

Standard

Extra High Voltage (EHV) Disconnecter and Earth
Switch Standard

R586396

Version 1.0, June 2018

Authorisations

Action	Name and title	Date
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Reviewed by	Santosh Dhakal, Asset Engineer	June 2018
Authorised by	Darryl Munro, Asset Strategy Team Leader	June 2018
Review cycle	30 months	

Responsibilities

This document is the responsibility of the Asset Strategy Team, Tasmanian Networks Pty Ltd, ABN 24 167 357 299 (hereafter referred to as "TasNetworks").

Please contact the Asset Strategy Leader with any queries or suggestions.

- Implementation All TasNetworks staff and contractors.
- Compliance All group managers.

Minimum Requirements

The requirements set out in TasNetworks' documents are minimum requirements that must be complied with by all TasNetworks team members, contractors, and other consultants.

The end user is expected to implement any practices which may not be stated but which can be reasonably regarded as good practices relevant to the objective of this document.

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Record of revisions

Section number	Details
Entire doc	Copied over verbatim from superseded Transend to TasNetworks template. Updated Transend to TasNetworks document reference numbers where known including Australian Standards.

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1 General

1.1 Purpose

To define the requirements from extra high voltage (EHV) disconnectors (hereafter referred to as disconnectors) and earth switches, under the responsibility of Tasmanian Networks Pty Ltd (hereafter referred to as TasNetworks).

1.2 Scope

This standard specifies the requirements for the design, manufacture, construction, testing at manufacturer's works, secure packaging, supply, transportation and delivery to site, with complete documentation, of disconnectors and earth switches.

1.3 Objective

TasNetworks has developed this standard for disconnector and earth switch design, manufacture, construction, testing and delivery to ensure:

- (a) that relevant Australian legal requirements are met;
- (b) ensure the requirements of the National Electricity Rules are met;
- (c) ensure personnel and public safety;
- (d) ensure ease of operation and maintenance;
- (e) ensure reliability and continuity of power supply to the electricity transmission system; and
- (f) support the implementation of TasNetworks' strategic performance objectives.

1.1 Certificate of conformance

A certificate of conformance with this standard must be submitted to TasNetworks prior to any new disconnector or earth switch being put into service in TasNetworks' system. The certificate of conformance must be duly supported with documents, drawings, test results, test reports, test certificates, completed check lists and other documents as applicable. Where TasNetworks has approved deviation to specific requirements of this standard, all such approvals must be included with the certificate of conformance.

TasNetworks will supply blank forms for certificate of conformance, to be completed by the Contractor.

The disconnector or earth switch will be accepted only after TasNetworks has accepted the certificate of conformance.

1.2 Precedence

Any conflict between the requirements of the standards, codes, specifications, drawings, rules, regulations and statutory requirements or various sections of this standard and other associated documents must be brought to the attention of TasNetworks for resolution.

1.3 Deviation

Special approval for a deviation to this standard may only be accorded if it does not reduce the quality of workmanship, or does not deviate from the objective or intent of the standard. A request for a deviation must follow a designated procedure that involves approval from TasNetworks. Deviations, if any, must be specifically requested and require approval in writing by TasNetworks prior to award of Contract.

1.4 References

As a component of the complete specification for a system, this standard is to be read in conjunction with other standards and documents as applicable. In particular, this includes the project specifications and the following:

1.4.1 TasNetworks standards

Extra High Voltage Post Insulator Standard	R574184
Extra High Voltage Disconnecter and Earth Switch Information to be provided with Tender	R5864915
Extra High Voltage Disconnecter and Earth Switch Deliverables	R586491
Operational & Equipment Earthing Standard Drawing, Earthing Termination Stations for Steel & Concrete Structures	NET-0177-00002/003
Operational Earthing Standard Drawing, Operational Earthing Equipment Structure Attachments Details	NET-0177-00002/006
Substation Standard Outdoor Switchyard Operator Earthmat Assembly and Details	TSD-SD-809-0002-004
NGK 110 kV Post Insulator (Cat. No. DA-108051MM)	NGK drawing S-135818
NGK 220 kV Post Insulator (Cat. No. 8A-108101MM)	NGK drawing S-135819

2 Service conditions

Service conditions shall not exceed the limits stated in AS/NZS 62271.1 Clause 2, together with the particulars of the system stated in Table 1 of this standard.

Specific environmental conditions for particular works will be stated in the project specifications.

3 Design requirements

All disconnectors and earth switches must comply with the requirements within Table 1 of this standard, the requirements detailed in AS 62271-102 and other applicable Australian and International Standards. Where a conflict exists, the most onerous requirement shall apply.

Any specific design, installation, operation and maintenance criteria for particular works will be stated in the project specifications, such as physical mounting arrangement (side-to-side or end-to-end), operating mechanism (motorised or manual) or with/without integral earth switch.

Table 1 Parameters for disconnectors

Sr. No.	Parameter	Unit	Value	
1.	Nominal system voltage (V_n)	kV	110	220
2.	Highest voltage	kV	123	245
3.	Power frequency withstand voltage (PFVV)	kV_{rms}	230	460
4.	Lightning impulse withstand voltage (LIWV)	kV_{peak}	550	1050
5.	Normal voltage variation (criteria for equipment design)	$\%V_n$	± 10	
6.	Frequency	Hz	50	
7.	Normal operating frequency excursion band	Hz	48.8 to 52	
8.	Power system frequency range	Hz	44.5 to 52	
9.	Normal combined voltage and frequency variation (criteria for equipment design)	%	± 10	
10.	Number of phases	-	3	
11.	Minimum ambient air temperature	$^{\circ}C$	minus 10	
	Particulars of disconnector and earth switch			
12.	Number of poles (mechanically coupled)	-	3	
13.	Installation	-	Outdoor	
14.	Insulation medium	-	Air	
15.	Rated short-time withstand current	kA	40	
16.	Rated peak withstand current	kA	108	
17.	Rated short-time	s	1	
18.	Rated current, continuous	A	2000	3150
19.	Primary terminal palm type (AS 62271-301)		8	9
20.	Rated bus-transfer current (AS 62271-102)	A	1600	1600
21.	Rated induced current switching class	-	A (AS 62271-102)	
22.	Mechanical endurance class (disconnecter)	-	M1 (AS 62271-102)	
23.	Electrical endurance class (earth switch)	-	E0 (AS 62271-102)	
24.	Neutral earthing	-	solidly earthed	
25.	Rated supply voltage of heater circuit	V_{ac}	240	
26.	Rated supply voltage of auxiliary (motor), indication and interlocking circuits	V_{dc}	125	
27.	Rated supply voltage range of auxiliary (motor), indication and interlocking circuits	V_{dc}	87.5 Vdc – 137.5 Vdc	
28.	Contact rating of auxiliary switches at 125 V_{dc}	A	4	
29.	Degree of protection by enclosure	IP	54	

Sr. No.	Parameter	Unit	Value
30.	Mode of operation (manual or motorised)	-	Motorised
31.	Minimum phase-phase clearance	mm	Refer to project specifications
32.	Phase spacing	mm	Refer to project specifications
33.	Mounting configuration	-	Refer to project specifications
34.	Height of support structure	mm	Refer to project specifications
35.	Commutating contacts fitted	Yes/No	No (unless specified in the project specifications for use in bus-transfer current switching applications)

3.1 General design

Disconnectors must:

- (a) be a double-break design, unless otherwise stated in the project specifications;
- (b) have all three poles mechanically coupled, unless otherwise stated in the project specifications;
- (c) be motorised and capable of being controlled locally at the disconnector or remotely, via a supervisory control and data acquisition (SCADA) system.
- (d) have a local control switch and a REMOTE-OFF-LOCAL control selector switch provided within a lockable disconnector control cubicle to meet the following functions:
 - (i) when switched to LOCAL, control from the local control switch must be enabled and remote close and open circuits must be disabled;
 - (ii) when switched to REMOTE, all external open and close circuits are enabled and all circuits to the local control switch must be disabled;
 - (iii) when switched to OFF, all local and remote open and close circuits must be disabled; and
 - (iv) position indication of control switch and control selector switch must be capable of being provided to SCADA, with an additional normally-open (NO) and normally closed (NC) contact provided on both switches.
- (e) be provided with a miniature circuit breaker (mcb), or overload relay and contactor, on motor supply circuit, if applicable, complete with any lock fittings to allow the mcb or relay to be securely locked and tagged in the open position;
- (f) be provided with slide-link disconnect terminals for effective isolation of all external d.c. circuitry. *The slide-link disconnect terminals must be Weidmuller type WTL 6/1, Phoenix type URTK/S or equivalent.;*
- (g) be capable of manual operation within the maximum force limits defined in section 5.105 of AS 62271-102, which states that the force needed to operate a disconnector or earthing switch shall not be higher than 60 N with a possible peak of 120 N during a maximum of 10 per cent of the total required revolutions;
- (h) be supplied with 70 mm², or equivalent, flexible earth connections with crimp lugs enabling all operating handles to be connected to the switchyard earthing system; and
- (i) be supplied with integral support structures. Support structures must be constructed with galvanized steel and conform to relevant Australian Standards for steel structures and welding. The support structure must include brackets for operational earthing points to be connected on each side of the disconnector. The brackets must be 'Mark 5' (as per drawing NET-0177-00002/006) to allow the

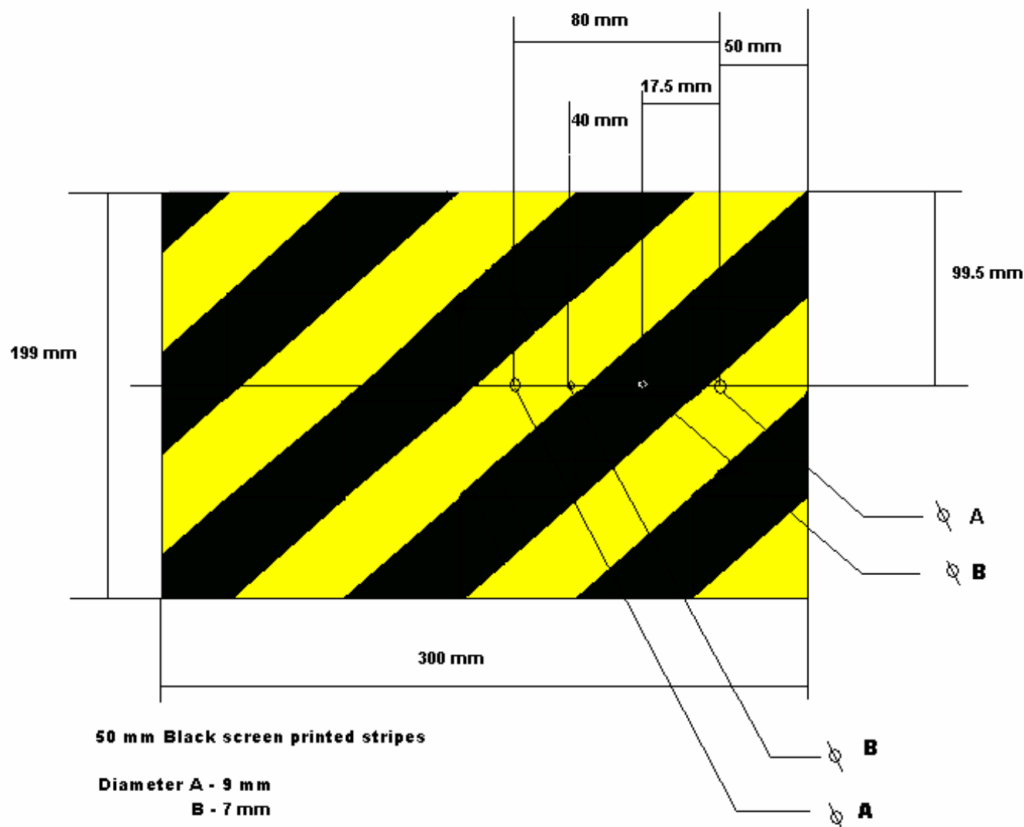
purchaser to install 'Type 10' operation earthing connection points, as detailed in NET-0177-00002/003.

3.1 Earthing switches

Where stated in the project specifications, disconnectors must be supplied equipped with integral earthing switches. A free-standing earth switch may also be specified. Earthing switches must:

- (a) conform to the requirements detailed in AS 62271-102 for 'normal service conditions';
- (b) have a short-circuit current withstand capability equivalent to the rated short-time withstand current capacity of the associated disconnector;
- (c) have earthing switch blades that allow connection of a copper conductor for direct bonding to the substation earthing system;
- (d) be designed such that the earth switch arms cannot not swing from an open to a closed position, or a closed to an open position, in the event of a failure of the operating mechanism.
- (e) have a lockable operating handle 1200 mm above ground level. The earth switch must not require a manual static effort of more than 250 N to operate the operating handle. A peak value of 450 N is acceptable during the initial 15° rotation;
- (f) be supplied with 70 mm², or equivalent, flexible earth connections with crimp lugs enabling all operating handles to be connected to the switchyard earthing system; and
- (g) be supplied with a visible, corrosion proof, 300 mm x 200 mm flag securely fitted to the top half of each of the earth switch arms, comprising 50 mm diagonal black stripes on a yellow background, similar to Figure 1.

Figure 1 Earth switch flag



3.1 Interlocking requirements

- (a) The disconnector mechanism must include a solenoid interlock to allow electrical interlocking with its associated circuit breaker/s to prevent making or breaking of load. An energising pushbutton must be provided for manual operation.
- (b) A free standing earth switch must include a solenoid interlock to allow electrical interlocking with its associated disconnectors or enclosure access gates. An energising pushbutton must be provided for manual operation.
- (c) The disconnector or earth switch (where fitted) must be capable of being padlocked in both the open and closed positions.
- (d) The disconnector must be mechanically interlocked with its integral earthing switch (where fitted) such that the:
 - (i) earth switch can only be closed when all poles of the disconnector are open; and
 - (ii) disconnector can only be closed when all poles of the earth switch are open.
- (e) The disconnector must be electrically interlocked with its integral earthing switch (where fitted) such that the disconnector can only be closed, in either local or remote mode, when all poles of the earth switch are open.

3.1 Post insulators

The project specifications will state if post insulators are to be provided by the supplier or by the purchaser.

- (a) If the disconnector supplier is to provide post insulators, the light-grey glazed porcelain insulators must conform to document Extra High Voltage Post Insulators Standard, R574184
- (b) If the purchaser is to supply the post insulators, then the disconnectors must be designed to allow the use of the following post insulators:
 - (i) for 220 kV disconnectors, NGK Post Insulators Cat. No. 8A-108101MM (see attached NGK drawing number S-135819); or
 - (ii) for 110 kV disconnectors, NGK Post Insulators Cat. No. DA-108051MM (see attached NGK drawing number S-135818).

3.1 Primary line terminals

Disconnecter must be provided with:

- (a) aluminium primary terminals of a type as listed in Table 1 of this specification, with horizontal orientation, to AS 62271-301; and
- (b) primary terminals that have minimum mechanical terminal load ratings as defined in table 3 of AS 62271-102.

3.1 Auxiliary switches

Disconnectors and earthing switches must be fitted with an auxiliary switch to provide indication and interlocking functions. It must be possible to fit additional switches to the disconnector and earthing switch if required. The auxiliary switch must:

- (a) comply with the requirements of Clause 5.4 of AS/NZS 62271.1;
- (b) be simple and robust, capable of easy adjustment at site, readily accessible and capable of maintaining their adjustment for long periods. All springs must be rust proof;

- (c) for disconnectors, have available for external wiring at least eight (8) spare normally-open (NO) contacts and eight (8) spare normally-closed (NC) contacts; and
- (d) for earth switches, have available for external wiring at least four (4) spare normally-open (NO) contacts and four (4) spare normally-closed (NC) contacts;
- (e) be capable of a contact arrangement of make-before-break; and
- (f) be suitably insulated to prevent tracking and moisture absorption.

3.1 Local control and operating cubicles

Local control and operating cubicles must:

- (a) be of a lockable type, constructed from high quality stainless steel (minimum grade 304) or Aluminium sheet metal panels of sufficient thickness and bracing to provide torsional rigidity;
- (b) have doors and covers providing ready access to all operating components for inspection and maintenance purposes. Door(s) must open to an angle of 120 degrees, and have stays fitted to prevent free swing;
- (c) be weather, vermin and dust proof and must have provisions to avoid formation of water pools;
- (d) have a minimum degree of protection to IP 54;
- (e) have a removable gland plate at the bottom of the cubicle to allow entry of all cables. The gland plate must be a minimum of 2 mm thick and suitable for drilling on site;
- (f) have thermostatically controlled space heaters with cut-off control switches to prevent moisture condensation. The heaters and thermostats must be:
 - (i) suitable for single phase 230 V, 50 Hz AC system operation;
 - (ii) rated to withstand temperatures of 100 °C;
 - (iii) capable of continuous service for the entire life of the unit;
 - (iv) easily accessible and easily replaceable; and
 - (v) supplied with appropriate settings and a recommended settings sheet for each installed heater and thermostat combination.

4 Other requirements

4.1 General construction

All equipment associated with the disconnector assembly must be designed to avoid pockets in which water can collect.

4.2 Earthing

- (a) Frames of all equipment supplied must be provided with reliable earth connection points and comply with relevant Australian Standards.
- (b) All connections to earth must comply with requirements of AS/NZS 3000 and be designed to provide a firm connection for the entire life of the equipment.
- (c) Disconnectors must be supplied with operator earth mats, as per drawing TasNetworks' Substation Standard Outdoor Switchyard Operator Earthmat Assembly and Details Drawing,

TSD-SD-809-0002-004 (note: the purchaser will arrange connection from the operator earth mat to the switchyard earthing system).

- (d) Earthing terminals must be suitable for connecting copper earthing strip size 40 mm x 6 mm using as a minimum 2 x 12 mm bolts with 40 mm centres.

4.1 Special tools

Any special tools required for the operation or maintenance of the disconnector and earth switch (where fitted) must be provided.

4.2 Documentation requirements

- (a) Dimensional plan and section drawings for the disconnector and earth switch and any associated accessories must be produced and submitted for approval by TasNetworks. The drawings must show the final outline dimensions, total mass, details of insulator, primary and earth terminals, support structure attachment points, lifting lugs, operating rods and adjustments, other fittings and accessories, and the materials utilised.
- (b) Separate rating and nameplate drawings must be produced and submitted for approval by TasNetworks.
- (c) Separate schematic and wiring diagrams, with label details must be produced and submitted for approval by TasNetworks.
- (d) Details on packaging and handling the equipment during transport and erection must be provided and submitted for approval by TasNetworks.
- (e) Operation and maintenance manual must be provided and submitted for approval by TasNetworks.
- (f) Separate construction drawings must show the mounting structures and all detail required to install the equipment, including minimum clearances in air (between poles and to earth), isolating distances, rated static and dynamic mechanical terminal loads.
- (g) All documents and drawings must be clear, legible and free from errors or omissions.
- (h) All documents and drawings must be in the English language ONLY.
- (i) Only SI system of units can be used. Units must be stated for all values.
- (j) Scales, where used, must be as per the applicable Australian Standards.
- (k) All drawings that are made to scale must include a scale block.
- (l) Electronic copies of drawings must be supplied on CD-rom in the AutoCad Release 14 format.
- (m) Only information relevant to the supplied disconnector and earth switch, if fitted, must be shown in the documentation and drawings.

4.1 Nameplates

- (a) The disconnectors must be provided with nameplates that are:
 - (i) legible and in the English language;
 - permanently and indelibly marked;
 - securely fixed in position;
 - weather proof and corrosion-proof;
 - made of stainless steel or a material of equal durability; and

- readable from ground level.
- (b) In addition to the actual device ratings and detailed requirements of Table 4 of AS 62271-102, the following information must be included on the disconnector nameplate:
 - (i) Purchaser: Tasmanian Networks Pty Ltd; and
 - (ii) Purchaser's Contract Number: refer to project specifications.

5 Testing

- (a) All components of the disconnector and earthing switch (where fitted) must be duly tested in accordance with applicable Australian and International standards. Where tests are optional in the standards, it will be considered that these tests are required by TasNetworks, unless otherwise requested by Contractor and agreed in writing by TasNetworks before the award of Contract.
- (b) All test reports must be forwarded to TasNetworks for approval and acceptance. The tests will be considered as completed only after approval and acceptance of test results by TasNetworks in writing. A list of the tests to be conducted on disconnectors and earthing switches (where fitted) is given below.

5.1 Type tests

- (a) Type tests are intended to prove the soundness of design of the disconnector and earthing switch (where fitted) and its suitability for operation under the conditions detailed in the project specifications. Type tests must be carried out before delivery. A certified test report, detailing the results of such tests along with the procedures followed, must be provided to TasNetworks. These tests must have been applied to a disconnector and earthing switch (where fitted) of identical design to that offered, or on a design which does not differ from that offered in any way which might influence the properties to be confirmed by the type test.
- (b) Where such tests have already been performed, a copy of the type test reports that qualifies for the exemption from conducting these tests must be provided with the tender.
- (c) Type tests for each type of disconnector and earth switch must be performed to relevant Australian and International Standards and must include all mandatory and optional type tests. Where type tests differ from the requirements under the relevant Australian and International Standards, the Contractor/Supplier must detail and submit a list of non-conformances to TasNetworks for consideration.

5.1 Routine tests

- (a) Routine tests must be conducted on the complete system to prove quality of manufacture and conformance with the relevant performance requirements of the applicable standards. Splitting of routine tests into separate stages for individual components of the system is not acceptable. Routine testing must be performed at the manufacturer's works prior to delivery.
- (b) Procedures for routine tests and supporting documentation must be submitted to TasNetworks for approval and acceptance. Routine tests must not be conducted unless the routine test procedures have been accepted and approved by TasNetworks.
- (c) Routine tests for each disconnector and earth switch must be performed to relevant Australian and International Standards, and must include a control wire check. Where routine tests differ from the requirements under the relevant Australian and International Standards, the Contractor/Supplier must detail and submit a list of non-conformances to TasNetworks for consideration.

6 Packaging

- (a) The supplier is responsible for ensuring adequate packaging is provided to minimize the risk of damage to equipment during delivery. The packaging must be suited to the particular methods of delivery and provide protection against damage from all foreseen hazards.
- (b) Details of packaging methods must be submitted to TasNetworks for review.

7 Data for asset management information system

- (a) TasNetworks maintains a comprehensive 'Asset Management Information System' (AMIS) that contains all design, test results and the condition of all TasNetworks assets. The AMIS also contains maintenance regimes for all assets.
- (b) The supplier must provide the information required to maintain the currency of AMIS for each asset in standard forms. TasNetworks will provide the forms to the selected supplier. Forms are required to be filled in for all new assets.

8 Maintenance procedures and plans

- (a) Detailed maintenance procedures covering the entire life of the disconnecter and earth switch must be provided, including installation, commissioning, maintenance and decommissioning procedures.
- (b) Adjustment procedures and diagrams must be provided.
- (c) Blank inspection and test plans for commissioning, maintenance and routine testing, for use by TasNetworks maintenance personnel, must be provided.

9 Information to be provided with tender

Requirements for information to be submitted as part of the tender are outlined in document R5864915.

10 Deliverables

Requirements for disconnecter and earth switch deliverables are outlined in document R586491.

11 Hold points

The hold points for disconnecter and earth switch include:

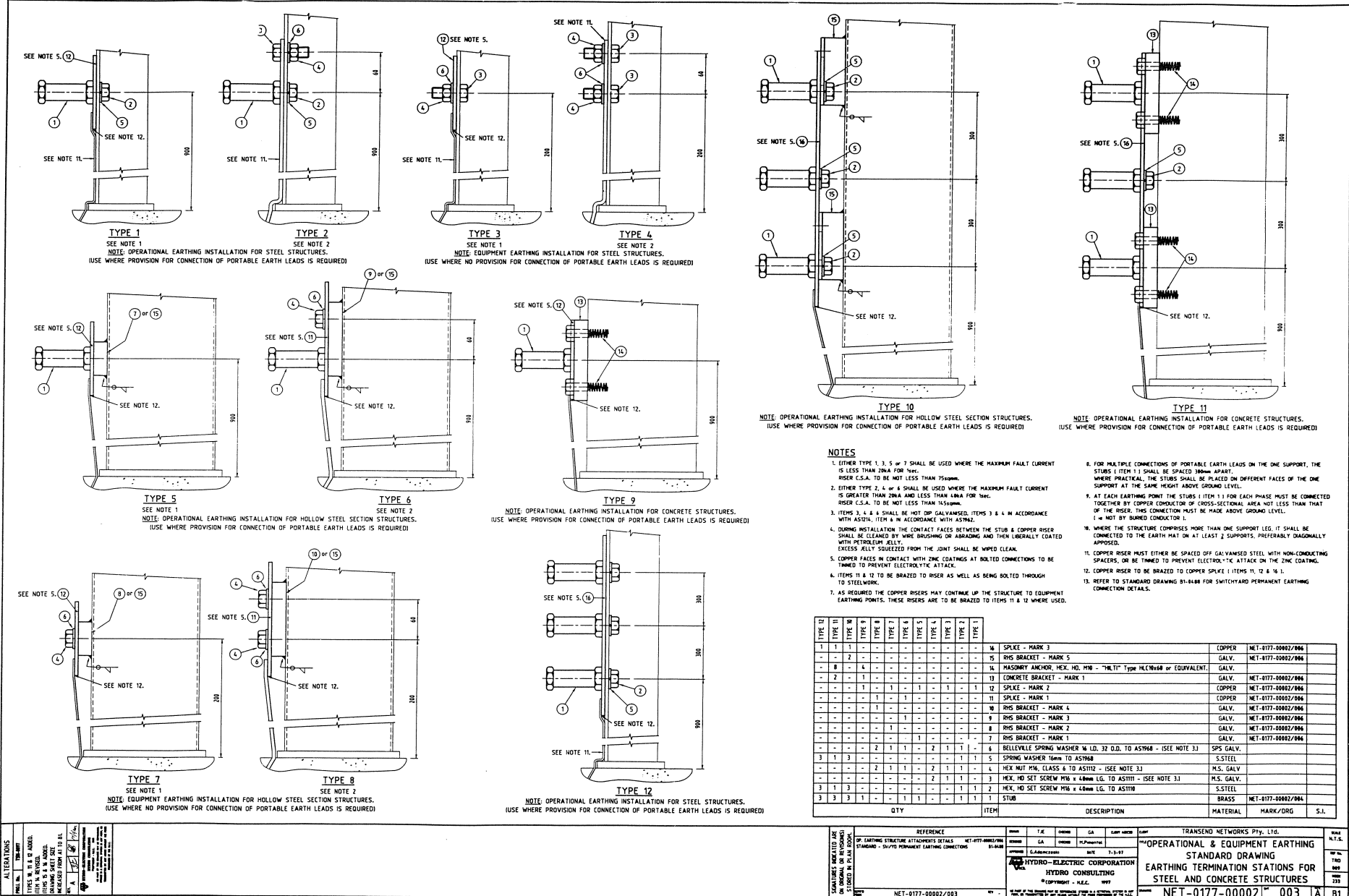
- (a) 'Critical design information documentation' must be submitted 4 weeks after receipt of letter of acceptance for TasNetworks' review, comments and approval prior to procurement of equipment.
- (b) 'Detailed design documentation' must be submitted prior to manufacturing of equipment, for TasNetworks' review, comment and approval.
- (c) 'Inspection and Test Plan' must be submitted three months prior to any testing of equipment, for TasNetworks' review, comment and approval.
- (d) 'Invitation to witness testing' must be submitted two weeks prior to any testing of equipment.

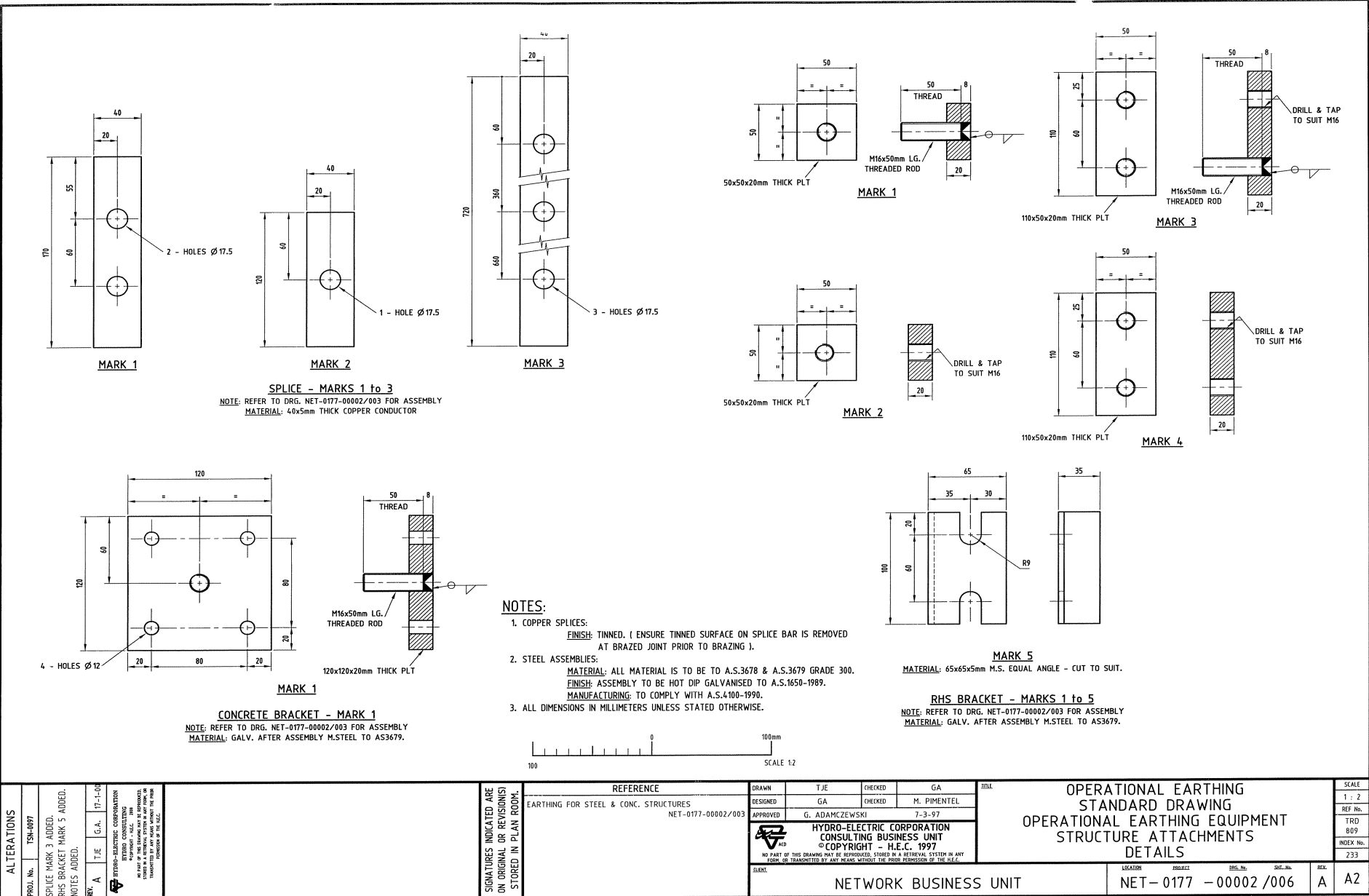
- (e) Complete updated design documentation and operations and maintenance manuals must be submitted one week prior to 'Factory Acceptance Testing (FAT)' for TasNetworks' preparation to attend FAT, if required.
- (f) Final training manuals must be provided at least two weeks prior to delivery of the EHV disconnector and earth switch, for use by the training team.
- (g) FAT results must be submitted to TasNetworks for approval with any non-conformances identified and rectified prior to shipment.
- (h) All as-built documentation, operation and maintenance manuals, test results and test certificates must be submitted to TasNetworks and be accepted by TasNetworks prior to acceptance of equipment.
- (i) Information for AMIS pertaining to design information, test results and maintenance regimes must be submitted to TasNetworks prior to acceptance of equipment.
- (j) Certificate of conformance must be submitted to TasNetworks prior to acceptance of equipment.
- (k) Inspection of each EHV disconnector and earth switch (where fitted) after delivery is required by TasNetworks prior to acceptance of equipment. The supplier is required to witness inspections of equipment after delivery to TasNetworks. The supplier may elect to appoint its representative to attend inspections after delivery.

12 Pantograph disconnectors

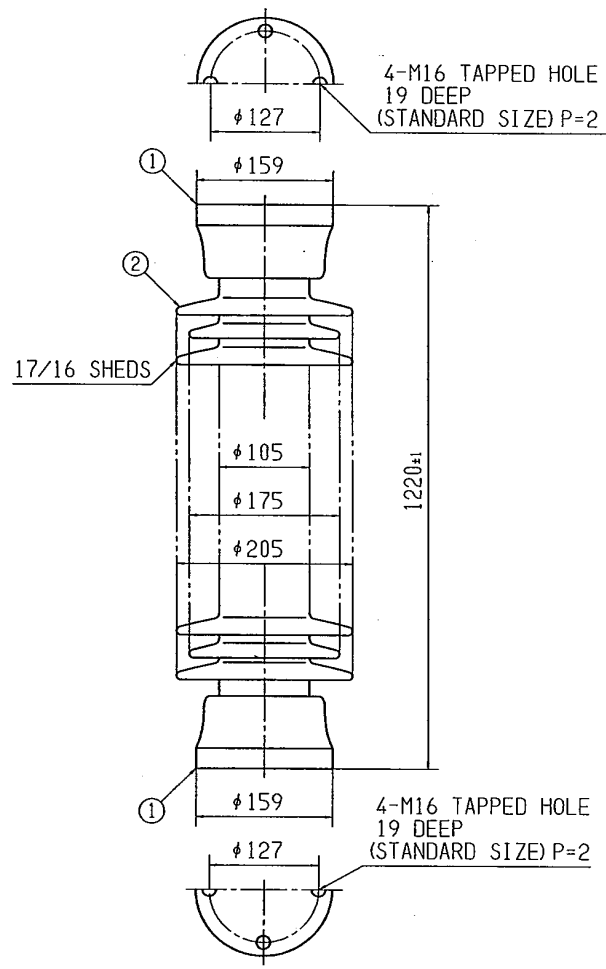
If specified in the project specifications, pantograph disconnectors, without integral earth switch, shall be supplied with the following requirements in addition to the existing requirements of the standard:

- (a) be supplied with fixed contact and mounting hardware for connection to a solid bus arrangement. The diameter and height of the solid bus will be stated within the project specifications;
- (b) be mechanically coupled for application at 123 kV, with one operating mechanism;
- (c) be mechanically phase segregated for application at 245 kV, with one operating mechanism per phase;
- (d) if mechanically phase segregated, be supplied with a suitably sized, stainless steel or Aluminium, lockable marshalling/control box to provide:
 - a common point for connection of inter-phase and external cabling to control boxes for all three poles;
 - a single point for local (motorised) control of all three phases; and
 - a single point for local control selector switch (remote-off-load).
- (e) mechanically phase segregated, have a separate auxiliary switch per pole; and
- (f) if mechanically phase segregated, provide an out-of-step alarm after a short time delay.





DRG. NO. S-135818



TECHNICAL DATA

SPECIFICATION APPLIED : AS 4398.2-1996

ITEM NO.	DESCRIPTION	DATA
1.	MIN. CREEPAGE DISTANCE-TOTAL. mm -PROTECTED. mm	3350 1290
2.	MIN. FAILING LOAD a. BENDING. N b. TENSION. N c. TORSION. N-m	8000 80000 5000
3.	WITHSTAND TEST VOLTAGE a. POWER-FREQUENCY DRY. kV b. POWER-FREQUENCY WET. kV c. IMPULSE. kV	300 230 550

NOTES : (1) WEIGHT : APPROX. 55 KG
(2) MARK ON PORCELAIN

108051
NGK
Year-Month

⑤			
④			
③			
②	PORCELAIN	1	
①	DUCTILE IRON	2	
ITEM	MATERIAL	REQD.	REMARKS

PORCELAIN: BROWN OR LIGHT GRAY
GLAZED.
FERROUS PARTS: HOT DIP GALVAN-

NGK INSULATORS, LTD.
SOLID-CORE
CYLINDRICAL POST INSULATOR

SCALE	OFF SCALE	DRN. <i>N. Vano</i>
UNIT	M. M.	CKD. <i>S. M. M.</i>
DATE	JAN. 28. 2003	APPD. <i>M. M. M.</i>

