



Technical Note - TN 080: 2015

Issued date: 09 December 2015

Effective date: 09 December 2015

Subject: Update to EP 16 00 00 02 SP *Outdoor Ground Type Distribution Transformer*

This technical note is issued by the Asset Standards Authority to notify the following updates to EP 16 00 00 02 SP *Outdoor Ground Type Distribution Transformer*, Version 2.1:

- update of Australian standards and International standards
- ASA type approval requirements
- additional dry type transformer parameters
- update to testing requirements
- updated transformer oil requirements

All references to AS 2374 *Power transformers* should be replaced with AS/NZS 60076 *Power transformers* unless otherwise stated.

All references to RIC should be replaced with RailCorp.

Unless stated otherwise the existing entire content in the identified section should be replaced by the content detailed in this technical note.

The following new section has been added after Section 2:

2.1 **ASA type approval**

Transformers procured to this specification require type approval by ASA prior to being allowed to be connected to the RailCorp electrical network. The current ASA process for type approval at the time of publication of this document is provided in TN 050:2014 *Electrical Type Approvals – Interim process*.

Replace the existing Section 3 (including Section 3.1 Australian Standards, Section 3.2 RailCorp Documents and Section 3.3 International standards) with the following:

3 Reference documents

International standards

EN 50180 Bushings above 1 kV up to 52 kV and from 250 A to 31.5 kA for liquid filled transformers

EN 50181 Plug-in type bushings above 1 kV up to 52 kV and from 250 A to 31.5 kA for liquid filled transformers

IEC 60840 Power Cables with extruded insulation and their accessories for rated voltages above 30 kV – Test methods and requirements

Australian standards

AS 1627.4 Metal finishing – Preparation and pre-treatment of surfaces Part 4: Abrasive blast cleaning of steel

AS 1627.5 Metal finishing – Preparation and pre-treatment of surfaces Part 5: Pickling

AS 2067 Substations and high voltage installations exceeding 1 kV a.c.

AS 2629 Separable insulated connectors for power distribution systems above 1 kV

AS 2700 Colour standards for general purposes

AS 3000 Electrical installations

AS/NZS 1891.4 Industrial fall-arrest systems and devices Part 4: Selection, use and maintenance

AS/NZS 4680: Hot-dip galvanised (zinc) coatings on fabricated ferrous articles

AS 60044.1: 2007 Instrument transformers Part 1: Current transformers

AS/NZS 60076.1 Power transformers Part 1: General

AS/NZS 60076.2: Power transformers Part 2: Temperature rise for liquid-immersed transformers

AS/NZS 60076.3: Power transformers Part 3: Insulation levels, dielectric tests and external clearances in air

AS/NZS 60076.5: Power transformers Part 5: Ability to withstand short circuit

AS/NZS 60076.7: Power transformers Part 7: Loading Guide for oil-immersed transformers

AS/NZS 60076.10: Power transformers Part 10: Determination of sound levels

AS/NZS 60076.10.1: Power transformers Part 10.1: Determination of sound levels – Application guide

AS/NZS 60076.11: Power transformers Part 11: Dry-type transformers

AS/NZS 60137: Insulated bushings for alternating voltages above 1000 V

AS 60529 Degree of protection provided by enclosures (IP Code)

Transport for NSW

TMD 0001 CAD and Drafting Manual – Electrical Design – Section 4

T MU AM 01002 MA Maintenance Requirements Analysis Manual

T MU HF 00001 ST Human factors Integration – General requirements

T HR EL 00002 PR Electrical Power Equipment – Integrated Support Requirements

T HR EL 20001 ST High Voltage AC and 1500 V DC Traction Power Supply Cable Requirements

EP 00 00 00 13 SP Electrical Power Equipment – Design Ranges of Ambient Conditions

EP 00 00 00 15 SP Common Requirements for Electrical Power Equipment

EP 02 00 00 01 SP Transformer Loss Evaluation

6 Performance characteristics

Replace the existing tables in Section 6 with the following:

Table 1 – General transformer parameters

Parameter	Designation/Rating
General	<ul style="list-style-type: none"> • Outdoor • Separate winding • Two or three phase unit (nominated in RFT)
Rated frequency	50 Hz
Type of cooling	ONAN (liquid immersed transformer) AN (dry type transformer)
Vector group	Dyn1
Rated power (preferred ratings)	75,200,500,1000,1500,2000 kVA
Neutral terminal	Star point or neutral of lower voltage winding shall be connected to a bushing, fully insulated from earth.
Method of neutral earthing of the system	Non-effectively earthed
Impedance	Refer to Table 1 of AS 60076.5 <i>Power transformers – Ability to withstand short circuit</i>
Taps on HV winding	± 2.5%, 0% and ± 5% (through externally operated off – circuit switches, capable of being locked in position, or externally bolted links)
Sound power level	Refer to AS 60076.10 <i>Power transformers, Part 10: Determination of sound levels</i>

Table 2 – Additional parameters for dry type transformers

Parameter	Designation/Rating
Degrees of protection provided by the enclosure	IP54 as per AS 60529 <i>Degree of protection provided by enclosures (IP Code)</i>
Insulation class	F (155°C)
Environment class	E1
Climate class	C1
Fire behaviour class	F1

Table 3 – Voltage and insulation levels

Rated voltage	System highest voltage	Rated insulation level – Lightning impulse	Rated insulation level – Power frequency
125 V to 433 V (rms)	1.1 kV (rms)	N/A	5 kV (rms)
11 kV (rms)	12 kV (rms)	95 kV (peak)	28 kV (rms)
33 kV (rms)	36 kV (rms)	200 kV (peak)	70 kV (rms)

Replace the existing Section 7.1 with the following:

7.1 Rating plate

A rating plate conforming to the requirements AS 60076.1 *Power transformers* and made of pacified stainless steel shall be firmly attached by means of screws at each corner to a bracket externally on the transformer enclosure. The plate shall not be attached to any removable cover.

The rating plate shall include the following in addition to the requirements of AS 60076.1:

- a diagram of connections
- TfNSW specification number and version.

The rating plate shall be located such that it can be easily read from ground level with the naked eye.

Replace the existing Section 7.6 with the following:

7.6 Finish

The main tank shall be shot blasted internally and externally to remove rust and scale in accordance with Class SA2½ 'near white' blast cleaning to AS 1627.4:2005 *Preparation and pretreatment of surfaces – Part 4: Abrasive blast cleaning of steel*.

The finished surface shall be in a suitable condition to provide good adhesion properties for the primary coat. The internal and external surfaces shall be prepared and the coating applied strictly in accordance with the manufacturer's instructions. The preparation and method of application for

the finish shall be suitable to ensure the transformer is corrosion free for the design life of the transformer.

Galvanising of surfaces in contact with oil is not permitted.

Stainless steel, 316 grade may be proposed for the enclosure for dry type transformers.

When an existing transformer suffers damage to its finish, the repair shall be to the original standard of finish.

Replace the existing Section 7.9 Insulating Oil with the following:

7.9 Oil

The transformer oil shall be naphthenic, corrosive sulphur free, non-inhibited, unpassivated, and be compliant with IEC 60296 *Fluids for electrotechnical applications – Unused mineral insulating oils for transformers and switchgear*. Detection of sulphur shall be in accordance with IEC 62535 *Insulating liquids – Test method for detection of potentially corrosive sulphur in used and unused insulating oil*.

Oil shall be polychlorinated biphenyl (PCB) free and any deliveries (including the transformer) shall be accompanied by a National Association of Testing Authorities, Australia (NATA) certificate confirming this requirement.

The transformer shall contain all required oil when despatched from factory and on delivery to site.

Replace the existing Section 9.1 Acceptance Tests with the following:

9.1 Acceptance tests

Routine tests to AS/NZS 60076.1 and AS/NZS 60076.11 (dry type transformers) shall be carried out on each transformer.

In addition to the routine tests as listed in AS 60076.1, a thermal image scan shall be completed on each transformer. This test, using thermal imaging equipment, shall record the temperature image at the rated current for the following:

- each face of the tank
- each face of the cooling radiator
- bushings, where fitted

Where a transformer has a metal screen, refer to Section 7.7, the metal screen shall be connected to the high voltage earth during the acceptance tests.

Replace the existing Section 9.2 Periodic Tests with the following:

9.2 Type tests

Type tests stated in AS/NZS 60076.1 and AS/NZS 60076.11 (dry type transformers) shall be carried out on one transformer of a batch. Type test certificates for each of these tests shall be accepted if it can be demonstrated that the transformer supplied is of a similar design to a previously type tested transformer.

The following additional tests shall be carried out:

- full dissolved gas analysis of transformer oil both before and after the temperature rise test
- lightning impulse voltage withstand tests including chopped wave tests on maximum tap, mid tap and minimum tap positions for the three phases respectively

A short circuit withstand test is not required however the designer is required to provide the short circuit design calculations.

The following new section has been added after Section 9.2:

9.3 Special test

Sound power level tests shall be conducted in accordance with AS 60076.10 *Power transformers: Determination of sound levels*.

Sound pressure check readings shall be carried out at full rated output during load loss testing and shall be included in the determination of the sound power level as per AS 60076.10.

The hot insulation resistance shall be recorded on transformers subjected to a temperature rise test.

The existing Section 10 and Section 10.1 have been replaced with the following:

10 Data set associated with the equipment

The data set explained in Section 10.1 through to Section 10.5 shall be supplied by the manufacturer and maintained for the transformer.

This data set shall remain the property of TfNSW.

10.1 Equipment manual

An operation and maintenance manual shall be provided for the equipment in accordance with the requirements of T HR EL 00002 PR. The requirements for the scope of the operation and maintenance manual are as detailed in T HR EL 00002 PR with the following additional content:

- photographs to be included from the manufacturing of transformer showing the winding and core
- detailed description including required plant for the oil filling procedure
- detailed step by step instruction for obtaining oil samples

The following new section has been added after Section 10.4:

10.5 Drawings and information

All drawings shall conform to the requirements of the TMD 0001 *CAD and Drafting Manual – Electrical Design – Section 4*.

All the drawings shall bear the plant serial numbers of all units.

The following drawings are required:

This list does not include component drawings which are required as part of the integrated support requirements and are included in the operations and maintenance manual.

- transformer arrangement drawings shall be drawn to scale with the following detail:
 - complete detail of the transformer with views of all sides of the transformer and detailed sections as required
 - dimensions, including overall size, position of HV and LV connectors relative to the centre lines of the tank and the level of the foundations
 - mass of the transformer complete both with and without oil
 - quantity of insulating oil required
 - complete listing of all fittings, accessories and parts with the associated manufacturer, part or model number and relevant ratings
- schematic and wiring diagrams shall include the following:
 - schematic diagrams of the transformer windings showing connections, tapplings and tabulations of current and voltage rating of all windings
 - schematic diagram of alarm and trip circuits
- drawings of the rating plate. Details shown on these drawings shall not vary from that shown on the plates fixed to the transformer.

All the above drawings shall bear the plant serial numbers of all units.

The calculation of inrush current is required.

Appendix A Technical schedule

The following additional information is required to be submitted as part of the technical schedule:

Additional Parameters for Dry Type Transformers

Degrees of Protection provided by the enclosure

Environment class

Climate class

Fire behaviour class

Replace the existing Appendix B – Requirements for technical aspects of tender evaluation with the following:

Appendix B Request for tender checklist

The table below provides the information that is required to be provided to the tenderer.

Table – Information to be provided to the Tenderer

Information	Detail to include in the RFT
Type of transformer required	Oil immersed or dry type
Input voltage	11,000 Volts or 33,000 Volts
Output voltage	125 Volts or 250 Volts or 433 Volts
Rated power	Required size
Quantity and size of cables HV and LV or low voltage bus-duct	Project specific, should be sourced from the designer
Delivery location	Project specific
Special transport or unloading requirements	Project specific
Special installation requirements such as limiting dimensions	Project specific

Authorisation:

	Technical content prepared by	Checked and approved by	Interdisciplinary coordination checked by	Authorised for release
Signature				
Date				
Name	Chris Lilly	Neal Hook	John Paff	Graham Bradshaw
Position	Principal Engineer Substations and HV Network	Lead Electrical Engineer	A/Chief Engineer Rail	Director Network Standards and Services

EP 16 00 00 02 SP

OUTDOOR GROUND TYPE DISTRIBUTION TRANSFORMER

Version 2.1

Issued April 2013

Reconfirmed 10 July 2019

Owner: Chief Engineer, Electrical

Approved by: Neal Hook
Chief Engineer
Electrical

Authorised by: Neal Hook
Chief Engineer
Electrical

Disclaimer

This document was prepared for use on the RailCorp Network only.

RailCorp makes no warranties, express or implied, that compliance with the contents of this document shall be sufficient to ensure safe systems or work or operation. It is the document user's sole responsibility to ensure that the copy of the document it is viewing is the current version of the document as in use by RailCorp.

RailCorp accepts no liability whatsoever in relation to the use of this document by any party, and RailCorp excludes any liability which arises in any manner by the use of this document.

Copyright

The information in this document is protected by Copyright and no part of this document may be reproduced, altered, stored or transmitted by any person without the prior consent of RailCorp.

Document control

Version	Date	Summary of change
2.0	May 2010	Application of TMA 400 format
2.1	April 2013	Update template

SUPERSEDED

Contents

1	Introduction	4
2	Scope and Application	4
3	References	4
3.1	Australian Standards.....	4
3.2	RailCorp Documents.....	5
3.3	Drawings	5
4	Definitions & Abbreviations	5
5	Functional Characteristics	5
5.1	General.....	5
5.2	Whole-of-Life Cost	6
6	Performance Characteristics	6
7	Technical Characteristics.....	7
7.1	Rating Plate.....	7
7.2	Terminal Arrangement	7
7.3	Earth Terminal.....	7
7.4	Lifting Attachments.....	8
7.5	Temperature-Rise Limits.....	8
7.6	Finish.....	8
7.7	Unearthed Secondary	8
7.8	Dry Type Transformers	8
7.9	Insulating Oil	8
7.10	Sealed Transformers.....	9
7.11	Valves and Plugs	9
7.12	Thermometer Pocket.....	9
7.13	Breather.....	9
7.14	Pressure Relief Vent	9
8	Maintenance	9
8.1	General.....	9
8.2	Oil Testing	9
9	Tests	10
9.1	Acceptance Tests.....	10
9.2	Periodic Tests	10
10	Data Set associated with the Equipment.....	10
10.1	Equipment Manuals	10
10.2	Test Results	10
10.3	Life Cycle Costing	10
10.4	Technical Schedule.....	10
Appendix A	Technical Schedule	11
Appendix B	Requirements for Technical Aspects of Tender Evaluation	13

1 Introduction

This document details the whole of life performance requirements for the purchase and maintenance of 2 and 3 phase outdoor, ground mounted distribution transformers for use in the RailCorp electrical network. It covers primary voltages of 11 kV and 33 kV and secondary voltages of 125 V, 250 V and 433 V. The standard design is based on oil-immersed transformers but this document does not exclude other types of transformers. This document includes transformers for use in padmount substations.

This document does not cover transformers used on the 2 kV network as it is in the process of being phased out, any replacement transformers should be sourced from decommissioned stock.

2 Scope and Application

This document details the whole of life performance requirements for the purchase and maintenance of 2 and 3 phase outdoor, ground mounted distribution transformers for use in the RailCorp electrical network. It covers primary voltages of 11 kV and 33 kV and secondary voltages of 125 V, 250 V and 433 V. The standard design is based on oil-immersed transformers but this document does not exclude other types of transformers. This document includes transformers for use in padmount substations.

This document does not cover transformers used on the 2 kV network as it is in the process of being phased out, any replacement transformers should be sourced from decommissioned stock.

The requirements of this document apply to all new outdoor, ground mounted distribution transformers.

3 References

3.1 Australian Standards

The following Australian Standards are either referenced in this document or can provide further information.

- | | |
|------------------|--|
| AS 1265:1990 | <i>Bushings for alternating voltages above 1000 V.</i> |
| AS 1627.4:2002 | <i>Metal finishing - Preparation and pre-treatment of surfaces - Abrasive blast cleaning.</i> |
| AS 1767.1:1999 | <i>Insulating liquids - Specification for unused minerals insulating oils for transformers and switchgear.</i> |
| AS 2067:1984 | <i>Switchgear assemblies and ancillary equipment for alternating voltages above 1 kV.</i> |
| AS 2105:1992 | <i>Inorganic zinc silicate paint.</i> |
| AS 2374.1:1997 | <i>Power transformers Part 1: General.</i> |
| AS 2374.2:1997 | <i>Power transformers Part 2: Temperature rise.</i> |
| AS 2374.3:1982 | <i>Power transformers Part 3.0: Insulation levels and dielectric tests - General requirements.</i> |
| AS 2374.3.1:1992 | <i>Power transformers Part 3.1: Insulation levels and dielectric tests - External clearances in air.</i> |
| AS 2374.5:1982 | <i>Power transformers Part 5: Ability to withstand short-circuit.</i> |
| AS 2374.6:1994 | <i>Power transformers Part 6: Determination of transformer and reactor sound levels.</i> |

- AS 2700:1996 *Colour standards for general purposes.*
AS 2735:1984 *Dry-type power transformers.*
AS 4680:1999 *Hot-dip galvanized (zinc) coatings on fabricated ferrous articles.*

3.2 RailCorp Documents

EP 02 00 00 01 SP - "Transformer Loss Evaluation"

3.3 Drawings

The following drawings form part of this document:

- None.

The following drawings can provide further information:

C 87206 Earthing system for fibreglass padmount substation.

4 Definitions & Abbreviations

For the purpose of this document the definitions given in AS 2374 apply. In addition the following definitions also apply:

2 phase system Where the secondary of a transformer is a two wire system, that is it has a voltage of 250 V or 125 V, then the primary winding of the transformer is connected across two phases of the high voltage system.

Distribution Transformer A transformer that transforms and controls the system voltages to a secondary voltage of nominally 433 V, 250 V or 125 V.

Primary winding The winding that receives the active power from the supply system, usually the winding having the highest rated voltage.

Principal tapping Is the mean tapping position. It is also the tapping to which the rated quantities are related.

Secondary winding The winding that delivers the active power to the load circuit, usually the winding having the lowest rated voltage.

5 Functional Characteristics

5.1 General

Outdoor ground mounted transformers are used on RIC's 11 kV and 33 kV distribution networks in the area bounded by Muswellbrook (north), Kiama (south) and Wallerawang (west).

The transformers covered by this document supply railway stations, signals, workshops and various other low voltage loads. They are not used for supplying DC traction loads.

The transformers shall be in accordance with AS 2374, except as detailed in this document.

5.2 Whole-of-Life Cost

The selection of the most suitable transformer shall be made on the basis of minimising the whole-of-life cost. The following factors must be considered in determining this:-

- Initial purchase price.
- Cost of changes to the Technical Maintenance Plan & Service Schedules or the creation of new manuals & schedules.
- Cost of manuals.
- Cost of maintenance.
- Cost of replacement parts.
- Cost of inventory spares.
- Environmental costs.
- Electrical Losses. Refer to document EP 02 00 00 01 SP - "Transformer Loss Evaluation" for the method of evaluating transformer losses.
- Cost of installation.
- Reliability and cost of failures.
- Cost of modifications to other parts of the installation.
- Lifetime of equipment.
- Discount Rate.
- Cost of staff training.
- Cost of Decommissioning and Disposal.
- Cost of special tools.
- Cost of changes and management of drawings.

6 Performance Characteristics

Number of phases	2 or 3.
Frequency	50 Hz.
Type	Outdoor, Ground type.
Type of cooling	Oil natural, air natural or Air natural.
Rated voltages	Refer to Table 1, below.
Tappings	Full kVA tappings on the primary winding at $\pm 2.5\%$ and $\pm 5\%$ of the principal tapping. Externally operated off-circuit switches, where used, shall be capable of being locked in position.
System highest voltage	Refer to Table 1 below.
System earthing	Non-effectively earthed.
Rated insulation level	Refer to Table 1 below.
Connection vector symbol	Dyn 1.
Neutral terminal	Star point of lower voltage winding shall be connected to a bushing and fully insulated from earth.
Impedance voltage at rated current and 75°C	Refer to AS 2374.5, Table 1.
Sound pressure level	Refer to AS 2374.6, Appendix AA.
Special physical characteristics	Refer to Section 5.

Rated Voltage	System Highest Voltage	Rated Insulation Level	
		Lightning Impulse	Power Frequency
125 - 433 V _{rms}	1.1 kV _{rms}	-	5 kV _{rms}
11 kV _{rms}	12 kV _{rms}	95 kV _{pk}	28 kV _{rms}
33 kV _{rms}	36 kV _{rms}	200 kV _{pk}	70 kV _{rms}

Table 1 - Voltage and Insulation Levels

Note:The transformer vector connection Dyn 1 is used on all RailCorp transformers with a low voltage secondary winding.

7 Technical Characteristics

7.1 Rating Plate

The rating plate shall meet the requirements of AS 2374.1, Section 7, and shall include a diagram of connections. A terminal marking plate complying with the requirements of AS 2374.1 Section ZC7 shall also be attached to the transformer. The plates shall not be attached to a removable cover.

7.2 Terminal Arrangement

The primary and secondary winding terminal bushings shall be mounted on opposite sides of the transformer enclosure. The arrangement for both sets of terminal bushings shall be A B C phases from left to right when viewed from the primary side (A and B only for a two phase transformer). When a neutral terminal is fitted, it shall be on the extreme left unless otherwise agreed to by RIC. The bushings shall comply with AS 1265 for normally polluted atmosphere.

Where a cable box is provided, provision shall be made to accommodate the termination of the required cables. Heat-shrink material may be used to obtain a satisfactory insulation level. Generally the cables terminated in a cable box shall enter from below.

For connections using lugs or terminals not insulated to the appropriate voltage, the following minimum clearances shall apply:

33 kV terminals	Between different phases	460 mm
	Between phase and earthed metal	380 mm
11 kV terminals	Between different phases	185 mm
	Between phase and earthed metal	160 mm
415/433 V terminals	Between different phases	110 mm
	Between phase and earthed metal	60 mm
125/250 V terminals	Between different phases	70 mm
	Between phase and earthed metal	60 mm

7.3 Earth Terminal

A suitable earthing terminal for the transformer enclosure shall be located externally, near the bottom of the enclosure.

7.4 Lifting Attachments

Lifting lugs shall be provided for lifting the transformer. For a transformer of 500 kVA or greater rating, brackets shall be provided at each corner to allow the corner to be lifted by a jack. The brackets shall be not less than 200 mm from the ground.

7.5 Temperature-Rise Limits

The transformer shall be capable of continuous operation at rated power without exceeding the maximum temperature-rise limits as specified in AS 2374.2, Section 4.2.

7.6 Finish

All external surfaces shall have welds made smooth, rough edges rounded and weld splatter removed. The transformer tank and cover shall remain corrosion free for the life of the transformer. The internal and external surfaces shall be prepared and the paint applied strictly in accordance with the manufacturer's instructions.

The expected minimum preparation for a new transformer is abrasive blast cleaning all steel surfaces in accordance with AS 1627, part 4 to Class 2.5. The internal steel surfaces painted with an oil resistant paint immediately after abrasive cleaning. The external steel surfaces painted with an inorganic zinc-rich paint immediately after abrasive cleaning.

When an existing transformer suffers damage to its finish the repair shall be to the original standard of finish.

7.7 Unearthed Secondary

Transformers used solely for supplying unearthed installations, such as signalling locations, shall be provided with a copper or aluminium metal screen located between the primary and secondary windings. The screen shall be at least 0.5 mm in thickness and is to be connected to a special insulated terminal. The metal screen shall be arranged to prevent leakage from any part of the primary windings to any part of the secondary windings of the transformers.

The manufacturer must be made aware that the secondary side of the transformer is not earthed under normal service conditions so that overvoltages due to the capacitances between windings and between windings and earth can be allowed for in the transformer design.

7.8 Dry Type Transformers

The requirements of Sections 7.9 to 7.14 shall not apply to dry type transformers.

7.9 Insulating Oil

Insulating oil shall comply with the requirements of AS 1767.1.

In order to comply with NSW Environment Protection Agency guidelines for PCB free materials the transformer oil must contain less than 2 milligrams per kilogram of PCB. After the transformer has been delivered to site and any oil added, as may be necessary, the suppliers shall arrange for the oil to be tested for PCB content and a certificate issued to the Purchaser showing the PCB content. Should the PCB content exceed 2 mg/kg then the suppliers shall arrange for the oil to be "treated" as necessary to reduce the PCB level below 2 mg/kg.

7.10 Sealed Transformers

Where a sealed transformer construction design is used the space above the oil shall be filled with inert gas or dry air. The gland for the tap changer switch shall be located below cold oil level. The tank cover and bracing shall be designed to prevent the accumulation of water.

The requirements of Sections 7.11 to 7.14 shall not apply to sealed transformers.

7.11 Valves and Plugs

A drain valve 25 mm nominal bore pipe internal thread with flanged plug shall be fitted at the bottom of the transformer tank to allow the oil and any moisture to be withdrawn.

A 25 mm nominal bore pipe internal thread with flanged plug shall be fitted above the maximum oil level of the transformer tank for filling purposes.

7.12 Thermometer Pocket

The thermometer pocket shall be located as near as practicable to the hottest part of the oil. It shall be fitted with a flanged plug, having a 25 mm pipe thread.

7.13 Breather

Dehydrating breathers that incorporate consumable components, for example silica gel, shall be of a type that allows easy replacement of the consumable components.

7.14 Pressure Relief Vent

A pressure relief vent may be fitted.

8 Maintenance

8.1 General

The relevant RailCorp Technical Maintenance Plans shall be adhered to for the maintenance of the type of transformer. Where a new type of transformer is purchased and installed that is not covered by the TMP then a new service schedule shall be created and the TMP updated. This shall include:

- The "Maintenance Policy", defining the practical means of maintaining the equipment.
- The tasks to be performed at each level of maintenance and staff skill levels required.
- Test equipment and tools.

It is preferable that the period for routine maintenance shall not be more frequent than for the type of transformer currently detailed in the RailCorp Technical Maintenance Plan.

8.2 Oil Testing

No oil testing is carried out on dry type transformers, sealed transformers and ventilated transformers under 100 kVA.

9 Tests

9.1 Acceptance Tests

Routine tests shall be carried out on each transformer to AS 2374.1 Section 10.1.1. The results shall be recorded. A record of a test certificate for type tests carried out on a similar transformer to AS 2374.1 Section 10.1.2 shall also be available for each transformer.

Where a transformer has a metal screen, refer to Section 5.7, the metal screen shall be connected to the high voltage earth during the acceptance tests.

9.2 Periodic Tests

Refer to RailCorp Technical Maintenance Plan.

10 Data Set associated with the Equipment

The following data shall be maintained for each transformer. This data shall be the property of RailCorp and maintained by the Maintenance Provider responsible for the installation in which the transformer is installed.

10.1 Equipment Manuals

The Equipment Manuals must be provided for the installation and shall include full instructions for the preventative, surveillance and corrective maintenance, comprehensive fault diagnosis, rectification procedures and staff training requirements. It shall include all drawings needed for the above. All drawings shall show sufficient detail to enable satisfactory maintenance of the equipment.

10.2 Test Results

The results of all tests relating to the transformer and the insulating oil, including acceptance tests and periodic and corrective maintenance tests, shall be recorded.

10.3 Life Cycle Costing

All the data and assumptions pertaining to the determination of the whole-of-life cost calculations shall be recorded.

10.4 Technical Schedule

The information listed in the attached Technical Schedule shall be maintained for each transformer.

Appendix A Technical Schedule

Manufacturer	.....
Serial number	.....
Year of manufacture	.....
Oil preservation system (refer to AS 2374.1 Section 8.2)	.....
Rated primary voltage	.....	V
Rated secondary voltage	.....	V
Rated power	.....	kVA
Connection vector symbol	.....
Maximum temperature rise of windings	.....	°C
Impedance voltage at rated current and 75°C/115°C* (Expressed as percentage of rated voltage)	.....	%
No-load current with rated voltage applied to the principal Tapping (Expressed as percentage of rated current)	.....	%
No-load current with 110% of rated voltage applied to the principal Tapping (Expressed as percentage of rated current)	.....	%
No-load loss	.....	W
Load loss	.....	W
Type of core steel - hot or cold rolled	.....
Brand or trade name and grade of core steel	.....
Flux density based on net cross-section of steel with rated voltage at rated frequency applied to the principal tapping		
- Limbs	.....	T
- Yoke	.....	T
Mass of windings only	.....	kg
Mass of transformer core and windings only	.....	kg
Mass of one transformer, complete with oil	.....	kg
Volume of oil required to fill one transformer	.....	litres
Is a pressure relief vent provided		*Yes/No
If so, what type	.....
Mean audible sound level	.....	db
Power frequency voltage test which the bushings will withstand without puncture or flashover in accordance with Section 21 and Table 1 of AS 1265.		
Primary bushing		
- Lighting impulse withstand voltage	.....	kVp
- Power frequency withstand voltage	.....	kVrms
Secondary bushings		

- Lightning impulse withstand voltage (if required) kVp
- Power frequency withstand voltage kVrms

Bushings, minimum clearance in air:

Between phases

- Primary mm
- Secondary mm

Phase to earth

- Primary mm
- Secondary mm

Is heat-shrink material provided on the higher volt terminals? *Yes/No

Type of insulating material used for windings

Type of material used for windings - copper or aluminium

Temperature class of insulation

Insulating liquid (oil/synthetic)

Overall Dimensions

- Length mm
- Width mm
- Height mm

Protective treatment applied to:

- Internal surfaces
-
- External surfaces
-

* Cross out where not applicable.

Departures from Specification

Are there any departures from the requirements of this Specification *Yes/No

Departures from the requirements of this Specification must be highlighted

Appendix B Requirements for Technical Aspects of Tender Evaluation

Evaluation of tenders

Tender submissions will be evaluated based on a number of criteria. One constant criterion is compliance with this specification. The Chief Engineer Electrical requires that persons evaluating the technical aspects of this tender have sufficient technical competence for the task.

Tender evaluation committees shall forward details of persons evaluating the technical aspects of the tender to the Chief Engineer Electrical for concurrence. This will normally be in the form of an email and is to include sufficient detail of the tender and the person to enable the Chief Engineer Electrical to satisfy himself of the merits of the evaluating person. A minimum of 4 weeks notice is required prior to the evaluation of the Tenders.

The Chief Engineer Electrical will advise within 5 working days only if the person is considered technically unsuitable for the technical evaluation.

Acceptance of product

A number of the specifications require acceptance of product at both the factory and at site. The purchaser is to advise the Chief Engineer Electrical the details of the person carrying out the acceptance testing for the concurrence of the Chief Engineer Electrical. A minimum of 4 weeks notice is required prior to the evaluation of the acceptance testing.

The Chief Engineer Electrical will advise only if the person is considered unsuitable for the acceptance testing.

The Chief Engineer Electrical reserves the right to nominate a representative to review and/or attend such acceptance.

Record Keeping

Where product is purchased against this specification, the Chief Engineer Electrical requires that relevant detail be provided so that it can be logged against this specification.

For RailCorp purchases, all records are recorded in Ariba.

Where this specification is utilised by parties external to RailCorp (Alliance parties, etc) then copies of all relevant technical information and evaluation shall be forwarded to the Chief Engineer Electrical for filing against the specification. In addition copies of selected commercial information pertaining to the ongoing support of the product as follows is also required.

- Warranty details
- Spare parts and associated availability
- Product support information.