	mm		
21.5	• Bottom of LV terminal palms to fins	mm		
22.	Distances:			
22.1	• HV phase centres (min) 11 kV	mm		
	• HV phase centres (min) 33 kV	mm		
22.2	• HV terminals to top of gland plate 11 kV (minimum)	mm		
	• HV terminals to top of gland plate 33 kV (minimum)	mm		
22.3	• LV bushing centre's (including neutrals)	mm		
23.	Serviceable life expectancy of transformer	Years		
24.	Inspection free interval	Years		
25.	Maintenance free interval	Years		
26.	Torque setting recommended for cable terminations:			
26.1	• HV Bushings	Nm		
26.2	• LV Bushings	Nm		
27.	Insulating oil			
27.1	Does it comply with AS 1767?	Yes/No		
27.2	Type	-		

Technical Specification for Ground Mounted Distribution Transformers

Ref.	Particulars	Unit	Specified Value/ Response	Guaranteed Performance
				All Items * except where specifically noted
27.3	Brand of oil used	-		
27.4	Method of filling	-		
27.5	PCB in oil detection limit	ppm		
28.	Material thickness			
28.1	Tank sides/floor	mm		
28.2	Lid	mm		
28.3	Cable box and cover	mm		
28.4	Fins	mm		
28.5	Maximum deflection of side walls	mm		

Technical Specification for Ground Mounted Distribution Transformers



Ref.	Particulars	Unit	Specified Value				Guaranteed Performance				
			Item 1	Item 2			Item 1	Item 2			
(B) Specific Transformer Parameters											
1.	Rated Power (ONAN rating)	kVA	100	315							
2.	Impedance Voltage	%	4.0	4.0							
3.	Sound Level As per 'reduced limit' of Appendix AA of AS2374.6	dB(A)	-	-							
4.	Dimensional limitations:										
4.1	Length (dimension parallel to plane of the core)	mm	-	-							
4.2	Width (including HV & LV cable boxes)	mm	-	-							
5.	Height										
5.1	• Bottom entry	mm	-	-							
5.2	• Top entry	mm	-	-							
6.	Overall mass Complete with all fittings filled with oil and ready for service	kg	-	-							
7.	Does this transformer comply with AS 2374.1.2 (MEPS)	Yes/No	Yes	Yes							
8.	No Load Loss	kW	-	-							
9.	Load Loss	kW	-	-							
10.	Calculated MEPS efficiency	%	-	-							
11.	Clearances in air (minimum)										
11.1	• HV phase-to-phase 11 kV / 33 kV	mm	184 / 437								
11.2	• HV phase-to-earth 11 kV / 33 kV	mm	160 / 380								
11.3	• LV phase-to-phase	mm	100								
11.4	• LV phase-to-earth (and neutrals)	mm	60								

Technical Specification for Ground Mounted Distribution Transformers

Ref.	Particulars	Unit	Specified Value				Guaranteed Performance			
			Item 1	Item 2			Item 1	Item 2		
11.5	• Bottom of LV terminal palms to fins	mm	200							
12.	Distances:									
12.1	HV phase centres 11 kV / 33 kV	mm	260 / 470							
12.2	HV terminals to top of gland plate 11 kV / 33 kV	mm	600 / 880							
12.3	LV bushing centres (including neutrals)	mm	200							
13.	Temperature rise limits:									
13.1	Top oil	°C	-	-						
13.2	Winding	°C	-	-	-	-				
14.	Minimum insulation resistance at 20°C (1 kV test after 1 minute) for:									
14.1	HV winding	MΩ	-	-	-	-				
14.2	LV winding	MΩ	-	-	-	-				
14.3	Core	MΩ	-	-						
15.	Insulating oil (required to fill to correct level at 15°C)	litre	-	-	-	-				
16.1	Positive Sequence Impedance Z/R/X	$Z\Omega = R\Omega + j.X\Omega$			-	-				
16.2	Positive Sequence Impedance Z/θ(deg)	$Z = A(x \text{ deg})$			-	-				
17.1	Zero Sequence Impedance as vector coordinates Z/R/X	$Z\Omega = R\Omega + j.X\Omega$								
17.2	Zero Sequence Impedance Z/θ deg	$Z = A(x \text{ deg})$								

Technical Specification for Ground Mounted Distribution Transformers



Ref.	Particulars	Unit	Specified Value				Guaranteed Performance			
			Item 3	Item 4	Item 5	Item 6	Item 3	Item 4	Item 5	Item 6
(B) Specific Transformer Parameters										
1.	Rated Power (ONAN rating)	kVA	500	750	1000	1500				
2.	Impedance Voltage	%	4.0	5.0	5.0	6.25				
3.	Sound Level As per 'reduced limit' of Appendix AA of AS2374.6	dBA	62	64	66	68				
4.	Dimensional limitations:									
4.1	Length (dimension parallel to plane of the core)	mm	1900	1950	2000	2050				
4.2	Width (including HV & LV cable boxes)	mm	1700	1750	1800	1850				
5.	Height									
5.1	• Bottom entry	mm	1900	1950	2000	2050				
5.2	• Top entry	mm	2350	2400	2450	2500				
6.	Overall mass Complete with all fittings filled with oil and ready for service	kg	-	-	-	-				
7.	Does this transformer comply with AS 2374.1.2 (MEPS)	Yes/No	Yes	Yes	Yes	Yes				
8.	No Load Loss	kW	-	-	-	-				
9.	Load Loss	kW	-	-	-	-				
10.	Calculated MEPS efficiency	%	99.13	99.21	99.27	99.35				
11.	Clearances in air (minimum)									
11.1	• HV phase-to-phase 11 kV / 33 kV	mm	184 / 437							
11.2	• HV phase-to-earth 11 kV / 33 kV	mm	160 / 380							
11.3	• LV phase-to-phase	mm	100							
11.4	• LV phase-to-earth (and neutrals)	mm	60							
11.5	• Bottom of LV terminal palms to fins	mm	200							

Technical Specification for Ground Mounted Distribution Transformers



Ref.	Particulars	Unit	Specified Value				Guaranteed Performance			
			Item 3	Item 4	Item 5	Item 6	Item 3	Item 4	Item 5	Item 6
12.	Distances:									
12.1	HV phase centres 11 kV / 33 kV	mm	260 / 470							
12.2	HV terminals to top of gland plate 11 kV / 33 kV	mm	600 / 880							
12.3	LV bushing centres (including neutrals)	mm	200							
13.	Temperature rise limits:									
13.1	Top oil	°C	-	-	-	-				
13.2	Winding	°C	-	-	-	-				
14.	Minimum insulation resistance at 20°C (1 kV test after 1 minute) for:									
14.1	HV winding	MΩ	-	-	-	-				
14.2	LV winding	MΩ	-	-	-	-				
14.3	Core	MΩ	-	-	-	-				
15.	Insulating oil (required to fill to correct level at 15°C)	litre	-	-	-	-				
16.1	Positive Sequence Impedance	$Z\Omega = R\Omega + j.X\Omega$								
16.2	Positive Sequence Impedance	$Z = A(x \text{ deg})$								
17.1	Zero Sequence Impedance	$Z\Omega = R\Omega + j.X\Omega$								
17.2	Zero Sequence Impedance	$Z = A(x \text{ deg})$								

Technical Specification for Ground Mounted Distribution Transformers



Ref.	Particulars	Unit	Specified Value			Guaranteed Performance			
			Item 7	Item 8	Item 9	Item 7	Item 8	Item 9	
(B) Specific Transformer Parameters									
1.	Rated Power (ONAN rating)	kVA	1500	315	750				
2.	Impedance Voltage	%	9.75	4.0	5.0				
3.	Sound Level As per 'reduced limit' of Appendix AA of AS2374.6	dB(A)	68	59	64				
4.	Dimensional limitations:								
4.1	Length (dimension parallel to plane of the core)	mm	2050	2000	1800				
4.2	Width (including HV & LV cable boxes)	mm	1850	2300	2800				
5.	Height								
5.1	• Bottom entry	mm	2050	1850	2100				
5.2	• Top entry	mm	2500	2680	3050				
6.	Overall mass Complete with all fittings filled with oil and ready for service	kg	-	-	-				
7.	Does this transformer comply with AS 2374.1.2 (MEPS)	Yes/No	Yes	Yes	Yes				
8.	No Load Loss	kW	-	-	-				
9.	Load Loss	kW	-	-	-				
10.	Calculated MEPS efficiency	%	99.35	99.04	99.21				
11.	Clearances in air (minimum)								
11.1	• HV phase-to-phase 11 kV / 33 kV	mm	184 / 437						
11.2	• HV phase-to-earth 11 kV / 33 kV	mm	160 / 380						
11.3	• LV phase-to-phase	mm	100						
11.4	• LV phase-to-earth (and neutrals)	mm	60						

Technical Specification for Ground Mounted Distribution Transformers



Ref.	Particulars	Unit	Specified Value				Guaranteed Performance			
			Item 7	Item 8	Item 9		Item 7	Item 8	Item 9	
11.5	• Bottom of LV terminal palms to fins	mm	200							
12.	Distances:									
12.1	HV phase centres 11 kV / 33 kV	mm	260 / 470							
12.2	HV terminals to top of gland plate 11 kV / 33 kV	mm	600 / 880							
12.3	LV bushing centres (including neutrals)	mm	200							
13.	Temperature rise limits:									
13.1	Top oil	°C	-	-	-	-				
13.2	Winding	°C	-	-	-	-				
14.	Minimum insulation resistance at 20°C (1 kV test after 1 minute) for:									
14.1	HV winding	MΩ	-	-	-	-				
14.2	LV winding	MΩ	-	-	-	-				
14.3	Core	MΩ	-	-	-	-				
15.	Insulating oil (required to fill to correct level at 15°C)	litre	-	-	-	-				
16.1	Positive Sequence Impedance Z/R/X	$Z_{\Omega} = R_{\Omega} + j.X_{\Omega}$								
16.2	Positive Sequence Impedance Z/θ deg	$Z = A(x \text{ deg})$								
17.1	Zero Sequence Impedance Z/R/X	$Z_{\Omega} = R_{\Omega} + j.X_{\Omega}$								

Technical Specification for Ground Mounted Distribution Transformers



Ref.	Particulars	Unit	Specified Value				Guaranteed Performance			
			Item 7	Item 8	Item 9		Item 7	Item 8	Item 9	
17.2	Zero Sequence Impedance Z/θ deg	Z = A(x deg)								

Technical Specification for Ground Mounted Distribution Transformers



SIGNATURE OF TENDERER: _____

Technical Specification for Ground Mounted Distribution Transformers



17. Attachment 2 - Additional Requirements

The Tenderer will list here and provide full details and supporting information for each of the Additional and Special Requirements as detailed in Clause 5.21.

Ref.	Particulars			Full Details Provided with Tender Submission – Yes/ No
Additional Requirements				
5.21.1	LV Current Transformer for Future Remote LV Metering	CT Class	CT Ratio	
	500kVA			
	750kVA			
	1000kVA			
	1500kVA			
*				
5.21.2	LV Cable Box			
	Item 10 – LV cable box with accessories to suit Item 3, 11kV 500 kVA transformer			
	Item 11 – LV cable box with accessories to suit Item 4, 11kV 750 kVA transformer			
	Item 12 – LV cable box with accessories to suit Item 5, 11kV 1000 kVA transformer			
	Item 13 – LV cable box with accessories to suit Item 6, 11kV 1500 kVA transformer			
5.21.3	Maximum Demand Indicator			
		WEBER CL3	PRIMARY SCALING	

SIGNATURE OF TENDERER: _____

Technical Specification for Ground Mounted Distribution Transformers



18. Attachment 3 - Risk Assessment

The Tenderer will complete the relevant items (as applicable):

Ref.	Particulars	Response
1.	Has the plant tendered been designed and manufactured in compliance with the Queensland Workplace Health and Safety Plant Code of Practice and can documentary evidence be provided?	
2.	Does the design of the transformer, and the recommended methods for: Assembly, erection, operation, testing, inspection, maintenance of repairs, comply with the requirements of the Queensland Workplace Health and Safety Plant Code of Practice.	
3.	Has a risk assessment been performed on the plant tendered, which meets the requirements of AS/NZS 4360?	
4.	A copy of the above mentioned risk assessment will be included with the tender.	
5.	Mechanical Design Considerations	
5.1	Is the plant designed to provide fault containment?	
5.2	Is guarding provided for protection from moving parts, sharp edges, hot/cold surfaces, etc?	
5.3	Are AC and DC secondary terminals protected by insulation?	
5.4	Is the plant designed to allow for routine maintenance without encroaching upon electrical approach limits?	
5.5	Is access to the plant necessary above 2.4 metres in height?	
5.6	If yes to 5.5 confirm compliance with the Queensland Workplace Health and Safety Advisory Standard Falls from Height 2000.	
5.7	What is the three dimensional clearances required for installation, operation, maintenance and testing of the plant.	
5.8	Indicate if there is any special stability requirements for transportation, installation, operation and maintenance of the plant.	
5.9	Is safe access provided for normal operational conditions?	
6.	Ergonomic Considerations:	
6.1	When designing the plant what ergonomic standards were adopted for the following conditions:	
6.2	(a) Working in confined spaces?	
6.3	(b) Operating forces, eg opening and closing switches?	
6.4	(c) Undesirable posture, eg installing HV cabling?	
6.5	(d) Access to components for installation, operation and maintenance?	

Technical Specification for Ground Mounted Distribution Transformers

Ref.	Particulars	Response
7.	Manual Handling Considerations:	
7.1	Is special lifting/handling equipment provided/required for individual components with a mass in excess of 15 kg?	
7.2	Is labelling provided on individual components with a mass in excess of 15 kg?	
7.3	Are lifting points/handles provided for individual components with a mass in excess of 15 kg?	
7.4	Are lifting points/handles provided to ensure a balanced lift?	
8.	Hazardous Substance Considerations:	
8.1	What hazardous substances are used/produced (including after failure):	
8.2	Are normal hazardous substance controls compatible with operational requirements?	
8.3	Is a Safety Data Sheet available for all hazardous substances contained within the plant?	
8.4	What are the expected hazardous substance changes/by products associated with the deterioration of a substance?	
8.5	What are the hazards associated with handling hazardous substances after plant failure?	
9.	Environmental Considerations:	
9.1	Does the plant contain components which could cause an environmental hazard should plant failure occur?	
9.2	If yes to 9.1 please list these components	
9.3	Can the tenderer demonstrate that the plant is designed to limit the extent of environmental hazard should plant failure occur?	
9.4.	Do all symbols and labels provided on the plant conform to the requirements of the Queensland Workplace Health and Safety Advisory Standard for Plant?	
9.5	What hazards, if any, are created should the plant be left in short or long term storage?	
9.6	Indicate if special training, unique for this plant, is required.	
9.7	Has the required EMF information (refer clause 11.2) been provided with the tender?	

SIGNATURE OF TENDERER: _____

Technical Specification for Ground Mounted Distribution Transformers



19. Attachment 4 - Rating Plate Details for Transformer

Ergon Energy Structured Plant Number (Available from Purchase Order):					
CONTRACT NO	CONTRACT-NO				
MANUFACTURER OF THE TX	MAKE-TX				
TOTAL WEIGHT (KG)	MASS-TOTAL				
MASS OF THE TX CORE (KG)	MASS-TX-CORE				
NUMBER OF PHASES	PHASE-NO				
SERIAL NUMBER	SERIAL_NUMBER				
COOLING FOR TX 1ST RATING	TX-COOLING-1				
TX COPPER LOSSES (KW)	TX-CU-LOSS				
TX HV MAX CURRENT (A)	TX-HV-MAX-A				
TX IRON LOSSES (KW)	TX-IRON-LOSS				
TX LV MAX CURRENT (A)	TX-LV-MAX-A				
1ST RATING OF TX (MVA)	TX-RATING-1				
NUMBER OF TAPS IN TX	TX-TAP-NO				
TAPPING RANGE FOR TX TAP RANGE	TX-TAP-RANGE				
VECTOR GROUP	VECTOR-GROUP				
TOTAL VOLUME OF OIL (L)	VOL-OIL-TOT				
PRIMARY VOLTAGE (KV)	VOLT-PRI-KV				
SECONDARY VOLTAGE (KV)	VOLT-SEC-KV				
YEAR OF MANUFACTURE	YOM				