Specification—Distribution Network Poles

Standard Number: HPC-8MJ-18-0001-2016

Document Control		
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** This person will have the power to grant the process owner the authority and responsibility to manage the process from end to end.*

*** Frequency period is dependent upon circumstances– maximum is 5 years from last issue, review, or revision whichever is the latest. If left blank, the default must be 1 year unless otherwise specified.*

Revision Control		
Revision	**Date**	**Description**
2	13/01/2022	Removed 12.5m 25kN option, concrete and composite materials, Distribution O/H Line Design Guide, consolidated transformer weight tables, general update.

STAKEHOLDERS *The following positions must be consulted if an update or review is required:*	
Manager Engineering & Project Services	*Regional Asset Managers*
Manager Asset Management Services	*Manager Health and Safety*
Works Delivery Coordinators	*Engineering Services Manager*

TABLE OF CONTENTS

1 SCOPE

This Specification covers the technical requirements for the design, fabrication, supply, testing and delivery of power poles (Poles) to Horizon Power (HP).

This specification applies to Poles for use on the distribution network with the line-to-line voltage range of 415 V up to and including 33 kV whose primary function is as a structure providing support for the overhead power lines and pole-mounted equipment.

This specification stipulates the performance parameters and requires the manufacturing process, test requirements and other information such as the inspection and maintenance process requirements during the Pole life cycle to be stipulated by the Tenderer.

2 NORMATIVE REFERENCES

2.1 Standards

The following documents contain provisions that, through reference in the text, constitute requirements of this specification. At the time of publication, the editions indicated were valid. All standards and specifications are subject to revision, and parties to agreements based on this specification are encouraged to investigate the possibility of applying the most recent editions of the documents listed below. Information on currently valid national and international standards and specifications can be obtained from SAI Global – Standards On-Line data base or equivalent standards database.

Table 1 Applicable Standards

STANDARD	TITLE
AS 1101.3:2005	Graphical Symbols for General Engineering- Welding And Non Destructive Examination
AS/NZS 1163:2016 (R2017)	Cold Formed Structural Steel Hollow Sections
AS/NZS 1170.2:2021	Structural Design Actions – Wind Actions
AS/NZS 1214:2016	Hot-galvanized coatings on threaded fasteners (ISO metric coarse thread series)
AS 1530.4:2014	Methods for fire tests on building materials, components and structures—Fire-resistance test of elements of construction
AS/NZS 1554.1:2014	Structural Steel Welding—Welding of Steel Structures
AS 1627.4:2005 (R2017)	Metal Finishing—Preparation and Pre-treatment of Surfaces – Abrasive Blast Cleaning of Steel
AS 1796:2001 (R2016)	Certification of Welders and Welding Supervisors

STANDARD	TITLE
AS/NZS 2312.2:2014	Guide to the Protection of Steel Against Atmospheric Corrosion by the Use of Protective Coatings – Hot Dip Galvanizing
AS/NZS 3678:2016	Structural Steel Hot Rolled Plates, Floor Plates and Slabs
AS/NZS 3679.1:2016	Structural Steel Hot Rolled Bars and Sections
AS/NZS ISO 3834.1:2008 (R2018)	Quality requirements for fusion welding of metallic materials - Criteria for the selection of the appropriate level of quality requirements
AS 4100:2020	Steel Structures
AS 4506:2005 (R2017)	Metal Finishing—Thermoset Powder Coatings
AS/NZS 4600:2018	Cold Formed Steel Structures
AS/NZS 4676:2000	Structural Designs Requirements for Utility Service Poles
AS/NZS 4677:2010	Steel Utility Services Poles
AS/NZS 4680:2006 (R2017)	Hot-Dip Galvanised (Zinc) Coatings on Fabricated Ferrous Articles
AS/NZS 4857:2006 (R2017)	Welding Consumables Covered Electrodes For Manual Metal Arc Welding of High Strength Steels- Classification
AS/NZS 7000:2016	Overhead line design—Detailed procedures
AS/NZ ISO 9001:2016	Quality Management Systems—Requirements
AS ISO 13822:2005 (R2016)	Bases for design of structures—Assessment of existing structures
AS/NZS ISO 18276:2006 (R2017)	Welding consumables—Tubular cored electrodes for gas shielded and non-gas shielded metal arc welding of high-strength steels—Classification (ISO 18276:2005, MOD)
ISO 286-1:2010	ISO System of Limits and Fits—Part 1: Bases of Tolerances, Deviations, and Fits

2.2 Horizon Power Documents

1. *Horizon Power Environmental Conditions HPC-9EJ-01-0001-2013*, Horizon Power, DM# 2302921, revision 0 released 26/05/2014, available at http://horizonpower.com.au/contractors-suppliers/contractors/manuals-and-standards/

2.3 Definitions and Acronyms

AS	Australian Standard
CAD	Computer Aided Drawing
CSIRO	Australia's Commonwealth Scientific and Industrial Research Organisation
ITP	Inspection and Test Plan
kV	kilo Volts
MDR	Manufacture Data Report
MSDS	Material Safety Data Sheet
Modified Backfill	Cement Stabilised Backfill consisting of Cement-Sand mix in the ratio of 1:8 thoroughly mixed in a rotary mixer or equivalent means
Pole	Power pole including all components, excluding attachments such as cross-arms and other brackets.
RFID	Radio-frequency identification
Spoil Backfill	Backfilling with excavated materials with proper compaction in a deep layer of 150 mm. Required compaction level is 90-95% Modified Maximum Dry Density

3 REQUIREMENTS

3.1 Pole Particulars

3.1.1 Pole Strength, Capacity and Length

The pole strength, capacity and length must be consistent (not identical) with current Horizon Power standards, as shown in **Table 2**.

Table 2 Currently used pole sizes and strengths

Item No.	Tip load capacity (kN)	Nominal Pole Length (m)	Pole length (above ground line) (m)
1	20	9.50	7.95
2	20	11.00	9.30
3	30	11.00	9.30
4	40	12.50	10.65
5	35	14.00	12.00

Poles with an assembled length exceeding 11.8 m should be composed of two pieces, joined appropriately (designed slip joint for steel, designed joint for concrete or other material).

3.1.2 Strength at Mounting Point Connections (holes through Pole)

The design and fabrication of the Pole must provide mounting points as detailed in Appendix C. The Pole design must ensure that there is sufficient strength at mounting points for the local loads, including the following equipment:

- Transformers (maximum 2000 kg);
- Switchgear (reclosers, sectionalisers, load-break switches, pole-top switches);
- Power quality equipment (regulators, reactors and capacitors);
- Cross-arms;
- Stays, both ground and aerial types;
- Control boxes and
- Streetlights.

Detailed stress and strain calculations on the mounting points for the maximum loading on the mounting point shall be provided by the Tenderer.

Due allowance must clearly be made in the submitted design calculations for shear, axial load, local stresses near positions of fittings and moment interaction where appropriate.

All pre-drilled holes must have plugs inserted to prevent water ingress until they are used, and must be suitable for the B90 life of the Pole (B90 life as defined in section 4.2). Plugs must not fall off or be susceptible to removal due to inadvertent contact, to prevent water and insect ingress.

The effects of drilling additional holes (maximum of three 22 mm diameter holes on each axis in addition to those in Appendix C) on the structural integrity of the pole must be clearly stated and explained.

3.1.3 Pole Embedment Depth

The embedment of a Pole is required to comply with foundation strength requirements as stated in AS/NZS 7000. Maximum Pole excavation diameter is limited to 600 mm and the required Pole embedment depths are given in **Table 3**.

Table 3 Standard Embedment Depths

Item No.	Pole Rating (kN)	Pole Length (m)	Pole Height above Ground Line (m)	Pole Embedment Depth (m)
1	20	9.5	7.95	1.55
2	20	11.0	9.30	1.70
3	30	11.0	9.30	1.70
5	40	12.5	10.65	1.85
6	35	14	12.00	2.00

The ground-line must be marked on the Pole to indicate the required 'Pole Height above ground line' as per **Table 3**. This marking must remain visible after the application of any ground-line protection and / or insulation coating. Soil conditions are defined in Table 4.

The proposal must confirm that the 'total pole length' offered for each pole rating is made up of the 'Pole Height above Ground Line' plus the 'Pole Embedment Depth' specified in Table 3.

3.1.4 Pole Deflection Limit

Pole deflection will be limited to less than 5% of pole length at 50% of Ultimate Lateral Load for pole tip loads.

Preferably provide indicative pole tip loads for pole deflections of 2% and 5% of the above ground pole lengths, i.e. from above ground marker to top of pole.

3.1.5 Slip Joint Alignment Marks

Two-piece steel Poles shall have the slip joint marked with:

- alignment guides, to allow assembly with the correct orientation of the two pieces, and
- depth-of-joint mark, to facilitate assembly to the designed slip-joint length.

Overlap of the slip joint must be consistent and within manufacturing tolerances.

3.1.6 Earthing

Conductive Poles must be designed to form a continuous conductive path from to the top of Pole to the ground line. One earthing point shall be provided, at the location identified in Appendix C. The earthing point must be located within 300 m from the ground line and consist of:

- A 14 mm diameter hole suitable for accommodating a M12 bolt
- A M12 stainless steel (grade 316) nut, welded to the surface of the hole

3.1.7 Ground-Line Protection

Poles susceptible to fire, corrosion and erosion from acid sulphate type soils or backfills and foundation materials (concrete) shall have a suitable ground-line protection that will stem the deterioration of the Pole during its service life (B90 life as defined in clause 4.2).

3.1.8 Insulative Coating

Poles provided with an insulative coating, inclusive of the Ground Line Protection see clause 3.1.8 above will be preferred. The insulative coating starting 2800 mm above ground level to 300 mm below ground level will sufficiently coat the Pole but not the provided earthing point and provide an effective electrical insulation of ≥20 kV.

Suitable coating repair kits and coating repair instructions to be provided.

3.2 Environmental Conditions

3.2.1 Condition of Services

The Pole will be used throughout regional areas of Western Australia in conditions where a wide range of solar radiation, pollution (salt bearing), high wind, soil types, lightning activities are experienced.

The *Horizon Power Environmental Conditions HPC-9EJ-01-0001-2013* [1] states these conditions. The Pole must be suitable for continuous operation under these environmental conditions for the duration of its life (B90 life as defined in clause 4.2).

3.2.2 Wild Fire

The Pole shall be resistant to bush fires, without compromising its structural integrity as well as any protective coatings or ground-line protection.

Reports of tests undertaken by a recognised testing agent, such as the CSIRO or equivalent, in accordance with AS 1530.8.2 must be available on request.

3.3 Materials

The materials used for the design of the Pole must comply with AS/NZS 4676 and relevant standards specified in **Table 1**. Materials must be free of defects, clean, free from loose scale and/or slag.

Steel Poles must be designed in accordance with AS 4100 *Steel Structures*, AS/NZS 4600 *Cold-formed Steel Structures*, and/or AS/NZS 4677 *Steel Utility Services Poles*, for the specified or rated loads. Any corrosion allowance in the design must be clearly indicated on all drawings provided.

Horizon Power shall require the technical data sheets detailing the property of the material (i.e. material composition), any other relevant data as well as the specific maintenance regime required to meet the Pole's expected life.

3.4 Foundations

Pole footings must be capable of withstanding the rated load of the Pole and local loads as covered in clause 3.1.2. The footing design must comply with AS/NZS 7000 Appendix L. The design must be done for both cohesive and cohesionless soils, as they are stated in **Table 4**. The width or diameter of the footing must be no greater than 600 mm.

Table 4 Assumed soil properties

Soil Type	Soil Description	Soil Density (kN/m³)	Internal Friction Angle (°)	Cohesion (kPa)	SPT Blow Count
Cohesive	Medium Stiffness clay	20	0	53	9
Cohesion less	Medium density sand	18	35	0	15

4 POLE DESIGN

4.1 General

The design of Pole must comply with AS/NZS 4676, be performed by a Chartered Professional Engineer (CPEng) Structural listed on the National Engineering Register (NER) and verified by an independent structural engineer, also a CPEng listed on the NER.

Pole types are shown in **Table 2** above. Detailed designs must be prepared and submitted to Horizon Power for each of the Pole types.

All Pole body cross sections must be circular or have a maximum of twelve sides. Horizon Power's preference is for twelve sided Poles.

4.2 Pole Life

The B90 life of the Poles, operating in the conditions of service as stipulated in section 3.2, must be 50 years.

B90 is defined as 90% of the installed population remaining in a serviceable state, excluding those failures caused by external factors (such as impact). Serviceable is defined as being fit for the designed purpose, according to the ISO 13822.

The inspection and maintenance requirements for the Pole and any special coating applied to ensure the B90 life is achieved must be included in the proposal.

4.3 Design Calculations and Drawings

Design calculations and drawings for the Pole types, lengths and drilling patterns as specified in clause 3.1.2 are required.

4.3.1 Calculations

Calculations and complete assembly procedures as applicable (including stay pretension and for a slip jointed pole) must be provided. The calculations of the Poles must be clearly and logically set out, be presented in such a way to allow assessment, without further reference to other sources. All assumptions and references must be clearly stated. Computer generated output will not be accepted unless all intermediate steps are clearly shown, permitting a clear understanding of the calculations.

A suitable analysis tool, PLS-CADD (as preferred by Horizon Power) must be used to demonstrate non-linear and buckling analysis performed on the Pole with models supplied. Where calculations are performed in accordance to a certain Standard, clear reference to the relevant section of the Standards must be clearly be shown.

4.3.2 Drawings

The requirements are:

- Drawings must be supplied with each page identified with an initial issue mark;
- Revised drawings must have a revision note specifically itemising the changes with ‘clouds’ encircling the current changed portion(s) of the drawings;
- Designs and drawings must be prepared using the SI system;
- Drawing format must be PDF, additional formats may be provided in addition (DGN or DWG)
- All notes, instructions and words used in documents must be in the English language;
- Drawings must be to scale and fully detailed. The intended paper size (to which the scale applies) must be stated on the drawing title block, e.g. *1:50 at A3*). Where required to facilitate construction assembly drawings must be submitted, all dimensions must be given and the material and finish of each part must be indicated.

5 POLE FABRICATION

Horizon Power Pole Types are detailed in **Table 2** with the following options:-

- Raw Poles with no drilling pattern; and
- Poles drilled as per Appendix C.

5.1 Tolerance of Dimensions

The tolerance of dimension must be in accordance with ISO 286-1, with critical dimensions in order to meet functional requirements (e.g. structural slip joint overlap for two-piece steel Poles, and attachment height as determined by pre-drilled holes) clearly indicated on the design drawings.

5.2 Welding

Welding must be carried out in accordance with AS/NZS 1554.1 and AS/NZS ISO 3834.1.

The welding of two or more lengths of available sections of material to form a single member of the required length will not be acceptable without the written approval from Horizon Power.

All welding performed must be carried out by qualified welders and welding Supervisors in accordance with AS 1796.

5.3 Galvanising

Galvanising must be carried out after the completion of all the fabrication processes in accordance with AS 4680. Fasteners must be hot dip galvanised in accordance AS/NZS 1214.

All steelwork must be galvanised piecemeal and any distortion caused by the galvanising process must be corrected before delivery.

After hot-dip galvanising the maximum allowable out of tolerance in any member must not exceed the requirements of AS 4100.

Special care must be taken to prevent damage to the galvanised surfaces during transport, handling, fabrication, and delivery. Rust streaks or foreign matter deposited on galvanised surfaces must be removed. Handling and storage of galvanised steelwork must ensure that the occurrence of “white rust” is avoided.

Damage to small areas of the galvanised finish may be repaired in accordance with Appendix E of AS/NZS 4680. Where the galvanising has been badly damaged or shows signs of early deterioration due to any cause (including white rust) the member must be stripped, regalvanised and returned. Regalvanising must only be carried out once on any member. Reports to be supplied to confirm where repairs have been conducted and that the Pole has not been recoated more than once.

6 POLE ASSEMBLY

Pole assembly instructions must clearly indicate:

a) Pole assembly procedure

b) Pole erection procedure

c) Procedure for drilling additional holes/ increasing hole sizes

d) Tooling and equipment used for all of the above.

7 LABELLING

In addition to the requirements of AS/NZS 4065 and AS/NZS 4677, the Pole must be provided with a numbering system that can be used to track back to the original source of the material used in its manufacture. This identification must be attached to the Pole post the manufacturing process and must be attached in method that does not cause deterioration.

The Pole label must include kilo newton (kN) rating, length (m) and weight (kg).

Where the Pole is supplied with a Radio Frequency Identification Device (RFID), details of the device, its hardware and tools for the RFID reader must be provided.

8 TEST PROTOTYPE

This section details the requirement for the load testing of prototype assembly of a Pole as an alternative to strength calculation.

8.1 General Requirements

The prototype load testing must be designed in accordance to AS/NZS 4676 section 7. The prototype Pole can be assembled and testing conducted from any location, but must be inspected and witnessed by Horizon Power's Representative. Ten working days' notice of the testing of each prototype must be given so that arrangement can be made for Horizon Power's Representative to be present on site.

All costs associated with prototype assembly including testing must be covered by the manufacturer. The prototype must be tested in accordance with the requirements pertaining in the applicable Australian Standards specified in **Table 1**.

The manufacturer must provide details of their test facilities and procedures to Horizon Power two weeks prior to the prototype testing commencing.

8.2 Modification of Prototype Poles

Modification of any prototype so that it will meet the design requirements as identified by the testing, must be endorsed by Horizon Power in writing. Such endorsement must not be taken as approval of the Pole.

Horizon Power may direct changes to the Pole details so that the design conforms to the requirements of the Technical Specification including any other requirements from time to time due to changes in the Regulations or Standards listed **Table 1**, and such changes must be incorporated into the constructed Pole from date of changes being notified.

8.3 Pole Testing and Design Verification

Horizon Power requires the verification of the performance of the Pole under the specified design loads. The structural tests of the prototype must be carried out in accordance with AS/NZS 4676 Appendix K. Test locations must be nominated by the manufacturer and agreed by Horizon Power. All materials, tools, instruments and other items necessary to undertake the tests must be provided by the manufacturer.

9 DISPOSAL STRATEGY

A recycling scheme for disposal of the Pole must stipulated.

10 DOCUMENTATION

10.1 Type Test Certificates/Reports

Test certificates, test reports or any other supporting documents supplied as evidence of compliance to the relevant standards must be made available in English for review by Horizon Power.

The following documents must be provided with each batch of Poles supplied:

1) Life cycle costing model for all Poles;
2) MDR report on the materials as per clause 10.2
   - Confirmation that the company has met the requirements of ISO 3834 Quality requirements for fusion welding of metallic materials;
   - Confirmation of the galvanising deposited on the metal internally and externally to AS/NZS 4680-2006;
3) Details of the coating system provided on the base of the Pole;
4) Detailed drawing of the pole showing the critical dimensions and the maximum wind loading the pole can handle;
5) Certified design calculation to prove compliance to wind loading in accordance to AS/NZS 1170.2;
6) Constructional data sheet, drawing and/or specification;
7) All test reports as stipulated in AS/NZS 4676:2000, Section 7.5.

10.2 Manufacturer Data Report (MDR)

Each MDR must comprise all the quality records pertinent to the material for which it is compiled and must include:

- Material and Pole test certificates
- Non-conformance reports (including a departures schedule in Appendix C)
- Concessions
- Type test certificates and/or reports
- Batch test certificates
- Non-destructive test results
- Heat treatment records
- Instrumentation tests and calibration reports
- Inspection and test plan (ITP's)
- Fabrication and treatment records
- Construction records
- Statutory approvals

All quality records must be provided in a form, where stipulated by Horizon Power, which is traceable through Horizon Power's purchase order number.

Unless otherwise approved in writing by Horizon Power, MDR's must be submitted electronically. Where the MDR includes multiple records of the same type, they must be grouped into sections and identified with a tabbed document divider.

APPENDIX A REVISION INFORMATION

(Informative) Horizon Power has endeavoured to provide standards of the highest quality and would appreciate notification of errors or queries.

Each Standard makes use of its own comment sheet which is maintained throughout the life of the standard, which lists all comments made by stakeholders regarding the standard.

A comment sheet found in **DM# 5595059**, can be used to record any errors or queries. This comment sheet will be referred to each time the standard is updated.

Date	Rev No.	Notes
0	06/09/2012	Initial Document Creation
1	10/10/2018	Revised pole lengths and pre- drilled hole locations. Revised design life definition. Removed P-F interval requirement.
2	013/01/2022	Removed 12.5m 25kN option, concrete and composite materials, Distribution O/H Line Design Guide, consolidated transformer weight tables, general update.

APPENDIX B QUALITY CONTROL (TO BE COMPLETED BY STORES)

DOCUMENT NUMBER	HPC-8MJ-18-0001-2016			**QUALITY ASSURANCE**		**DM# NUMBER**		
DEVICE DESCRIPTION	**LABEL MATERIAL NO.**			**POWER POLE PURCHASE**		**ASSET OWNER**		
	ASSET ID/ STOCK NO							
MANUFACTURER			**DIMENSION**					

ITEM	**OPERATION/EQUIPMENT/FACILITY**	**DOCUMENT REF.**	**WHO CHECKS**	**INITIAL**	**DATE/ TIME**	**QUALITY ASSURANCE CRITERIA**	**PASS Y/N**	**COMMENTS**
1.1	Name of Manufacturer					*******		
1.2	Week & Year of Manufacture					*******		
1.3	Horizon Power Order Number					*******		
1.4	Horizon Power Stock Number					*******		
1.5	Parameters (length, capacity)					*******		
1.6	Weight					*******		
1.7	Batch Number					*******		
1.8	Galvanising					*******		
1.9	Ground-line protection					*******		
1.10	Insulative coating					*******		

2	DOCUMENTATION							
2.1	Material Safety Data Sheets					Clear, Legible and in English		
2.2	Batch Test and Inspection Reports					Clear, Legible and in English		

SYMBOLS AND ABBREVIATIONS								
H = HOLD POINT	S = SUPERVISOR							
W = WITNESS POINT	T = TECHNICIAN, EL = ELECTRICIAN	REVISION						
V = VERIFICATION POINT	E = ENGINEER	DATE						
S/C = SUBCONTRACTOR	PM = PROJECT MANAGER	APPROVED BY						

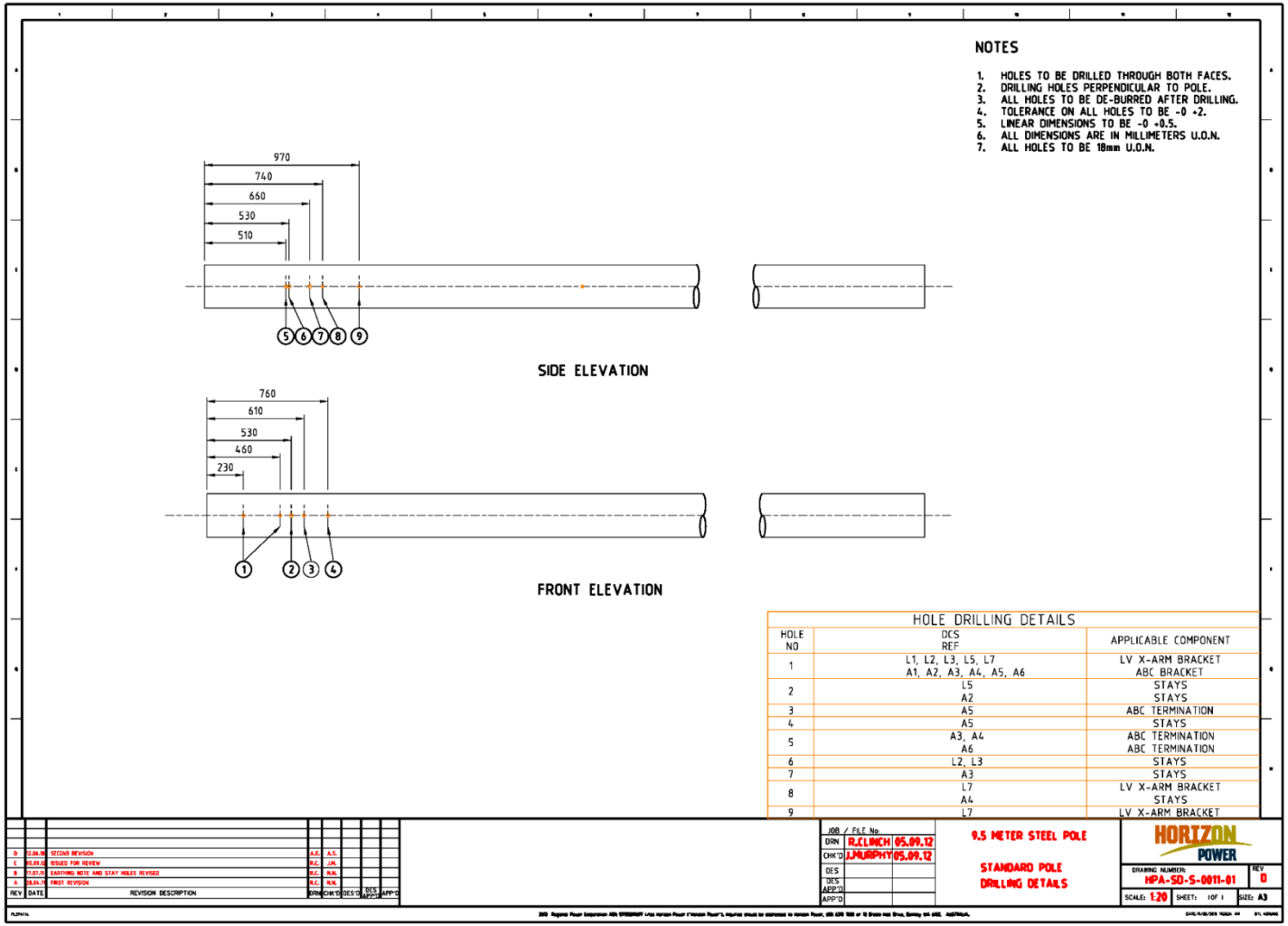
APPENDIX C DRAWINGS

Attached drawings indicate the positions that holes are to be pre-drilled for 9.5 m, 11 m and 12.5 m Poles. Two holes in 0° orientation allow a bolt in the same direction as the highest conductor on the Pole and two holes in 90° orientation allow a bolt perpendicular to the highest conductor on the Pole.

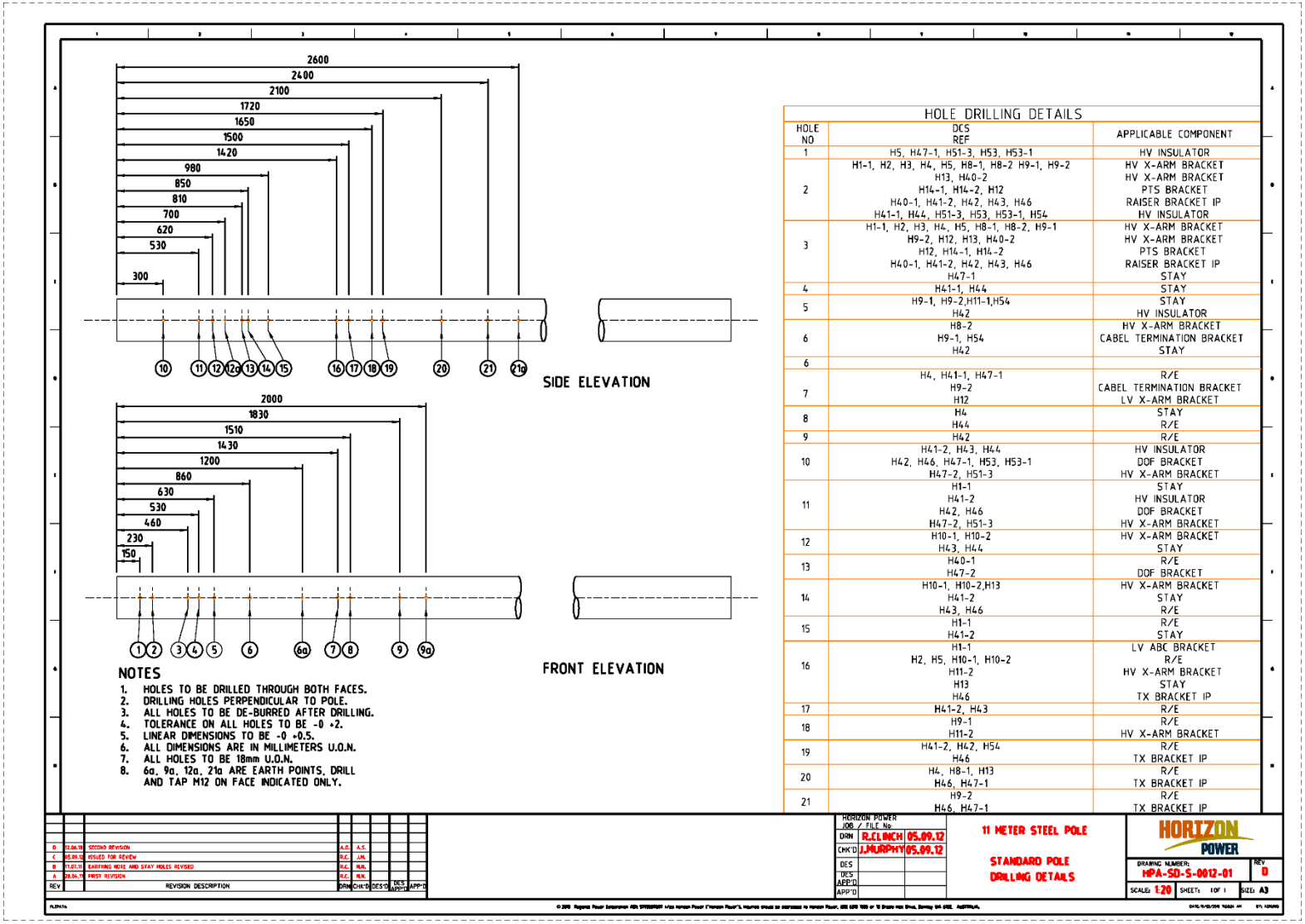
No pre-drilled holes are required on 14 m Poles.

Holes numbered and ending with an ‘a’ indicates that they are earth points with a single hole with welded nut, as described in Clause 3.2.

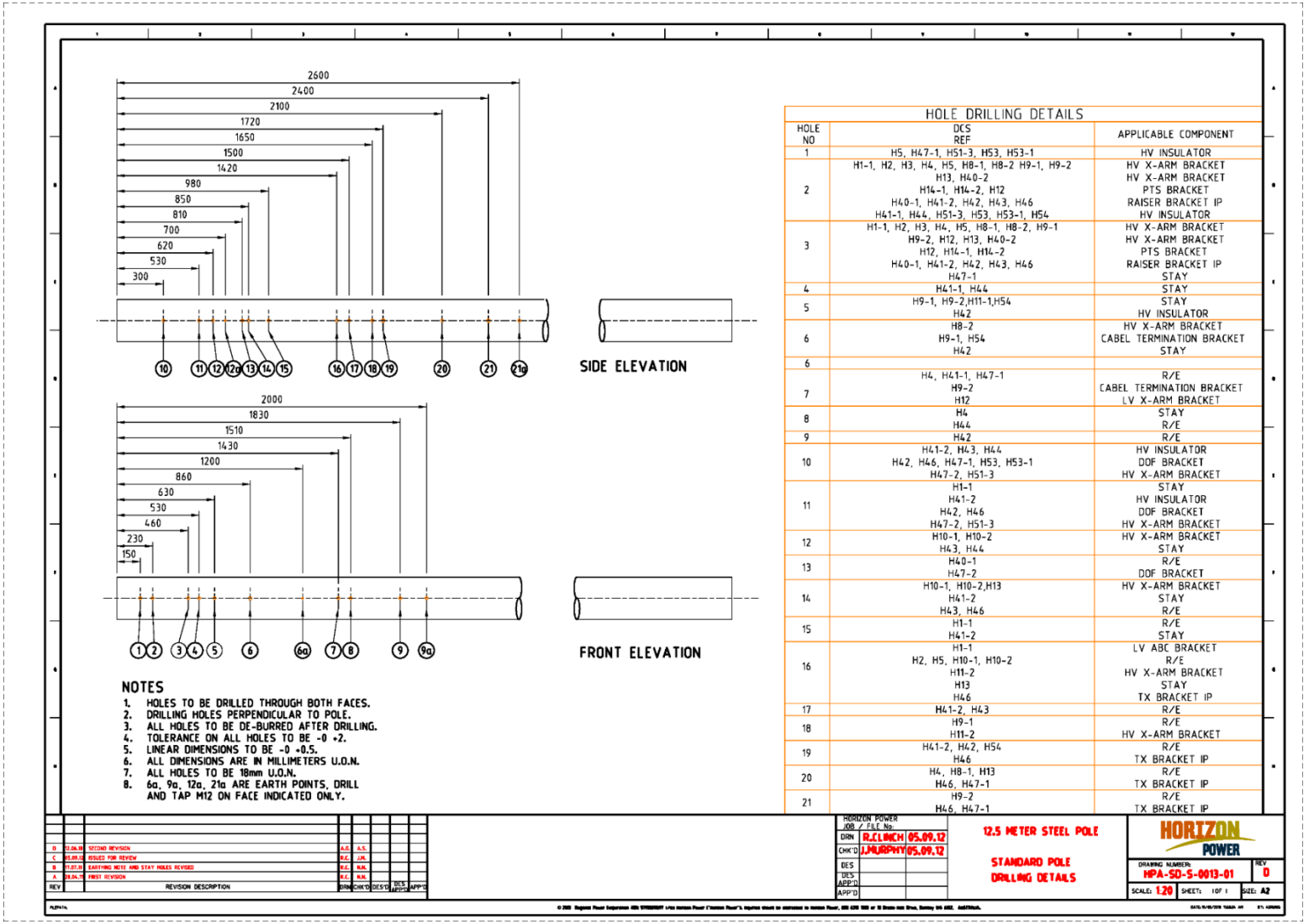
9.5 m Pole Drawing



11 m Pole Drawing



12.5 m Pole Drawing



Pole Embedment Depth Drawing