

TCS 014-3.1-2001



**SPECIFICATION
FOR THE
SUPPLY OF
FRANGIBLE STREET LIGHTING POLES**

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**Intelligent Transport Systems Group
60 Denmark Street Kew 3101**

Phone: (03) 9854 2103 Fax: (03) 9854 2319

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PREFACE

A. GENERAL

This specification has been developed by VicRoads. It is one of a number of technical specifications, and associated standard drawings, which set out the requirements for roadside ITS devices, traffic signal equipment and other electrical equipment and associated devices and control systems.

This specification is intended for use in all relevant works undertaken by or on behalf of VicRoads.

B. APPROVED PRODUCTS

Where indicated within this specification, equipment supplied for use under this specification shall hold current VicRoads 'Type Approval' certification.

Amendment History		
Amendments	Date Issued	Details
No. 1	April 2008	<ul style="list-style-type: none"> • Revised requirements for slip base bolt tightening torque. • Removal of warranty clause

***Specification updates.** VicRoads specifications and associated standard drawings are subject to periodic review. To keep the specifications up to date, amendments or new editions are issued as necessary. It is therefore important for users of VicRoads specifications to ensure that they have the latest version and associated amendments.*

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1.0 SCOPE

This specification covers the requirements for the design, manufacture, testing, approval and supply of frangible (slip base and impact absorbing) poles for street lighting on Roads Corporation (hereinafter called VicRoads) projects.

2.0 DEFINITIONS

2.1 FRANGIBLE POLES

For VicRoads street lighting purposes both slip base poles and impact absorbing poles are referred to as frangible poles.

2.2 SLIP BASE POLES

Slip base street lighting poles can be either ground set mounted or plate set mounted and shall comply with the requirements of VicRoads drawings numbered TC-1065B and TC-1066A.

2.3 IMPACT ABSORBING POLES

Impact absorbing street lighting poles can be either ground set mounted or plate set mounted and shall comply with the requirements of VicRoads drawing numbered TC-1064A.

Impact absorbing poles are poles which will:

- (a) deform progressively so as to decelerate an impacting vehicle at a controlled rate and finally bring it to rest whilst still in contact with the pole. The base of the pole is to remain attached to the footing after impact;
- (b) collapse on vehicle impact in a predictable and acceptable manner; and
- (c) have fully acceptable structural strength in its undamaged condition.

3.0 APPROVAL PROCESS

- 3.1 To supply frangible poles to VicRoads' projects, suppliers' poles must be Type Approved.
- 3.2 To obtain approval, the supplier must clearly demonstrate that the pole conforms to this specification, and:
- (a) Shall submit to VicRoads the information detailed in Section 4 of this specification.
 - (b) May be required to carry out a load test on a prototype pole in accordance with the requirements of Section 7 of this specification.
 - (c) Shall be required to carry out a crash test on a prototype impact absorbing pole in accordance with the requirements of Section 8 of this specification.
 - (d) Must show evidence of proof engineering of the poles by a Consultant appearing on the list of VicRoads approved consultants.
 - (e) Must demonstrate that the supplier has in place a quality system meeting the requirements of Section 9 of this specification.
- 3.3 A review of the information submitted by the supplier will be carried out by VicRoads to determine whether the pole will be Type Approved.

4.0 INFORMATION TO BE SUBMITTED

The supplier shall submit the following information when applying for Type Approval. The information shall be sufficiently detailed to enable VicRoads to assess the structural integrity of the poles and shall be accompanied by the results of the proof engineering.

4.1 POLE DESIGN

- (a) Fully detailed workshop drawings of the frangible pole including cross-sections and dimensions, material details, weld details and protective coating details based on the design calculations in (b) below.
- (b) Design calculations carried out by an appropriately qualified structural engineer who is experienced in the design of steel structures and who has qualifications admitting to Corporate

Membership of the Institution of Engineers, Australia. The design shall also be verified in accordance with the requirements of AS/NZS ISO 9001:1994 "Quality systems - Model for quality assurance in design, development, production, installation and servicing".

The calculations must show that the pole satisfies the design requirements in Section 5 of this specification and the manufacturing requirements in Section 6 of this specification.

- (c) Proof engineering of the poles to be carried out by a Consultant appearing on the list of VicRoads approved consultants for proof engineering of structures.

4.2 FABRICATION

An inspection report by a suitably qualified consultant providing details of the manufacture of each prototype pole fabricated in accordance with Section 6.1 of this specification.

4.3 GALVANISING

Details of the galvanising of each prototype pole carried out in accordance with section 6.2 of this specification.

4.4 PROTECTIVE COATING

Details of the protective coating systems for the ground set section of each prototype pole demonstrating that the protective coating systems fully conform to the requirements of Section 6.3 of this specification.

4.5 PROTOTYPE TESTING

Details of load testing of each prototype pole carried out in accordance with Section 7 of this specification.

4.6 CRASH PERFORMANCE (IMPACT ABSORBING POLES ONLY)

Test results from an appropriately qualified body, acceptable to VicRoads to prove that a pole will perform as an impact absorbing pole as described in Section 8 of this specification.

4.7 QUALITY ASSURANCE

Evidence that the supplier operates and maintains a quality system to AS/NZS ISO 9002:1994 "Quality systems - Model for quality assurance in production, installation and servicing" in accordance with the requirements of Section 9 of this specification.

5.0 DESIGN REQUIREMENTS

5.1 Frangible street lighting poles shall be designed to withstand loadings due to wind and the self weight of the pole, brackets and lanterns as follows:

- (a) Wind forces shall be based on:
 - (1) The design wind speed for the Ultimate Limit State shall be 45m/s;
 - (2) The design wind speed for the Serviceability Limit State shall be 35m/s;
 - (3) The maximum deflection under the serviceability design wind loading shall not exceed 5% of the luminaire mounting height;
 - (4) The drag coefficients of AS1170.2-1989 Loading Code – Wind loads shall be used; and
 - (5) The pole design shall be based on providing an in-service fatigue life of not less than 30 years.
- (b) Structural design shall be in accordance with AS4100-1998 Steel structures.
- (c) The pole shall be designed to carry a single or double bracket, up to 5m outreach for VicRoads type brackets (see TC-1060C, TC-1061C, and TC-1067A) and up to 4.5m outreach for a standard curved style Victorian Electricity Supply Industry (VESI) bracket, in any configuration. Calculations shall be based on a lantern mass of 20 kg and a projected area of 0.25 square metres. Copies of VESI (ex SECV) bracket drawings VX15/153/2, 3, 10, 14 & 19 which show the allowable VESI style bracket details are available from any of AGL, Citipower, Powercor, TXU, or United Energy if required.

- 5.2 The nominal height of the pole shall be the length of the pole measured from the lower surface of the base plate to the shoulder at the lower end of the bracket mounting spigot.

The nominal pole heights shall be as follows:

- (a) slip base poles 8.5, 11.0, and 13.5 metres; and
 - (b) impact absorbing poles 8.5 and 11.0 metres.
- 5.3 Designs shall comply with the requirements of VicRoads drawings numbered TC-1065B and TC-1066A for slip base poles and VicRoads drawing numbered TC-1064A for impact absorbing poles.

6.0 MANUFACTURING REQUIREMENTS

6.1 FABRICATION

Poles shall be manufactured from steel and shall comply with the following requirements:

- (a) Steel shall comply with the requirements of:
 - AS/NZS 3679.1: "Structural steel - Hot-rolled bars and sections";
 - AS/NZS 3678: "Structural steel - Hot-rolled plates, floor-plates and slabs";
 - AS/NZS 1594: "Hot rolled steel flat products"; and
 - AS1163: "Structural steel hollow sections".
- (b) Welded steel joints shall comply with the requirements of:
 - AS/NZS 1554.1: "Structural steel welding - Welding of steel structures"; or
 - AS/NZS 1554.5: "Structural steel welding - Welding of steel structures subject to high levels of fatigue loading", if appropriate.
- (c) Seal welds shall be in accordance with:
 - AS/NZS 1554.1: "Structural steel welding - Welding of steel structures"; or
 - AS/NZS 1554.5: "Structural steel welding - Welding of steel structures subject to high levels of fatigue loading" if appropriate, and shall be continuous.

- (d) Exposed corners shall be machined or ground to a radius of 3mm minimum.
- (e) Steel bolts, nuts and washers shall comply with the following Australian Standards:
 - AS1110 ISO metric hexagon bolts and screws (precision);
 - AS1111 ISO metric hexagon bolts and screws (commercial);
 - AS1112 ISO metric hexagon nuts (including thin nuts, slotted nuts and castle nuts);
 - AS/NZS 1252:1996 High strength steel bolts with associated nuts and washers for structural engineering; and
 - AS1275 Metric screw threads for fasteners.
- (f) Nuts and bolts shall be re-run after galvanising.
- (g) All extension joint(s) shall be "tek-screwed" or otherwise fixed both sides of the pole extension joint(s).
- (h) Any internal corners, such as cut-outs for doors or slots, shall have a radius of five (5) times the plate thickness.
- (i) The slip base pole slip flanges (top and bottom) and the slip washer shall be flat and free of protrusions, irregularities and deformations.

6.2 POLE PROTECTIVE COATING SYSTEM

After fabrication of the frangible pole section, all steel components shall be hot dip galvanised in accordance with AS/NZS 4680 "Hot-dip galvanized (zinc) coatings on fabricated ferrous articles". The coating mass requirement for a single surface shall be not less than 600 grams per square metre minimum average coating mass, equivalent to a thickness of 0.085 mm. Actual thickness shall be measured in accordance with Appendix G of AS/NZS 4680.

6.3 POLE BASE PROTECTIVE COATING SYSTEM

After fabrication, the ground set section of both the slip base pole and the impact absorbing pole shall be galvanised in accordance with Section 6.2 above.

After galvanising, an additional protective coating system for the ground set section shall be provided which satisfies the following.

6.3.1 General

The process shall be suitable for the intended purpose.

Protective coating of the ground set section shall comply with the following general requirements:

- (a) the total protective coating system for the ground set section shall have a minimum life of 25 years from the time the pole is first placed in service; and
- (b) the protective coating system shall be tough and durable. It shall be impermeable and shall be resistant to damage during transportation, installation and operation.

6.3.2 Materials

The protective coating material shall be one of the following:

- (1) epoxy powder coating (see 6.3.2.1)
- (2) painted film (see 6.3.2.2)
- (3) heat shrink (see 6.3.2.3)

Carcinogenic materials are not to be used.

6.3.2.1 Epoxy Powder Coating

VicRoads requires a fusion bonded epoxy powder coating which will exhibit a tough and flexible film for protection from extreme environments.

The protective system shall meet the following requirements:

- (a) Australian Standards

The powder coating shall comply with the following Australian Standards:

- AS/NZS 4506:1998 "Metal finishing – Thermoset powder coatings"; and
- AS3754-1990 "Safe application of powder coatings by electrostatic spraying".

- (b) Application

The galvanised metal substrate may be prepared by grit blasting with angular grit or optionally chemically pre-treated, either by

dried-in-place silicate chromate or by phosphating. The powder coating may be applied by electrostatic spray, by fluidised bed dripping, or by flock spraying (non-electrostatic) onto the pre-heated pipe. The finished powder coating shall be not less than 400 micron thick.

(c) Coverage

The powder coating shall be applied to external surfaces of the ground set section from the underneath face of the flange to a line 250mm above the bottom edge of the section.

(d) Coating Integrity

The powder coating shall exhibit:

- (1) corrosion resistance;
- (2) long life;
- (3) resistance to cathodic disbandment;
- (4) resistance to termites, and
- (5) shall be puncture resistant.

(e) Colour

The powder coating shall be of a colour distinctively different to the colour of the galvanised coating on the pole base section. Red is preferred.

6.3.2.2 *Painted Film*

- (a) After galvanising the ground set section shall have a paint protective coating applied to external surfaces from the underneath face of the flange to a line 250mm above the bottom edge of the section.
- (b) The painted coating is to be applied so that the thickness of the dry film is not less than 0.4mm. A light sand blast or suitable chemical treatment shall be given to the metal surface to ensure good adhesion of the paint.
- (c) Suppliers are required to supply the following information:
 - Paint manufacturer.
 - Paint identification code.
 - Type of materials in paint system.
 - Description of surface preparation.

- Type of primer used, if any.
- Number of coats in system.
- Guaranteed minimum dry film thickness in millimetres. The actual thickness shall be measured by a thickness meter approved by the Roads Corporation.
- Name and address of sub-contractor (if any) and details of processing to be done by sub-contractor.
- Copy of paint manufacturer's technical data sheets shall be supplied.

6.3.2.3 *Heat Shrink*

(a) Type

A chemically inert polymer (such as polyolefin) or equivalent heat shrinkable sleeve material containing:

- (1) an integral closure patch; and
- (2) A highly-tacky corrosion resistant adhesive sealant pre-coated inside the sleeve.

(b) Size

The protective coating shall totally envelope the circumference and the length (noting (e) below) of the pole base with a minimum 100 mm jointing overlap.

(c) Thickness

The heat shrink sleeve backing shall be at least 1.4mm thick.

The high-tacky adhesive sealant layer shall be at least 1.0mm thick.

(d) Colour

The protective coating shall be of a colour distinctively different to the colour of the galvanised coating on the pole base section. Black is the preferred colour.

(e) Position

The top edge of the protective coating shall be positioned 30mm below the underside of the flange on the base section of the pole.

(f) Application

The supplier shall submit details of the application of the additional protective coating system in accordance with Section 4.3 of this specification.

(g) Bonding

(1) Peel strength

The protective coating shall pass a peel strength test in accordance with ASTM D1000. The coating must exhibit an adhesive failure of the adhesive with the backing such that, when peeled, the adhesive must remain on the galvanised surface due to the peel value of the galvanised surface.

(2) At conduit entry point

The supplier shall ensure correct bonding around the two cutout sections for the cable entry conduits.

(h) Faults

Installed heat shrink protective coatings exhibiting cracking, burnt areas, poor adhesion, excessive bubbling, incorrect positioning, incorrect sizing or damage or flaws of any other kind may, at the discretion of the Superintendent, be rejected at no cost to VicRoads.

6.4 MARKINGS

Each frangible street lighting pole shall be legibly and durably marked on the exterior surface of the pole near the base with the following information:

- (a) the name, trade name or trademark of the manufacturer or responsible supplier.
- (b) nominal pole height, catalogue number or marking which shall distinguish the particular pole from other similar items supplied and/or manufactured by the supplier.
- (c) batch or serial number or other mark which will clearly identify the date of manufacture of the item.

6.5 ALTERNATIVE DESIGNS

Notwithstanding anything contained in this section related to fabrication in steel or protective coating of the ground set section, the supplier may submit designs fabricated or coated with alternative materials subject to VicRoads being provided with documentary evidence that the lighting pole will perform in an acceptable manner.

7.0 PROTOTYPE TESTING

- 7.1 At the sole discretion of VicRoads, prototype testing shall be carried out in accordance with this section when so ordered or directed.
- 7.2 The supplier shall submit to VicRoads evidence of any previous prototype testing or equivalent satisfactory performance of each prototype pole. If evidence to support satisfactory performance of previous prototype testing or equivalent satisfactory performance is neither available, nor acceptable to VicRoads, a prototype of each pole shall be subject to load testing to evaluate serviceability and strength performance as detailed below.
- 7.3 A prototype pole subject to load testing under this Section shall be manufactured in accordance with the details submitted in Section 4 of this specification and shall be representative of the poles supplied to VicRoads.
- 7.4 Prototype testing shall be carried out in accordance with Clause 6.16, Testing of Structures or Elements (Section 6 - Steel and Composite Construction) of the Australian Bridge Design Code (ABDC).
- 7.5 Points of application of the test load, method of applying the load and measuring instruments shall be subject to the approval of VicRoads.
- 7.6 The criteria for acceptance for strength and serviceability shall be in accordance with Clause 6.16.5.3, of the ABDC and the following additional requirements:
- (a) The maximum elastic deflection at the top of the pole under the serviceability limit state test load shall not exceed 5% of the luminaire mounting height.
 - (b) After removal of the strength limit state test load, the permanent deformation at the top of the pole shall not exceed 1% of the nominal pole height.

- 7.7 Prototype testing shall be carried out in the presence of a person nominated by VicRoads. The supplier shall give a minimum of one week's notice to VicRoads prior to testing commencing.
- 7.8 VicRoads will at no cost to the supplier arrange for a suitably qualified person to be on site during testing carried out within 150 km radius of the Melbourne Post Office. The supplier shall be responsible for reasonable travelling and accommodation costs required for any test carried out at a location further than a 150 km radius of the Melbourne Post Office.
- 7.9 All costs of testing are to be borne by the supplier.

8.0 CRASH PERFORMANCE (IMPACT ABSORBING POLES ONLY)

- 8.1 The supplier shall provide evidence of full scale impact testing and analysis, carried out by an appropriately qualified and experienced organisation acceptable to VicRoads, along with certification from an approved Consultant that the pole is suitable and adequate for use as an impact absorbing pole. The supplier shall also provide a video tape of the crash tests in standard speed VHS/Pal format.
- 8.2 8.5m and 11.0m prototype impact absorbing poles subject to crash performance testing under this Section shall be manufactured in accordance with the details submitted in Section 4 of this specification and shall be representative of the poles to be supplied to VicRoads.
- 8.3 Points of application of the crash test load, method of applying the load and measuring instruments shall be subject to the approval of VicRoads.
- 8.4 For crash testing, impact absorbing poles shall be installed on a standard in-ground or else plate set base with the top of the pole flange positioned 75mm +/- 25mm above ground level, and the floor pan of the crash vehicle shall be not less than 125mm above ground level. The crash vehicle is not to impact the pole flange. The pole shall mount a 5m long standard VicRoads style straight bracket upon which is loaded a 20kgm luminaire.
- 8.5 The point of impact is to be not more than 1/4 width of the vehicle from the longitudinal centerline of the vehicle. In impacting the pole, the vehicle must be brought to rest by the pole in a controlled manner. Any pitch, yaw or roll shall be such that the vehicle will not overturn or spin away from the pole.
- 8.6 The typical pole performance required is that for frontal impact by a vehicle of 1200 kg mass impacting the pole at 60 km/hr, the pole will produce decelerations, measured at the vehicle floor pan, no greater

than 10g averaged over any 50 millisecond period, nor greater than 10g for any period longer than 10 millisecond.

- 8.7 Prototype crash testing shall be carried out in the presence of a person nominated or approved by VicRoads. The supplier shall give a minimum of one week's notice to VicRoads prior to testing commencing.
- 8.8 All costs of crash testing are to be borne by the supplier.
- 8.9 Where determined by VicRoads, VicRoads may at no cost to the supplier arrange for a suitably qualified person to be on site during crash testing carried out within 150 km radius of the Melbourne Post Office. The supplier shall be responsible for reasonable travelling and accommodation costs required for any crash test carried out at a location further than a 150 km radius of the Melbourne Post Office.

9.0 QUALITY ASSURANCE REQUIREMENTS

- 9.1 The supplier shall operate and maintain a Quality System to Australian Standard AS/NZS ISO 9002:1994 "Quality systems - Model for quality assurance in production, installation and servicing".
- 9.2 The quality assurance system shall cover all work carried out in the manufacture and supply of frangible street lighting poles to VicRoads, and shall be subject to the requirements of audit therein.
- 9.3 If an order is placed by VicRoads for the supply of frangible street lighting poles under a supply contract, a contract specific quality plan shall be submitted to the Superintendent within 14 days of the acceptance of the tender.

10.0 SUPPLY

- 10.1 Frangible street lighting poles for VicRoads projects shall be manufactured and supplied in accordance with the details submitted under Section 4 of this specification.
- 10.2 Each finished frangible street lighting pole shall be handled and individually packed in such a manner so as to prevent any damage to the pole or to the protective coating during storage, handling and transport.
- 10.3 The poles shall be supplied assembled complete, with the exception that for transportation purposes, the octagonal base section may be supplied separately. If the base is supplied separately, the slip base

mounting bolts and washers must be held captive with the pole flange or base flange. Where the poles are supplied fully assembled the slip base mounting bolts shall be tightened to a torque of 150 Nm for transportation purposes only.

- 10.4 As indicated on VicRoads drawings numbered TC-1065B and TC-1066A, the slip base mounting bolts for slip base poles shall be installed with the nuts in the upper position to facilitate later re-torque to the 90 ± 10 Nm operational torque. Note that at the time of installation the slip base mounting bolts are to be slackened off one at a time and re-torqued to 90 ± 10 Nm.
- 10.5 Cable clamps for slip base poles are to be supplied as shown on VicRoads drawings numbered TC-1065B and TC-1066A, however cables and cable terminations shall be supplied by others.

11.0 ACCEPTANCE

- 11.1 The frangible street lighting poles supplied shall conform to a sample previously supplied to, and formally accepted by, the VicRoads Traffic and Road Use Management Department. Such acceptance shall be subject to the issue of a Certificate of Type Approval or Notification of Acceptance by the System Implementation Section. Sample units for testing shall be provided by the supplier when required.
- 11.2 Reference to “approved” within this specification shall mean individual components or methods that have been previously accepted by the System Implementation Section.

APPENDIX A – ASSOCIATED VICROADS DRAWINGS

TC-1064A IMPACT ABSORBING POLE ASSEMBLY GROUND SET MOUNTED

TC-1065B SLIP BASE POLE ASSEMBLY GROUND SET MOUNTED

TC-1066A TRANSITION BASE ASSEMBLY FOR SLIP BASE POLE PLATE SET MOUNTED

TC-1060C STREET LIGHTING BRACKET – TYPE 1

TC-1061C STREET LIGHTING BRACKET – TYPE 2

TC-1067A STREET LIGHTING BRACKET – STIFFENING PLATE

TC-1601 RAG BOLT ASSEMBLY