PART B-02

TITLE: DISTRIBUTION INFRASTRUCUTRE UP TO AND INCLUDING 33kV

SPECIFICTION NO: B-02

INCEPTION DATE: AFTER GAZETTING (WORKING DOCUMENT FOR A 3 YEAR PERIOD)

AMENDMENTS / REVISIONS

DATE	PAGE	PARAGRAPH	DESCRIPTION	ORIGINATOR	APPROVED

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1 SCOPE

The specification covers the manufacture, supply, delivery and erection on site including testing and commissioning of the following equipment:

(a) Step Down Transformers
(b) Miniature Substations.
(c) Ring main units for rated voltages up to and including 33kV
(d) Pole mounted distribution transformers up to and including 33kV.
(e) Ground mounted distribution transformers up to and including 33kV.
(f) Earthing of distribution installations up to and including 33kV

The following standards shall be complied with this standard:

GENERAL INFORMATION

The following Standards and Acts shall take precedence:

- National Electricity Act of Namibia
- Occupational Health and Safety Act of Namibia
- Labour Act of Namibia
- Quality of Service Standard
- Quality of Supply Standard
- NamPower Specifications for the Erection of Overhead Power Lines
- NamPower Specifications and General Conditions for Survey and Route Clearing for New Power Lines

The following Standard shall be used as reference:

NRS 033 : Electricity Distribution – Guidelines for the application design, planning and construction of medium voltage overhead power lines up to and including 33kV, using wooden pole structures and bare conductors.

NRS 034 : Guidelines for the provision of electrical distribution networks in residential areas.

NRS 043 : Code of practice for the joint use of structures for power and telecommunication lines

NRS 059 : Recommendations to minimize problems associated with the theft of transformer neutral and neutral earthing copper conductors

NRS 060 : Code of practice for clearances for electrical systems with rated voltages up to and including 145kV, for the safety of persons

NRS 082 : Recommended maintenance policy for electricity networks

SANS 10280 : Overhead power lines for conditions prevailing in South Africa

POWER TRANSFORMERS

Regional Standards

NRS 054 : Power Transformers

SANS 60076-1 : Power Transformers Part 1: General

SANS 60076-2 : Power Transformers Part 2: Temperature Rise

SANS 60076-3 : Power Transformers Part 3: Insulation levels, dielectric tests and external clearances in air.

SANS 60076-5 : Power Transformers Part 5: Ability to withstand short circuit

International Standards

IEC 60076 : Power transformers

IEC 61558 : Safety of power transformers

VOLTAGE TRANSFORMERS

Regional Standards

SANS 60186 : Voltage transformers

International Standards

IEC 61558 : Safety of transformers, reactors, power supply units and similar products

IEC 60186 : Voltage transformers

DISTRIBUTION TRANSFORMERS

NRS 079 : Mineral Insulating Oils

SANS 780 : Distribution Transformers

SANS 555 : Unused and reclaimed mineral insulator oils for transformers and switchgear.

SANS 1037 : Standard Transformer bushings

SANS 1371 : Ceramic hollow insulators for standard transformer bushings

BUSHINGS

Regional Standards

SANS 1037 : Standard Transformer bushings

International Standards

IEC 60137 : Insulated Bushings for Alternating Voltages Above 1kV.

RING MAIN UNITS

Regional Standards

SANS 1874 : Metal enclosed ring main units for rated a.c. voltages above 1kV up to and including 24 kV.

International Standards

IEC 60298 : A.C. Metal enclosed switchgear and control gear for rated voltages greater than 1kV up to and including 52kV

MINIATURE SUBSTATIONS

SANS 1029 : Miniature substations

SANS 1030 : Standard longitudinal miniature substations

EARTHING

NamPower : Code of Practice for the Earthing of Low Voltage Distribution Systems

SANS 10199 : The design and installation of an earth electrode

SANS 1063 : Earth rods and couplers

SANS 10200 : Neutral Earthing in medium voltage industrial power systems

SANS 10292 : Earthing of low-voltage (LV) distribution systems

ESKCAAB4 : Zinc coated earth conductor, guy and stay wire for transmission lines.

SANS 10313 : The protection of structures against lightning

CIRCUIT BREAKERS

Regional Standard

SANS 767-1 : Earth leakage protection units Part 1: Fixed earth leakage protection circuit breakers

SANS 767-2 : Earth leakage protection units Part 2: Single phase portable units

SANS 60934 : Circuit breakers for equipment (CBE)

SANS 10142-1 : The Wiring of premises Part 1: Low-voltage installations

SANS 152 : Low voltage air break switches, air break disconnections, air break switch disconnections and fuse combination units.

SANS 156 : Moulded case circuit breakers

SANS 60056 : High-voltage alternating current circuit breakers

SANS 60265-1 : High voltage switches Part 1: Switches rated for voltages 1kV and less than 52kV

SANS 6227 -100 : High voltage switchgear and control gear Part 100: High Voltage alternating current circuit breakers

International Standard

IEC 60056 : High voltage alternating current circuit breakers.

IEC 60376 : Specification and acceptance of new sulphur hexafluoride (SF_6).

IEC 60898 : Electrical accessories – circuit breakers for over current protection for household and similar installations

VC 8036 : Industry Standards for Circuit Breakers

PAINT AND FINISHING

NRS 002 : Graphical Symbols and Labelling for electrical diagrams

SANS 1091 : National colour standards for paints

SANS 935 : Hot dip galvanised zinc coatings on steel wire

SANS 121 : Hot dip galvanised coatings on fabricated iron and steel articles.

SANS 10064 : The preparation of steel surfaces for coating

SANS 679 : Zinc chromate primers for steel.

BS 183 : Specification for galvanized steel wire.

BS 381 : Paint

BS 2569 : Zinc Metal Spraying

2 STEP DOWN TRANSFORMERS

A standard flanged transformer will be used all in accordance with SANS 780 and SANS 60186. The flange and outside dimensions of the transformer section will conform to the standardised dimensions in order to facilitate full inter-changeability of this section.

The transformer bushing, terminals, valves, fittings, etc. will be situated well within the flanged space to facilitate the removal of the transformer section without disturbing the equipment compartments. The transformer will be of the following specifications.

Nominal continuous voltage rating	Specific to the Quality of Supply Code and in accordance with SANS 780
No-load voltage ratio	Specific to design and in accordance with the Quality of Supply Code and SANS 780
Frequency	50Hz
Number of phases	3
Vector group	Dyn 11 or Yzn 11
Tappings	Tap change facilities ± 5% or ± 2%
Oil filling	The transformer will be supplied with oil according to manufactures specification
Oil	The transformer oil will be according to SANS 555 and supplier's recommendations.
Nitrogen filing	The transformer will be supplied with a positive pressure filled with nitrogen with pressure indicator. (Not applicable to Distribution Transformers under 2MVA)
Cooling	ONAN (Oil natural or air natural)
Losses	The losses will be in accordance with the low-loss table compiled by the SANS 780
Design	The transformer will be of the hermetically sealed Type or of the bolted type, approved by the Engineer as required by the Supply Authority.
Fittings	Oil drain cock and plug, oil level gauge, thermometer Pocket and dial thermometer with slave pointer, sealed oil filling pipe, lifting lugs. Fittings shall be provided as required by design specification and subject to the approval of the Engineer.

Transformers shall contain copper windings for coastal conditions up to 40 km inland from the coastal region, due to corrosion

2.1 Cable terminations

2.6.1 Cable terminations will be heat-shrink, cold shrink or compound types for PILC or XLPE cables approved by the Engineer and Supply Authorities.

2.6.2 Cables will be clamped according to design requirements and to the approval of the Engineer

2.6.3 Minimum clearance between cables and jumpers and any sharp metal edges or protrusions will be according to Standards according to voltages

2.6.4 All terminals will be shrouded according to cabling needs and specifications. .

2.6.5 High tension connections between fused switch units and the transformer will be suitably blank off to prevent touching.

2.2 Miscellaneous

2.2.1 Painting

All exposed metal surfaces of the transformer will be prepared for painting in accordance with SANS 10064 and be painted in accordance with SANS 780 providing a total dry film thickness of 0,125mm.

2.2.2 Labels and Notices

All notices, labels and warning signs as required under the Machinery and Occupational Safety Act will be provided.

Each transformer will be provided with a traffolyte label bearing the installation name with engraved lettering 40mm high and filled with black enamel to the satisfaction of the Engineer. Transformer specification plates shall be issued by the standards body that has approved the equipment baring their mark of certification

All incoming and outgoing feeder cables will be marked with a stencilled lead identification tag with 10mm high lettering stating the point of supply name of the load supplied name.
All cable boxes shall be marked clearly indication the MV and LV compartments.

2.2.3 Information and Drawings

Dimensioned drawings and a manufacturer's specification must be submitted to the Engineer for approval. A manufacturer's specification sheet of the transformer stating losses, efficiencies, weights and principal dimensions must be submitted to the Engineer for approval.

2.2.4 Erection of Step-down Transformer

Suitable plinths with concrete footing bricked up and plastered or concrete plinths will be provided for the erection of the transformer.

The top of the transformer plinth will reach at least 340mm above the surrounding natural ground level and will be manufactured according to approved detail drawings. The concrete plinth will be 500mm longer and wider on each side than the installed mini transformer.

3 MINIATURE SUBSTATIONS

3.1 Scope

This part of the specification covers the manufacture supply and delivery of the miniature substation in accordance with SANS 1029 and SANS 1030.

3.2 Construction

The miniature substation shall comprise three compartments, the medium voltage (MV), transformer and the low voltage (LV) compartment all flanged and bolted together and fixed to a common frame suitable for mounting on a concrete foundation. The design of the miniature substation shall be such that it is suitable for outdoor installation in places accessible to the public without requiring additional fencing. The only acceptable miniature substation shall be as specified in SANS 1029 and SANS 1030 depending on the design requirements.

The medium voltage and the low voltage compartments shall be manufactured from folded steel and shall be adequately sized to take the equipment specified below. The compartments shall be fitted to the flanged transformer so that seen from the front of the substation the MV compartment is situated to the left, the LV compartment to the right of the substation and the transformer in the back part of the LV compartment but bordering the MV compartment.

A common inclined, roof shall be provided over the whole substation providing adequate ventilation, shielding against rain and a run-off for water. The roof shall be secured in position to prevent it from being blown off under adverse weather conditions and it shall be detachable from the inside of the compartments only as to make the fixing tamperproof.

The MV and LV compartments shall be covered on top with a sheet steel lid having an opening with pipe insert for aeration of the compartments into the roof space formed by the common roof and the covers of the compartments. The double roof over the compartments is intended to prevent excessive heating up of the compartments exposed to the direct radiation of the sun and to prevent dust from penetrating through the tops of the compartments.

The construction shall generally conform to the relevant standard specification issued by SANS 1029 and SANS 1030.

All substations at coastal regions up to and including 40 km inland from coastlines shall be built indoors. All equipment, including transformers and switchgear shall also be placed indoors due to the corrosive atmosphere in the area.

3.2.1 Specific requirements for construction:

(a)	System nominal voltage	:	Specific to design but in accordance with SANS 1029 and SANS 1030 and the Quality of Supply Code
(b)	Outer cladding	:	Mild steel. Note coastal or environmental Specifications are to be Adhered to as stipulated by the Supply Authority and Engineer
(c)	Doors	:	Only one door for the MV-compartment and one door for the LV-compartment shall be equipped for padlocking from the outside.

All other doors shall be opened from the inside of the miniature substation after opening one of the above pad-lockable doors. All door hinges shall be concealed. A metal cover of 4.5mm thickness shall be fitted over each locking mechanism to protect the padlock against vandalism.

(d) Final finish : in accordance with SANS 1091

3.3 MV Compartment Equipment

A compact, metal clad, totally enclosed 3 way ring main unit in accordance with SANS 1874 shall be provided in the MV compartment. The switchgear shall comprise of two load break isolators, for the incoming and outgoing cables and one fuse T-off with fuses rated for the protection of the transformer.

The unit shall be installed in the compartment and the connections to the transformer completed. All shrouds and terminals shall be provided suitable for terminating the incoming and outgoing cables.

One operating handle shall be supplied with the switchgear unit and a suitable bracket provided at below the ring main unit to accommodate the handle. A spare set of fuses shall be provided and accommodated in a bracket on the inside of the MV door. A copper earth bar shall be provided in the MV compartment to which all exposed metal parts shall be earthed. Provision must be made for connecting to the earth bar, the substation earth, screens of the cables and the earth bar of the LV compartment.

3.3.1 Specific requirements for MV compartment

(a) Cable fixture

(i) Type of MV cable termination : Heat shrink XLPE / PILC type for up to conductor size applicable to specifications.

(ii) Cable clamping facility : Required at a level 600mm below MV switch terminals, on hot-dip galvanized bracket supplied with mini-substation.

(b) Special transformer protection : 230 V 50Hz shunt trip unit required on MB tee-off switch, controlled by a contract on an oil temperature indicator and thermostat, mounted in a pocket into transformer tank. Indicator/thermostat to be accessible from LV compartment, and contact operating temperature to be adjustable between 60°C and 100°C, according to an easily readable scale. Cable between thermostat and shunt trip to be 6,0mm² unarmoured PVC copper conductor cable run in protective sections of straight conduit and protected by means of 10A HRC fuse mounted directly on LV

busbars. Label: “Shunt trip fuse behind” to be fitted on front panel over LV switchgear.

(c) Shunt-trip pushbutton : A panel mounting push button with bezel which will trip the transformer switch via the shunt-trip coil shall be provided in the LV-compartment. This push button must be easily accessible and labelled: “Push to trip Transformer Tee-off Switch”.

(d) MV Switch : A ring main unit (oil or SF_6) with fuses for the transformer tee-off, with shunt trip. Spare set of fuses to be provided.

(g) Earth fault indicating relay : Split-core CT and electrically reset earth fault indication relay

3.4 LV Compartment Equipment

The equipment to be provided in the LV compartment shall be rated and wired as shown as single line diagram on the drawing forming part of the detail specification. All equipment shall be mounted on a mounting plate fixed to a free standing frame in the compartment and shall be complete with the necessary connections, fuses, instruments, links, supports, gland plates ready drilled and the necessary sundries including all integral wiring.

3.4.1 Specific requirements for LV compartment

3.4.1.1 LV-Compartment Equipment

Note: Entire LV compartment to be safe-to-touch when cover plate panel over LV switchgear is fitted.

DESCRIPTION	**UP TO 500kVA**
a) Moulded case current limiting feeder circuit breakers: Minimum breaking capacity, symmetrical to SANS 156: i) Number required/rating/poles	 15 kA 5/TP
b) Pre-fitted mounting provision with removable cover for additional MCB’s as per above item i) 3 P, 15kA	 3
c) Back-up 60 A HRC fuses in totally enclosed fuse holders for street lighting	3
d) Street lighting contactor, dust proof industrial type, vertically mounted, 40A, 3P, 230 V coil	1

e) Photocell, mounted in LV compartment behind polycarbonate translucent window with extruded metal protective cover, to control streetlight contactor, protected by means of 6 A HRC fuse in totally enclosed fuse holder	1
f) 15 A by-pass switch, to by-pass photocell for control of street lighting contactors	1
DESCRIPTION	**UP TO 500kVA**
g) Galvanized P1000 unistrut channel for termination of LV cables	1,5 m
h) Set of three current transformers, sensing total transformer LV current, class 1, to control ammeters, ratio.	250:5 500:5 800:5
i) Set of three instantaneous indicating and thermal maximum demand combination ammeters with built-in saturation CT, integrating over 15 minutes, ATW "slip-in scale" 96mm type, for operating from 5 A CT secondary, scaled	0-300 A 0-500 A 0-800 A plus 10% overscale
j) One voltmeter, ATW "slip-in-scale" 96mm complete with selection switch to select R-Y, R-B, Y-B, R-N, Y-N and B-N connected via 6 A HRC fuses connected directly to busbars	0-500 V
k) kWh and maximum demand meter, programmed for CT ratio	1
l) 6 A HRC for earth fault indicating relay in LV compartment, complete with internal unarmoured cable connection (2,5mm²) to relay position, run via straight sections of galvanized conduit	1
m) Labels for all MV and LV switchgear, one per item of equipment as well as labels for MV and LV sections	Set

3.4.2 Busbars and Earth Bar

Three phase busbars and one neutral busbar shall be provided in accordance with SANS10198. The material of the busbars shall be copper. At the lower end of the compartment an earth bar shall be provided to which all metal parts of the substation are to be bonded. The neutral of the substation shall be connected to the earth bar at one point only by means of a removable link. Provision shall be made to connect the substation earth to the earth bar.

3.4.3 Circuit Breakers

The main and feeder circuit breakers connected to the busbars shall comply with SANS 156.

The circuit breakers shall be suitable for operation on 400/250 V and the minimum rupturing capacity shall be 15kA. The trip characteristics shall be in accordance with SANS 156.

3.4.4 Gland Plates

The gland plates shall be drilled to provide for all outgoing circuits suitable for use with cables having the number of cores and conductors sizes as indicated on the drawing or as advised when ordering.

3.4.5 Equipment Front Panel

To prevent operators from inadvertent contact with current carrying parts all equipment shall be shrouded or a detachable front panel shall be provided. The front panel shall be fitted with the necessary cut outs for the faces of the equipment and the operating levers of the circuit breakers.

3.4.6 Accessibility to Equipment

All equipment shall be easily accessible for installation, maintenance and repair purposes from the front of the substation through the doors of the LV compartment.

3.5 Transformer

A standard flanged transformer shall be used all in accordance with SANS 780. The flange and outside dimensions of the transformer section shall conform to the standardised dimensions in order to facilitate full inter-changeability of this section.

The transformer bushing, terminals, valves, fittings, etc. shall be situated well within the flanged space to facilitate the removal of the transformer section without disturbing the equipment compartments. The transformer shall be of the following specifications.

Nominal continuous rating	Specific to design in accordance with SANS 1029 and SANS 1030
No-load voltage ratio	In accordance with SANS 1029 and SANS 1030
Frequency	50Hz
Number of phases	3
Vector group	Dyn 11 or Yzn 11
Tappings	Tap change facilities ± 5% or ± 2%
Oil filling	The transformer shall be supplied with the first filling of oil.
Oil	The transformer oil shall be according to SANS 555
Cooling	ONAN (Oil natural, air natural)
Losses	The losses shall be in accordance with the low-loss table compiled by the SANS 780
Design	The transformer shall be of the hermetically sealed type.

Fittings	Oil drain cock and plug, oil level gauge, thermometer pocket and dial thermometer with slave pointer, sealed oil filling pipe, lifting lugs.

3.6 Cable terminations

2.6.1 Cable terminations shall be heat-shrink or cold shrink types approved by the engineer.

2.6.2 Cable shall be clamped with wooden brackets for proper mounting purposes.

2.6.3 Minimum clearance between cables and jumpers and any sharp metal edges or protrusions shall be at least a minimum of 75mm

2.6.4 All terminals shall be shrouded with heat-shrinkable shrouds.

2.6.5 High tension connections between fused switch unit and the transformer shall be suitably blanked off to prevent touching.

3.7 Miscellaneous

3.7.1 Painting

All exposed metal surfaces of the transformer shall be prepared for painting in accordance with SANS 10064 and be painted in accordance with BS 2569 providing a total dry film thickness of 0,125mm.

3.7.2 Labels and Notices

All notices, labels and warning signs as required under the Machinery and Occupational Safety Act shall be provided.

Each miniature substation shall be provided with an aluminium or traffolyte label bearing the mini-sub name with engraved lettering 40mm high and filled with black enamel to the satisfaction of the Engineer.

All the equipment in the mini-sub shall also be clearly marked with traffolyte engraved labels permanently secured below the equipment. All incoming and outgoing feeder cables shall also be marked with a stencilled lead identification tag with 10mm high lettering stating the point of supply name of the load supplied name.

3.7.3 Information and Drawings

Dimensioned drawings and a manufacturer's specification must be submitted to the Engineer for approval. A manufacturer's specification sheet of the transformer stating losses, efficiencies, weights and principal dimensions must be submitted to the Engineer for verification.

3.7.4 Erection of Miniature Sub-station

Suitable plinths with concrete footing bricked up and plastered or precast concrete plinths shall be provided for the erection of the miniature substations.

The top of the sub-station plinth shall reach at least 300mm above the surrounding natural ground level and shall be manufactured according to approved detail drawings. The concrete

plinth shall be 100mm longer and wider on each side than the installed mini-sub. The mini-sub shall be secured to the plinth with M12 hook bolts cast into the concrete and U-bracket 50 x 50 x 10 x 6mm clamped to the mini-sub base, in accordance with drawing specifications.

4 RING MAIN UNITS FOR RATED VOLTAGES UP TO AND INCLUDING 24KV.

4.1 Scope

This standard covers the manufacture, supply, delivery, erection on site, testing and commissioning of ring main units up to and including 24kV, of the in- or outdoor, extensible or non-extensible metal clad type to the standards of SANS 1874.

4.2 Non-extensible ring main units

The non-extensible ring main unit type shall comprise two load breaking fault making manual operated switches (for incoming and outgoing ring cable) and an automatic fuse switch for T-off. The fuse rating shall be as required.

4.3 Extensible ring main units

The extensible ring main unit shall have extensible busbars to which non-automatic load break switches and automatic fuse switches are coupled. Each unit shall be a complete unit with number of ways and type of switches as required.

4.4 General design

All ring main units shall be complete with fuses, first filling of oil, earthing and cable test facilities.

4.4.1 Ratings

All ratings shall be design specific, approved by the Engineer and in applied in accordance with SANS 1874

4.4.2 Tripping

The fuse switch shall employ HRC fuse-elements arranged for three phase tripping.

4.4.3 Interlocks

The fuse switches, switches, fuse holders and access doors, earthing switches and test sockets shall be interlocked in such a manner as to provide the safe operation of the complete unit.

4.4.4 Cable boxes

Boxes are to be cast iron or welded steel construction and to comply with SANS 1874. Support structures shall be arranged so that the bottoms of the cable boxes are not less than 20cm above floor level.

4.4.5 Locking devices

Means shall be provided for locking the various units with padlocks in the “ON”.”OFF” and “earthed” positions and for padlocking access doors.

4.4.6 Indicators

Mechanical indicators shall be provided to indicate whether the circuits of the switch unit are in the “ON”, “OFF” or “earthed” position.

4.4.7 Test Certificate

Copies of all type test certificates shall be submitted to the Engineer for approval.

Duplicate copies of all routine test certificates shall be submitted when or before the unit is delivered to site.

4.4.8 Earthing

Earthing of the ring main unit shall be done in accordance with standard earthing practice for such equipment in accordance with SANS 10200 and SANS 10292.

Each ring main unit shall include a copper earthing bar of width not less than 25mm and cross sectional area of not less than 125mm² to facilitate earthing of cable sheath(s) and armour. Holes of 12mm in diameter shall be provided for the connection of earth conductors, the earth bar shall be pre-drilled at all extensible ring main units so that no additional site work is required when the earth bar is extended. Consult SANS 10198 for further requirements of earthing bars.

4.4.9 Miscellaneous

The following shall be included in the extent of supply:

- holding down bolts
- first filling of oil and compound
- earthing material to the standards of SANS 10200
- Three spare fuses rated as required shall be supplied for each fuse switch
- Main circuit designation, which shall comprise engraved labels of at least 150mm wide and 35mm high, the largest possible characters, shall be used. The minimum size of characters to be used is 10mm high. The label shall be screwed to the front of the ring main unit.

5 POLE-MOUNTED DISTRIBUTION TRANSFORMERS UP TO AND INCLUDING 33kV

Pole-mounted distribution transformers shall generally comply with the provisions of SANS 780, SANS 1037, NRS 027.

-	Primary voltage	Design specific in accordance with SANS 780
-	Secondary voltage	Design Specific
-	Frequency	50Hz
-	Dyn11 or Yzn11 with tap changer of ±5%	
-	transformer oil to SANS 555	
-	ONAN cooling	
-	Sealed type	
-	Open bushings and outdoor terminals on both MV and LV side	
-	Mounting facility for surge diverters below MV bushings	
-	Suitable for single pole mounting up to 100kVA (with pole-mounting brackets, bolts washers and nuts)	
-	Suitable for H-pole cradle mounting for >25kVA	

Rated capacities vary between 25kVA and 315kVA.

5.1 Transformer cradle

Galvanized steel to SANS 121, complete with 22mm diameter holes and support brackets – complete with all M20 x 200 and M20 x 75 bolts, curved washers, spring washers.

5.2 Labelling

Each transformer installation shall be labelled with a traffolyte type label or of approved type by the design Engineer and Supply Authoroty, of at least 200mm x 200mm indicating the transformer number or name in the largest possible letters, black lettering on yellow background.

5.3 Installation

Only transformers of 25kVA and smaller shall be single pole mounted, all other sizes up to and including 315kVA shall be cradle mounted.

Transformers greater than 315kVA shall be ground mounted and shall have enclosed bushings.

6 GROUND MOUNTED DISTRIBUTION TRANSFORMERS UP TO AND INCLUDING 33kV.

Ground mounted distribution transformers shall generally comply with the provisions of SANS 780, SANS 1037, NRS 027.

-	Primary voltage	Design Specific in accordance with SANS 780
-	Secondary voltage	Design Specific
-	Frequency	50Hz

- Dyn11 or Yzn11 with tap changer of ±5%
- Transformer oil to SANS 555
- ONAN cooling
- Sealed type
- Closed bushing and cable end boxes on both MV and LV side
- Suitable for ground mounting on a concrete plinth

Rated capacities vary between 25kVa and 1 MVA.

6.1 Labelling

Each transformer installation shall be labelled with a traffolyte type label or of approved type by the design Engineer and Supply Authority, of at least 200mm x 200mm indicating the transformer number or name in the largest possible letters, black lettering on yellow background.

6.2 Installation

The pad mounted transformer shall be installed on a concrete plinth cast 400mm deep which shall protrude 300mm above the natural ground level. Cable trenches for both the MV and LV cables shall be cast and filled with soilcrete of 1:10 concrete to soil mixture after the installation of the cabling.

7 TRANSFORMER INSTALLATION EARTHING.

7.1 Earthing of miniature substation

Earthing requirements of mini-substations shall be in accordance with SANS 1029.
Two earth spikes shall be provided for earthing of each miniature substation. The spikes shall be provided at opposite ends of the substation 5000 mm away and the earthing leads terminated on the earth bar provided on the switchgear and inside the LV compartment.

Earth spikes shall be copper covered steel bars as “Copper weld” driven into the ground so that the tip reaches a depth of 2.400 mm below normal ground level. The earthing lead, a green PVC insulated 70mm² copper conductor shall be connected to the top of the spike by means of the special connection clamp. The connection clamp and from the clamp 100mm of the earthing spike and the earthing lead shall be covered at least 2mm thick all over by hand setting compound or tar applied at pouring temperature and taped close half lap with PVC insulating tape at least 3 layers after cooling down.

If further clarity is required on earthing requirements, the following standards can be consulted:

SANS 10200: Neutral Earthing in Medium Voltage Industrial Power Systems

SANS 10198: The Selection, Handling and installation of electric power cables of rating not exceeding 33kV: Part 3 – Earthing Systems

SANS 10292: Earthing of Low Voltage Distribution Systems.

7.2 Earthing of distribution transformers

The following specification shall be complimented by SANS 10200 SANS 10292:

(a) The transformer MV surge diverter earth shall be connected to the transformer tank earthing stud.

(b) The transformer tank earthing stud shall be connected to the MV three-point-star earth electrode arrangement with insulated copper earth lead (size dependent on short circuit ratings – 70mm² minimum)

(c) The transformer LV neutral shall be bonded to the transformer tank earthing stud (MV earth) via a metal oxide valve (MOV) surge diverter to protect the transformer.

(d) The transformer LV phase surge diverter earths shall be connected to the transformer neutral bushing.

(e) The transformer neutral bushing shall be connected to the LV three-point-star earth electrode arrangement with 70mm² insulated copper earth lead. This may be directly from the transformer, or via the distribution kiosk/board earthing bar.

(f) Bare portions of transformer MV and LV earth electrode arrangements shall be separated by at least 5000mm, so that the LV earth is outside the resistance area of the MV earth.

(g) The transformer MV earth electrode arrangement and bare parts of consumer's ECC shall be separated by at least 5000mm, so that the ECC is outside the resistance area of the MV earth.

Where split earthing and combined earthing issues are raised, the following standards shall be consulted and applied:

SANS 10200: Neutral Earthing in Medium Voltage Industrial Power Systems
SANS 10292: Earthing of Low – Voltage Distribution Systems.