

**Main Roads  
Technical Standard**

**MRTS201  
General Equipment  
Requirements**

**Thermal testing of Enclosures**

**Appendix B**

**Provision for Thermal Testing of Enclosures**

**October 10**

 **Queensland** Government

## **TRADEMARKS ACKNOWLEDGEMENT**

Terms mentioned in this document that are known or understood to be trademarks, whether registered or not, have been identified. Where trademarks have been confirmed as registered in Australia, this has been indicated by the addition of the ® symbol, otherwise the ™ symbol is used. While all care has been taken to identify trademarks, users should rely on their own inquiries to determine trademark ownership. Use of a term in this document as a trademark should not be regarded as affecting the validity of any trademark.

## **IMPORTANT INFORMATION**

The requirements of this document represent Technical Policy of the department and contain Technical Standards. Compliance with the department's Technical Standards is mandatory for all applications for the design, construction, maintenance and operation of road transport infrastructure in Queensland by or on behalf of the State of Queensland.

This document will be reviewed from time to time as the need arises and in response to improvement suggestions by users. Please send your comments and suggestions to the feedback email given below.

## **FEEDBACK**

Your feedback is welcomed. Please send to [mr.techdocs@tmr.qld.gov.au](mailto:mr.techdocs@tmr.qld.gov.au).

## **DISCLAIMER**

This publication has been created for use in the design, construction, maintenance and operation of road transport infrastructure in Queensland by or on behalf of the State of Queensland.

Where the publication is used in other than the department's infrastructure projects, the State of Queensland and the department gives no warranties as to the completeness, accuracy or adequacy of the publication or any parts of it and accepts no responsibility or liability upon any basis whatever for anything contained in or omitted from the publication or for the consequences of the use or misuse of the publication or any parts of it.

If the publication or any part of it forms part of a written contract between the State of Queensland and a contractor, this disclaimer applies subject to the express terms of that contract.

## **COPYRIGHT**

Copyright protects this publication. Except for the purposes permitted by and subject to the conditions prescribed under the Copyright Act, reproduction by any means (including electronic, mechanical, photocopying, microcopying or otherwise) is prohibited without the prior written permission of the department. Enquiries regarding such permission should be directed to the Contracts and Technical Capability Branch, Queensland Department of Transport and Main Roads.

© State of Queensland (Department of Transport and Main Roads) 2011



<http://creativecommons.org/licences/by-nc-nd/2.5/au>





# Table of Contents

	Page
1 INTRODUCTION .....	1
2 DEFINITION OF TERMS AND NOTATIONS .....	1
3 REFERENCE DOCUMENTS .....	1
4 PURPOSE OF THE TEST .....	1
5 TEMPERATURE RANGE OF ITS EQUIPMENT .....	2
6 TEMPERATURE CONTROL DEVICES .....	2
7 DESCRIPTION OF TEST PARAMETERS .....	2
7.1 Temperature .....	2
8 TEST PROCEDURE .....	2
8.1 General .....	2
8.1.1 Temperature Sensors .....	2
8.1.2 Test Sites .....	2
8.2 Default internal load of enclosure .....	2
8.3 Cyclic Thermal Performance Testing .....	2
8.3.1 General Requirement .....	3
8.3.2 Procedure .....	3
8.4 Steady-State Thermal Performance Testing .....	3
8.4.1 General Requirement .....	3
8.4.2 Procedure .....	3
8.5 Data Acquisition .....	4
9 DOCUMENTATION OF TEST RESULTS .....	4



# Provision for Thermal testing of enclosures

## 1 INTRODUCTION

This specification contains procedures for evaluating the thermal performance of Intelligent Transport System (ITS) and Electrical enclosures for outdoor use in Queensland. It is based on a review of historical climatic conditions, the likely thermal performance range of various ITS and Electrical products and an analysis of existing thermal evaluation techniques.

## 2 DEFINITION OF TERMS AND NOTATIONS

Terms used in this standard are defined in Table 2 below.

**Table 2 - Definitions**

Term	Definition
Director (ITS & ET)	The Director of the Intelligent Transport Systems and Electrical Technology Business Unit of Transport and Main Roads Road Systems Operations Division
Free Air	As specified in IEC 60068-1:1992, Section 4.4
$T_A$	Average ambient temperature of the test chamber
$T_I$	Maximum internal temperature of the enclosure being tested
$\Delta T$	Temperature difference ( $T_I - T_A$ )

## 3 REFERENCE DOCUMENTS

The requirements of the referenced documents listed in Table 3 below apply to this specification. Where there are inconsistencies between this standard and a referenced International and Australian Standard or a Main Roads Technical Standard then the requirements specified in this Standard shall take precedence. Unless specified otherwise, the latest version of each document shall be applicable, including its amendments to date.

**Table 3 - Referenced Documents**

Document ID	Document Name / Description
AS 2853-1986	Enclosures – Temperature-controlled – Performance testing and grading
IEC 60068-1-1992	Environmental testing. Part 1: General and guidance
AS 60068.2.2-2003	Environmental testing - Part 2-2: Tests - Tests B: Dry heat
AS 60068.2.14-2003	Environmental testing - Tests - Test N: Change of temperature
AS 60068.2.78-2003	Environmental testing - Part 2.78: Tests - Test Cab: Damp heat, steady state
MRTS201	General Requirements for ITS Equipment
MRTS226	Telecommunications Field Cabinets

## 4 PURPOSE OF THE TEST

The purpose of this specification is to ensure that ITS and Electrical enclosures used by Transport and Main Roads will be fit for the environmental conditions in which they will be deployed. The primary objective of testing is to determine whether the desired internal temperature of an enclosure is achieved and maintained across of range of ambient temperatures. Secondary objectives include:

- Whether there is any damage or wear to any part of the enclosure, as a result of the test;
- Thermostat performance throughout the tests; and
- Performance of the cooling system throughout the tests.

## 5 TEMPERATURE RANGE OF ITS EQUIPMENT

ITS and Electrical enclosures must maintain an internal temperature below the temperature operating range of equipment installed in the cabinet. Unless specified otherwise, the cabinet shall maintain an internal temperature ( $T_I$ ) below 50°C.

## 6 TEMPERATURE CONTROL DEVICES

The purpose of the temperature control devices is to maintain a desired internal temperature ( $T_I$ ) by adjusting control parameters in accordance with variations in ambient temperature ( $T_A$ ). The system generally comprises of electric fans and/or peltier devices and thermostats, but may also utilise passive design such as integral solar shields or double skin enclosure walls.

## 7 DESCRIPTION OF TEST PARAMETERS

### 7.1 Temperature

Generally, the internal heat load of the cabinet combined with solar radiation will result in positive temperature difference. The temperature difference ( $\Delta T$ ) between the ambient ( $T_A$ ) and the maximum internal enclosure temperature ( $T_I$ ) should be maintained as specified in MRTS226. The relationship between these parameters can be expressed as:

$$\Delta T = T_I - T_A$$

The manufacturer shall nominate if the cabinet is rated for a standard or extended temperature range. Standard and extended cabinets will be tested to a maximum ambient temperature ( $T_A$ ) of 38°C and 44°C respectively. Unless specified otherwise, the cabinet shall maintain an internal temperature below 50°C ( $T_I$ ).

## 8 TEST PROCEDURE

### 8.1 General

#### 8.1.1 Temperature Sensors

Temperature sensors shall have response times that are short in comparison to the thermal variations of the environment they measure.

The temperature sensors used in the test procedure shall be in accordance with Clause 5.2, Category 2, of AS 2853-1986.

#### 8.1.2 Test Sites

A test site is a location at which a temperature sensor is positioned for the purpose of temperature measurement. There are two types of test sites, namely, *Standard sites* and *Supplementary sites*. The selection of these sites for any type of enclosure shall be in accordance with Clause 5.3 of AS 2853-1986. Unless specified otherwise, the calculation of the number of standard test sites ( $N$ ) in accordance with AS 2853-1986 shall utilise a cabinet grade ( $G$ ) of 1 and 3 for standard and extended cabinets respectively.

### 8.2 Default internal load of enclosure

ITS and Electrical enclosures are intended for housing equipment with varying heat emitting characteristics. The distribution of the heat load in an enclosure shall be as close as possible to the distribution of the load in the intended application. Unless otherwise specified, the default load of telecommunications field cabinets shall be 500 W, distributed as follows:

- (i) 250 W for the top section (the top third of the cabinet);
- (ii) 125 W for the middle section (the middle third of the cabinet); and
- (iii) 125 W for the bottom section (the bottom third of the cabinet)

The top, middle and bottom sections shall be evenly allocated for the entire height of the cabinet.

### 8.3 Cyclic Thermal Performance Testing

Cyclic temperature testing is used to simulate the effects of sudden ambient temperature changes, which, for the purposes of this test are assumed to be changes of approximately  $1 \pm 0.2$  C/min. The general requirements and procedures for this test are as follows:

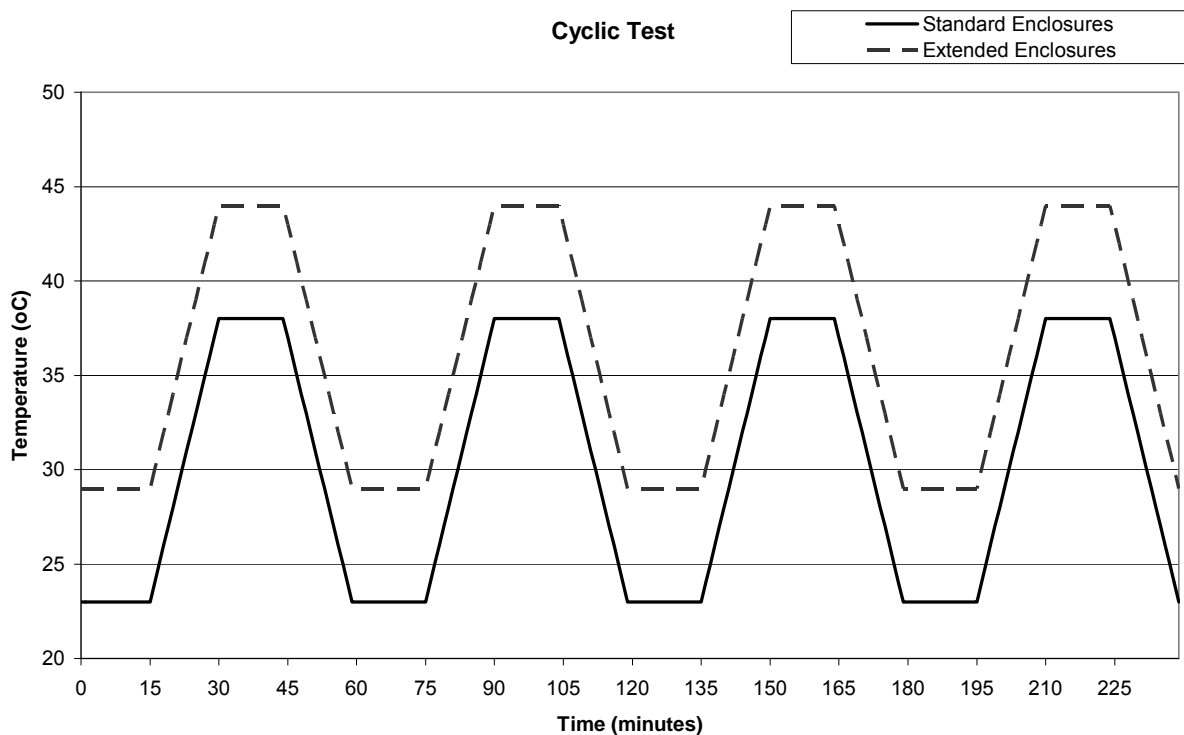
**8.3.1 General Requirement**

- Ambient temperature simulation shall be in accordance with AS 60068.2.14-2003 Test Nb; and
- The absolute value of humidity shall be set to  $20 \text{ g/m}^3 \pm 3\%$  for the duration of the test. Relative humidity shall not exceed 90%.
- Standard and extended enclosures shall be tested over a temperature ranges 23 - 38°C and 29 - 44°C respectively.

**8.3.2 Procedure**

- The ambient temperature shall be set to  $23 / 29^\circ\text{C} \pm 5\%$  for 15 minutes (or until temperature and humidity stabilise), vary linearly from  $23 / 29^\circ\text{C} \pm 5\%$  to  $38/44^\circ\text{C} \pm 5\%$  in 15 minutes, allowed to stabilise at  $38/44^\circ\text{C} \pm 5\%$  for 15 minutes (or until temperature and humidity stabilise) and drop back to  $23 / 29^\circ\text{C} \pm 5\%$  in a further 15 minutes. This 60 minute cycle shall be repeated back-to-back, four times.
- The ambient temperature-time characteristic is shown graphically below in Figure 8.3.2.

**Figure 8.3.2 – Cyclic Test Procedure**



**8.4 Steady-State Thermal Performance Testing**

Steady State Thermal Performance Testing is used to confirm the cabinet will perform with maximum thermal loading. The general requirements and procedures for the test are as follows:

**8.4.1 General Requirement**

- Relative humidity shall be set to  $80 \pm 3\%$  for standard enclosures, and  $60 \pm 3\%$  for extended enclosures in accordance to AS 60068.2.78-2003; and
- Ambient temperature simulation shall be in accordance with AS 6068.2.2-2003 Test Bd.

**8.4.2 Procedure**

- The ambient temperature in the test chamber shall be maintained at the specified value  $\pm 5\%$  for at least 4 hours in accordance with Clause 7.2. The internal enclosure temperature ( $T_i$ ) shall be stable for the final 2 hours of the test.

### 8.5 Data Acquisition

Before each test commences, the following checks shall be completed:

- The correct allocation of the heat load;
- The activation of the temperature control system including the thermostat and fans; and
- The correct placement of the internal and external temperature sensors.

Data from each temperature sensor shall be captured at intervals of 30 seconds, for the duration of each of the tests.

## 9 DOCUMENTATION OF TEST RESULTS

The presentation of the results shall specifically address the objectives of this specification as outlined in section 4, as well as providing the following:

- A record of all the temperature sensors and their time-stamped readings
- The maximum internal temperature ( $T_i$ ) at each 30s interval, as well as the identifier of the sensor producing the maximum temperature reading
- The average internal temperature at each 30s interval
- The average ambient temperature ( $T_A$ ) at each 30s interval
- The temperature difference between the cabinet and ambient temperature ( $\Delta T$ ) at each 30s interval
- The difference between the maximum and minimum cabinet temperatures at each 30s interval
- A plot of  $T_i$ ,  $T_A$  and  $\Delta T$  with time (s)
- The set-point of the thermostat used in testing
- A diagrammatic layout which clearly shows the location of all of the test sensors in the cabinet, test sources, cooling devices and air inlets.
- Details of the manufacturer and model of the test sensors and data logger
- A clear, high resolution photo of:
  - The test enclosure both before and after the test;
  - The location of all of the test sensors in the cabinet; and
  - The testing equipment including; test chamber, radiation and conduction heat sources, and data loggers.

Test results shall be presented using an electronic Microsoft Excel Spreadsheet template provided by the Director (ITS & ET). A double sided A4 hard copy of the test report and an electronic copy of the report and the populated excel spreadsheet template shall be provided to the Director (ITS & ET) upon completion of testing.