

Master Specification Part TUN-ITS-DC2

Tunnel Closure Systems

September 2024



Government of South Australia
Department for Infrastructure
and Transport

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Document Information

Document Information

K Net Number:

Document Version: 1

Document Date: 30/09/2024

Document Amendment Record

Version	Change Description	Date
0	Initial issue	31/08/2023
1	Updated cover page	30/09/2024

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TUN-ITS-DC2 Tunnel Closure Systems

1 General

- a) This Master Specification Part sets out the requirements for the design, supply, installation and testing of Tunnel closure systems, including:
 - i) the documentation requirements, as set out in section 2;
 - ii) the technical requirements, as set out in section 3;
 - iii) the control and monitoring requirements, as set out in section 4;
 - iv) the installation requirements, as set out in section 5;
 - v) the reliability, Design Life, and functionality safety requirements, as set out in section 6;
 - vi) the maintainability requirements, as set up in section 7; and
 - vii) the verification and testing requirements, as set out in section 8.
- b) For the purposes of this Master Specification Part, Tunnel closure systems includes the following subsystems:
 - i) Tunnel closure traffic signal lanterns;
 - ii) Tunnel closure system controller; and
 - iii) emergency closure barriers.
- c) This Master Specification Part does not apply to traffic signals used for traffic control at intersections and pedestrian crossings.
- d) The design, supply, installation and testing of Tunnel closure systems must comply with the Reference Documents, including:
 - i) AS 1742 Manual of uniform traffic control devices;
 - ii) AS 2144 Traffic signal lanterns;
 - iii) AS/NZS 2276 Cables for traffic signal installations;
 - iv) AS 2339 Traffic signal posts, mast arms and attachments;
 - v) AS 2578 Traffic signal controllers;
 - vi) AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules);
 - vii) AS 60529 Degrees of protection provided by enclosures (IP Code);
 - viii) Department Pavement Marking Manual (available from: https://dit.sa.gov.au/standards/standards_and_guidelines); and
 - ix) TSI-SP-069 Control Equipment for Road Traffic Signals.

2 Documentation

2.1 Design Documentation

In addition to the requirements of PC-EDM1 “Design Management”, the Design Documentation must include:

- a) a Tunnel closure and diversion strategy report including the details and rationale for the locations of the Tunnel closure system sites in accordance with section 3.1b);

- b) layout plans of the Tunnel closure system sites including:
 - i) stop line;
 - ii) Tunnel closure traffic signal lanterns;
 - iii) Tunnel closure system controller and its enclosure;
 - iv) emergency closure barriers;
 - v) safety treatments, such as vehicle barriers, etc;
 - vi) maintenance access; and
 - vii) adjacent ITS equipment;
- c) the layout plans of the Tunnel closure system required by section 2.1b) must show:
 - i) the emergency closure barrier boom arms in the closed positions;
 - ii) the offset between the boom arm tips to allow passage of Emergency Services vehicles; and
 - iii) the swept path of a fire appliance manoeuvring through the boom arm tips as required by section 3.4n);
- d) the proposed Tunnel closure system controller required by section 3.2b); and
- e) system architecture diagram.

2.2 Construction Documentation

In addition to the requirements of PC-CN3 “Construction Management”, the Construction Documentation must include:

- a) datasheets of the Tunnel closure traffic signal lanterns;
- b) datasheets for the Tunnel closure system controller; and
- c) datasheets, including performance information, for the emergency closure barriers.

2.3 Quality Management Records

In addition to the requirements of PC-QA1 “Quality Management Requirements” or PC-QA2 “Quality Management Requirements for Major Projects” (as applicable), the Quality Management Records must include the verification records required by section 8.2.

3 Technical requirements

3.1 General

- a) Each Tunnel closure system site must be provided with the following:
 - i) stop line;
 - ii) Tunnel closure traffic signal lanterns;
 - iii) Tunnel closure system controller; and
 - iv) emergency closure barriers.
- b) A Tunnel closure and diversion strategy must be developed, submitted as part of the Design Documentation, and must include Tunnel closure system sites as follows:
 - i) on freeway carriageways in advance of each Tunnel entry portal;
 - ii) on freeway entry ramps preceding each Tunnel entry portal;

- iii) on entry ramps into the Tunnel;
 - iv) on in-Tunnel exit ramps at divergent points; and
 - v) downstream of the divergence points in Tunnels.
- c) The Tunnel closure system's stop lines must be provided in accordance with the requirements of the Department Pavement Marking Manual.

3.2 Tunnel closure system controller

- a) The Tunnel closure system controller must be a traffic signal controller either:
- i) consistent with other traffic signal controllers used by the Principal; or
 - ii) in accordance with the Contract Documents.
- b) Where the Tunnel closure system controller has not been specified in the Contract Documents, the proposed Tunnel closure system controller must be nominated in the Design Documentation.
- c) The Tunnel closure system controller required by section 3.2a) must:
- i) control and monitor the Tunnel closure traffic signal lanterns;
 - ii) control and monitor the emergency closure barriers; and
 - iii) monitor for conflicting outputs to prevent conflicting displays or actions.
- d) The Tunnel closure system controller must be housed within an ITS enclosure in accordance with RD-ITS-S3 "ITS Enclosures".
- e) A field processor compliant with the requirements of RD-ITS-S6 "Field Processors" must be used to provide an interface between the Tunnel closure system controller and STREAMS.

3.3 Tunnel closure traffic signal lanterns

- a) The Tunnel closure traffic signal lanterns must be 3-aspect (red / amber / green).
- b) The Tunnel closure traffic signal lanterns must:
- i) be in accordance with AS 2144 Traffic signal lanterns;
 - ii) comply with the requirements of RD-EL-S3 "Supply of LED Traffic Signal Lanterns";
 - iii) have 300 mm diameter aspects; and
 - iv) be housed in a single mounting enclosure.
- c) Tunnel closure traffic signal lanterns must be:
- i) positioned in line with or downstream of the stop line;
 - ii) mounted with the lanterns in a vertical alignment;
 - iii) provided on traffic signal posts adjacent to both shoulders of the freeway carriageway or freeway entry ramp; and
 - iv) provided over the centre of each lane on freeway carriageways.
- d) A "Stop here on red signal" (R6-6) sign, in accordance with AS 1742 Manual of uniform traffic control devices, must be provided on each Tunnel closure traffic signal post.

3.4 Emergency closure barriers

- a) Emergency closure barriers must be installed to prevent traffic from entering the Tunnel when the occurrence of an incident requires full closure of the Tunnel.

- b) Emergency closure barriers must be provided downstream of the stop line at each Tunnel closure system site with adequate space between the emergency closure barriers and stop line to allow Emergency Services vehicles to manoeuvre through the emergency closure barrier gaps as required by section 3.4l)iii) and section 3.4m)iii).
- c) Emergency closure barriers must include vertical lifting boom arms which minimise the requirement for adjustment of the boom controller.
- d) Emergency closure barriers boom arms must be frangible and:
 - i) break away with vehicle impacts at speeds greater than 10 km/h;
 - ii) bend or distort with vehicle impacts at lower speeds;
 - iii) minimise any damage to the boom controller if the barrier arm is struck; and
 - iv) not move from their assigned position, breakaway or distort under wind loads for their installed location.
- e) Emergency closure barriers must include an interlock contactor to inhibit power to the boom motor and:
 - i) the interlock contactor must be controlled by the Tunnel closure system controller; and
 - ii) the emergency closure barriers controller must connect to the boom arm motor via the interlock contactor.
- f) Emergency closure barriers must be capable of raising and lowering the boom arm in fewer than 10 seconds per operation.
- g) Emergency closure barriers must include skirting that extend from the boom arms to the road surfaces when the boom arm is fully lowered to enhance the conspicuity of the barrier.
- h) Emergency closure barriers must include high visual impact red conspicuity LEDs that are automatically activated immediately when the boom arm starts moving towards the barrier lowered position.
- i) Emergency closure barriers must include a local override to raise and lower the boom arm. The over-ride must be secured against unauthorised use.
- j) Emergency closure barriers must be provided with the lowered boom arm located at right angles to the traffic flow.
- k) Emergency closure barriers must be provided such that the boom arms span all lanes of the carriageway or entry ramps to inhibit vehicles (other than Emergency Services vehicles as required by sections 3.4l)iii) and 3.4m)iii)) from passing when the boom arms are lowered.
- l) Where 2 emergency closure barriers are required to span all lanes, the emergency closure barriers must:
 - i) be provided adjacent to both shoulders;
 - ii) have the boom arm pair span all lanes and both shoulders of the carriageway to inhibit vehicles from passing when the boom arms are lowered; and
 - iii) include an 8 m to 12 m offset between the tips of the boom arms to allow passage of an Emergency Services vehicle.
- m) Where one emergency closure barrier is required to span all lanes, the emergency closure barrier must:
 - i) be provided adjacent to the left (nearside) shoulder;
 - ii) span the left (nearside) shoulder and all entry ramp lanes to inhibit vehicles from passing once the boom arms are lowered; and
 - iii) include a gap up to 3 m between the tip of the boom arm and right (offside) verge to allow passage of an Emergency Services vehicle.

- n) The location of the emergency closure barriers in relation to the stop line must provide enough manoeuvre room for a fire appliance travelling from the farthest lane or hard shoulder through the gap required by section 3.4l)iii) or section 3.4m)iii).

3.5 Back-up power supply

Tunnel closure systems must:

- a) be connected to the Tunnel essential power system where the Tunnel closure system site is located within proximity to the Tunnel portal; or
- b) have back-up power supplies provided in accordance with RD-ITS-D1 "Design of Intelligent Transport Systems (ITS)".

4 Control and monitoring requirements

- a) The Tunnel closure system controller must integrate, for control and monitoring, with:
 - i) STREAMS; and
 - ii) the PMCS.
- b) The Tunnel closure system controller must monitor and report its status including faults.
- c) The Tunnel closure system controller must monitor and report the status of:
 - i) Tunnel closure traffic signal lanterns, including:
 - A. all signals off;
 - B. 'red' on;
 - C. 'amber' on;
 - D. 'green' on;
 - E. signal conflicts; and
 - F. lantern faults; and
 - ii) emergency closure barriers, including:
 - A. barrier 'up';
 - B. barrier 'down';
 - C. barrier arm conspicuity LEDs;
 - D. barrier arm conspicuity LED conflicts; and
 - E. barrier down >10 degrees.
- d) The Tunnel closure system controller must ensure all Tunnel closure traffic signal lanterns are not illuminated during normal operations not associated with tunnel closure operations, unless the traffic signal lanterns are also used as part of a ramp metering system.
- e) Each Tunnel closure system, upon receiving the "closure" command, must undertake the following actions:
 - i) the amber Tunnel closure traffic signal lanterns must be illuminated for a user configurable display time between 4 to 6 seconds;
 - ii) the red Tunnel closure traffic signal lanterns must be illuminated after the amber Tunnel closure traffic signal lantern is switched off;
 - iii) the emergency closure barrier boom arms must lower, after a user configurable time delay between 0 and 60 seconds, from the illumination of the red Tunnel closure traffic signal lanterns;

- iv) the emergency closure barriers must activate the high visual impact red conspicuity LEDs upon lowering of the boom arms; and
 - v) the red Tunnel closure traffic signal lanterns must remain illuminated for the duration of the Tunnel closure.
- f) Each Tunnel closure system, upon receiving the “open” command, must undertake the following actions:
- i) the emergency closure barrier boom arms must raise to the “open” position;
 - ii) once the emergency closure barrier boom arms are in the “open” position, the high visual impact red conspicuity LEDs must be switched off;
 - iii) the red Tunnel closure traffic signal lanterns must be switched off, after a user configurable time delay of 0 to 60 seconds, from the emergency closure barrier boom arms reaching the “open” position; and
 - iv) the green Tunnel closure traffic signal lanterns must be illuminated for a user configurable display time of 0 to 60 seconds, after the red Tunnel closure traffic signal lanterns are switched off.
- g) The emergency closure barrier boom arms must be able to be raised and lowered remotely during a Tunnel closure event whilst the red Tunnel closure traffic signal lanterns are illuminated.

5 Installation requirements

Installation of Tunnel closure systems equipment, including Tunnel closure system controller, Tunnel closure traffic signal lanterns, signals posts, footings and cabling, must be in accordance with the requirements of:

- a) RD-ITS-C1 “Installation and Integration of ITS Equipment”;
- b) RD-EL-C2 “Installation of Traffic Signals”; and
- c) RD-EL-C3 “Supply and Installation of Conduits and Pits”.

6 Reliability, Design Life, and functional safety requirements

- a) Tunnel closure system equipment must be designed and provided to comply with the systems engineering requirements and the analysis for reliability, availability, maintainability, and safety (RAMS) in accordance with PC-EDM6 “Systems Engineering”.
- b) Tunnel closure system equipment must comply with the Design Life requirements of:
 - i) RD-ITS-D1 “Design of Intelligent Transport Systems (ITS)”;
 - ii) the Contract Documents.
- c) Tunnel closure system equipment must be capable of operating in an ambient temperature external to an ITS enclosure in the range of -15°C to +55°C.
- d) Tunnel closure system equipment must have the following minimum IP ratings in accordance with AS 60529 Degrees of protection provided by enclosures (IP Code):
 - i) equipment not housed within an ITS enclosure - IP55;
 - ii) equipment housed within an ITS enclosure - IP52; and
 - iii) emergency closure barriers - IP54.
- e) The emergency closure barriers must:
 - i) be rated for 1 million or more cycles; and

- ii) remain in the last state (opened or closed) in the event of communications failure or total power loss (including UPS).

7 Maintainability

Emergency closure barriers boom arms and skirting must allow for rapid replacement of the damaged boom arm in the event of an impact.

8 Verification requirements and records

8.1 Testing and commissioning

Testing and commissioning procedures and documentation of the Tunnel closure systems and component equipment must comply with the requirements of:

- a) RD-ITS-C1 “Installation and Integration of ITS Equipment”; and
- b) PC-CN1 “Testing and Commissioning”.

8.2 Verification records

The Contractor must supply written verification as part of the Quality Management Records that the requirements listed in Table TUN-ITS-DC2 8-1 have been complied with.

Table TUN-ITS-DC2 8-1 Verification requirements

Master Specification reference	Subject	Record to be provided
RD-ITS-S1 “General Requirements for the Supply of ITS Equipment”	Testing and acceptance	Factory Acceptance Testing records
RD-ITS-C1 “Installation and Integration of ITS Equipment”	Testing and commissioning	Test records as required by RD-ITS-C1 “Installation and Integration of ITS Equipment”
PC-CN1 “Testing and Commissioning”	Testing and commissioning	Test procedures as required by PC-CN1 “Testing and Commissioning”