



Ergon Energy Corporation Limited

Specification for Prototyping and Testing of Pole Structures

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1. Scope

This specification covers the Contractor's responsibility for prototyping and the structural type, proof and electrical type testing of pole structures. These tests may be a basis of acceptance or rejection of the pole element designs and fabrication provided by the Contractor for the Principal's structure arrangements or the structure designs provided by the Contractor's designer.

2. References

Nil

3. Acronyms, and Abbreviations

3.1 Acronyms and Abbreviations

NATA National Association of Testing Authorities (Australia)

4. Security

Nil

5. Safety, Environmental and Ergonomic Considerations

As per Ergon Energy's Safety, Environmental & Ergonomic Policies.

6. General

A complete structure of each type nominated by the Superintendent shall be prototyped (trial assembled) before testing or production to verify detail design and fabrication methods and tolerances. Production structure fabrication shall not commence until the Superintendent has approved such prototypes. The poles used for testing shall be made to the same standards as those that will apply to all poles during production. These standards shall include bar or wire size and grade, concrete mix, curing and testing methods, structural steel quality, connections, bolt size, geometry and surface finish. The Contractor shall be responsible for ensuring the conformity of the structures used on tests with the corresponding production structures. All costs associated with prototyping of structures shall be included in the Schedule of Rates Items for Prototyping of Structures.

Load testing, if required by the Superintendent may be carried out with the poles vertical or horizontal. If tested in the horizontal position, provision shall be made for suitable supports to minimise bending moment induced by the weight of the structure. However, the test loads shall be increased to allow for secondary effects which the pole would encounter if it were vertical.

The test structures shall be erected on a rigid base with the pole held rigidly at the butt and by an amount equal to the nominal depth of planting.

The selected structures shall successfully withstand the loads specified for the various conditions given in the Specification, including a load test on the antifall wire and ladder system.

The Superintendent reserves the right to test the structures at other than the Contractor's nominated testing station. In this event, the Principal will arrange for and meet the costs of such

tests, and the Contractor shall supply and deliver the structure components required to such testing station or other places as directed. The Superintendent will negotiate an amount with the Contractor for the delivery. A duly authorised representative of the Contractor shall be entitled to witness any such test.

6.1 Structural Type Testing

For type testing, each structure tested shall be fully fitted with crossarms, overhead earthwire extensions and stay attachments in accordance with structure designs and test loads and stay restraint loads shall be applied at their normal in-service load application points. These stay restraint loads shall be applied in the direction of the proposed in-service stays.

A type test may be carried out on one structure of each type required to be supplied. The Superintendent will nominate those structures required to be type tested. The type test for each structure type shall include all loading conditions for that structure type as shown on the relevant Drawings. Tests are to be carried out on the longest poles scheduled for production. The costs of this testing shall be included in the Schedule of Rates for Testing of Structures. The type test shall include load testing of the anti-fall wire and anchorage.

6.2 Structural Proof Testing

Two percent of all poles shall, in addition to the requirements of Type Tests, be subjected to proof load testing. These tests shall be carried out on random length undressed poles. The costs of this testing shall be included in the costs tendered under Schedule of Rates for Structure Supply and Delivery.

6.3 Electrical Type Testing

6.3.1 Fault Current Test

If the Superintendent directs, one complete concrete pole element shall be subjected to a power frequency current of 10,000 amperes for 0.5 seconds. The current shall be applied between the concrete pole element's tip and butt earthing ferrules. The test current shall be applied twice with a maximum of 30 seconds between first and last applications. The resistance between the two tested ferrules shall be measured before and after the current test.

6.3.2 Resistance Test

A resistance test shall be carried out on the longest of each pole type nominated by the Superintendent. The resistance shall be measured between the tip and butt earthing ferrules.

The costs of this testing shall be included in the Schedule of Rates for Testing of Structures.

Alternatively the Principal may accept certified type test results from similar power frequency current tests providing full details of such tests are submitted with tender. These details shall include drawings of the ferrule connection of the tested pole element.

7. Loading Sequence – Structural Type Tests

The tests shall cover six steps of 60%, 75%, 90%, 95%, 100% and 110% or failure of the specified strength limit state load (amplified by the appropriate factor for P-Delta effects).

The 95% step is used so that readings may be taken just before the specified 100% step is reached. If the test station has facilities for continuous recording with simultaneous incremental application of all loads, this step may be omitted by the Superintendent.

As all loads approach and pass 100%, care shall be taken to avoid overloading any point of application.

Loads shall be applied in such a way as to avoid any dynamic effect. However, bolt slip in the joints during the structure test shall be accepted. For each step, the time during which loads are applied may be as short as possible but not less than two minutes and will depend upon the time necessary for the testing station to adjust the loads in accordance with the above and record the relevant values.

For the 100% step, the loads shall be maintained for two minutes.

If the material employed for the structure is not steel and has a creep tendency, the Superintendent may request a longer duration of load application for the 100% step to account for material creep.

8. Acceptance Criteria

8.1 Structural Type Test

8.1.1 Reinforced Concrete Poles

At 60% of the strength limit state load, the load shall be reduced to zero and the permanent set measured. The test will then proceed as above. The permanent set after removal of the test load of 60% of the limit state load, shall not exceed 10% of the deflection at test load. The hair cracks produced in testing shall clearly close up on removal of the test load specified above.

The test load at failure shall equal or exceed 100% of the strength limit state load amplified by the P-Delta effect.

8.1.2 Prestressed Concrete Poles

At 60% of the strength limit state load, the load shall be reduced to zero and the permanent set measured. The test will then proceed as in Section 3 until failure. The permanent set after the removal of the test load of 60% of the ultimate load shall not exceed 7.5% of the deflection at the test load. No visible hair cracks shall occur at the test load of 60% of the limit state load.

The test load at failure shall equal or exceed 100% of the limit state load amplified by the P-Delta effect.

8.1.3 Steel Poles

As per Clause 8.1.1 above except that cracking will not be acceptable.

8.2 Structural Proof Tests

8.2.1 Reinforced Concrete Poles

At a maximum applied load equal to 60% of the strength limit state load, the load shall be reduced to zero and the permanent set measured. The deflection at each measurement, and the permanent set after removal of the test load, shall not exceed by more than 15% of the corresponding values for the poles subjected to the type test.

8.2.2 Prestressed Concrete Poles

At a maximum applied load equal to 60% of the strength limit state load, the load shall be reduced to zero and the permanent set measured. The deflection of each measurement, and the permanent set after removal of the test load, shall not exceed by more than 15% the corresponding values for the poles subjected to the type test.

No visible hair cracks shall occur during the test.

8.2.3 Steel Poles

As per Clause 8.2.1 above.

8.3 Electrical Type Test

8.3.1 Fault Current Test

No physical change or cracking on any part of the concrete pole element's surface shall occur as a result of this test. There shall be no damage to the earthing ferrules.

The resistance between the tested earthing ferrules measured not less than 60 minutes after the test shall be within 10 percent of that measured before the test.

8.3.2 Resistance Test

The resistance of each pole type shall be less than 10 milliohms.

9. Testing Equipment – Structural Tests

The test bed shall be such that it can hold the pole structures rigidly in place at the butt end during testing and be able to resist all moments generated by that testing.

Provisions shall be made for the application of both transverse and longitudinal forces. The direction of the longitudinal forces must be that of the conductors supported by the crossarms and be spaced according to the length of crossarms. It is necessary to compensate for any vertical components generated from pulling ropes not being at their correct angles due to loading constraints. Transverse and longitudinal loads shall be applied at a number of points simultaneously on the pole structure.

The measurement of the applied forces shall be made by inserting load cells in the pulling ropes as near as possible to the point of loading on the test structure. Frictional and like losses shall be checked for their magnitude. The cell shall be selected so that it will be used for measurement within a range as near as possible to the maximum load capacity of the cell. The selected cell shall be allied with its measuring instrument to be used in the test and the combination calibrated by using certified dead weights prior to and following every test.

Forces shall be applied using electrically operated capstans or equivalent approved by the Superintendent. The pull supplied shall always be even and smooth and not subject to variation brought about by the continuous increase in drum diameter.

Forces shall be displayed by Potentiometric Load Indicators or equivalent devices.

Measurement and recording of deflections at the positions nominated by the Superintendent shall be carried out.

The weight of load cells, ropes, tackles, mechanical advantages etc., shall be an added load on the structure and must be taken into consideration in preparing the loading table in the test programme and in deciding the nett values of the applied force.

All calibration shall be carried out in a NATA registered laboratory and to the satisfaction of the Superintendent.

10. Presentation of Test Results

10.1 Structural Tests

The test report shall include the following data:

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- (a) The type of tested structure.
 - (b) The name and address of the structure manufacturer and of the designer.
 - (c) The name and address of the client.
 - (d) The dates and location of testing.
 - (e) The names of persons present during the tests.
 - (f) A list of various assembly and detail drawings relating to the structure tested, including any modification of the drawings referred to.
 - (g) A dimensioned line diagram of the structure showing the various load points and directions of loading to be applied and a table with the specified loads.
 - (h) Diagram showing the rigging arrangement used to apply the test loads.
 - (i) Brief description of the test facility including the number, location, range and calibration charts or tables of every load transducer or other load measuring devices, as well as the accuracy of the equipment used to measure the test loads.
 - (j) One table per test showing the loads required at the various points on the structure and for the various loading steps.
 - (k) One table per test showing the various deflection values measured.
 - (l) In the case of failure:
 - a table showing the maximum loads applied to the structure just before the collapse;
 - a brief description of the failure;
 - the dimensional and mechanical characteristics of the failed elements.
 - (m) Photographs showing the whole of the structure and, possibly, details of the failure.
 - (n) Environmental meteorological data during the sequences of tests.

10.2 Electrical Tests

The test reports shall include the following data:

- (a) for both fault current and resistance tests:
 - the type of tested structure;
 - the name and address of the structure manufacturer and of the designer;
 - the name and address of the client;
 - the dates and location of testing;
 - the names of persons present during the tests;
 - resistance values between tested earthing ferrules;

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- details of instrument(s) used for resistance measurements;
 - statement confirming that the tested pole element has met the acceptance criteria

(b) for the fault current test only:

- a drawing showing the ferrule connection detail;
- a statement confirming the applied current magnitude and duration;
- photographs of tested ferrules and their surrounding concrete both before and after the test.

11. Failure of Test Structure

Should any components of the test structure not withstand the specified tests and where the Principal is responsible for their design adequacy, the Superintendent shall provide modified designs to the Contractor. The Contractor shall make the necessary modifications to the test structure and repeat the test to the satisfaction of the Superintendent. The costs of additional testing, changed members in the test structure and stand-down time shall in this event be met by the Principal at the appropriate Schedule rates.

Should any components of the test structure not withstand the specified test loads, and where the Contractor is responsible for their design adequacy, the Contractor shall suitably modify the design and the test structure and repeat the tests to the satisfaction of the Superintendent. All costs associated with the modifications and additional testing shall in this event be met by the Contractor.