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TR 2607

Issue A

June 2016

Performance Specification for Electronic Motorway Display Equipment

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1 INTRODUCTION

1.1 Background

1.1.1 Highways England (formerly the Highways Agency) owns and operates an extensive range of Electronic Motorway Display Equipment on its motorways and All-Purpose Trunk Roads and these are currently used to provide both mandatory (e.g. speed limits) and advisory information to motorists.

1.1.2 As part of an initiative to become 'easier to do business with' and to become more open to offers from a broader range of suppliers of the most reliable and most energy-efficient equipment, Highways England has embarked upon a process of redrafting its technical requirements in a less prescriptive and more performance-based style and to align with European Standards.

1.1.3 As one of the outputs of that initiative, this specification defines the generic performance requirements for Highways England Electronic Motorway Display Equipment. The requirements related to particular Display Equipment types are given in the appendices.

1.1.4 This specification shall be read in conjunction with:

- BS EN 12966: Road vertical signs - Variable message traffic signs
- TR2608: Control and Interface Specification for Electronic Motorway Display Equipment
- TR1100: General Technical Requirements for Motorway Communications Equipment.

1.2 Scope and Purpose

1.2.1 BS EN 12966 is the European Standard for variable message traffic signs.

1.2.2 BS EN 12966 requires manufacturers to “CE” mark their Products and provide a Declaration of Performance (DoP) with the performance classes defined, including those related to the Construction Products Directive (89/106/EEC)

1.2.3 This specification describes:

- The performance classes that are required
- A generic set of performance requirements for Electronic Motorway Display Equipment for characteristics not covered by BS EN 12966
- The requirements related to the Structural Design Statement process required for manufacturers to verify that their Equipment can be safely supported by the host infrastructure and to achieve Highways England Technical Approval Authority (TAA) approval (Appendix B)
- The specific requirements for particular Display Equipment types, including the interfaces they shall be compatible with on their mounting structures in the Appendices D to J

- Guidance on the information to be provided by Purchasers in situations where Equipment variations are needed to cover specific operational requirements Appendix K.

1.2.4 TR2608 describes control and system interface performance requirements.

1.2.5 TR1100 describes general technical requirements for motorway control equipment. The requirements which apply are all those in respect of Equipment characteristics that are not already covered under BS EN 12966.

1.2.6 Together, these specification describe the overall performance requirements for Electronic Motorway Display Equipment from the point of the roadside system interface to the display presented to the motorist.

1.2.7 Together, these specifications supersede a number of previous specifications for Motorway Signals and Message Signs and associated ancillary items, together with the approval processes described therein, including:

Product/Comment	**Version 2 Specification**	**Version 3(note) Specification**
AMI	MCE0107	TR2526
Cable Marshalling Unit	*Included above*	TR2531
MS 2x12	TR2519	TR2519
MS3	TR2195	TR2527
MS3 Enclosures	TR2196	*Included above*
MS4	MCE2214	TR2528
MS4 (Enclosures elements)	MCE2215	*Included above*
Interfaces/ Gantry Controller	TR2521	TR2529
Ambient Light Monitor/ Sensor	MCE0110	TR2530
General Sign/Signal Requirements	N/A	TR2525

Note: Version 3 specifications were largely withdrawn in 2010 prior to equipment being supplied to them.

1.3 Definition, Acronyms and Abbreviations

1.3.1 A comprehensive Glossary of Terms covering this specification is given in Appendix A.

1.4 Mutual Recognition

1.4.1 The Mutual Recognition clause in TR1000 applies.

1.5 Implementation

1.5.1 This specification will be immediately implemented from the date of issue for all new approvals.

1.6 Assumption Made in the Preparation of the Document

1.6.1 Products shall set their displays and operate as part of the National Motorway Communications System (NMCS) Signals Sub-System and/or Message Sign Sub-System. Consequently, there are certain interfaces and operational features that are essential to ensure interoperability.

1.6.2 This document assumes that manufacturers are familiar with Highways England control equipment, its interfaces and operational requirements, including those relating to the Code of Connection detailed in MCH1514.

1.7 Feedback and Enquiries

1.7.1 Users of this document are encouraged to raise any enquiries and/or provide feedback on its content and usage to the dedicated Highways England team. The email address for all enquiries and feedback is:

Standards_Feedback&Enquiries@highways.gsi.gov.uk

2 NATIONAL REQUIREMENTS

2.1 General

2.1.1 This section outlines the UK National performance requirements for Electronic Motorway Display Equipment.

2.1.2 The purpose of Electronic Motorway Display Equipment is to allow traffic control centres to provide complete and clear displays of mandatory and advisory information in a timely, safe, reliable and consistent manner, in all weather conditions, thus contributing to the safe and efficient use of the roads. To achieve this, Electronic Motorway Display Equipment shall:

- Respond to incoming commands from traffic control centres and action them
- Monitor and report its operational and fault status so traffic control centres can determine when Equipment is unlikely to be able to set a display, if requested.
- Switch off displays when performance falls below the required performance level
- Provide locally measured ambient light levels, when configured to do so.

2.1.3 Across the range of Equipment currently defined, display types include the following, as defined in the appendices for each Equipment type:

- Aspects (e.g. advisory or mandatory speed limits; symbols representing lane closure)
- Text Messages
- Pictograms (e.g. roadworks symbol)
- Other Legends (e.g. Junction layouts)

2.1.4 New display types may also be specified by Purchasers, within the performance requirements of this Specification.

2.1.5 The Display Equipment covered by this specification will usually be installed on gantry structures that are described by reference to BD51/14, but may also be installed on posts at the roadside at some locations. To assist in minimising Mean Time to Repair and the need for working at height, certain interfaces shall be accessible from a roadside cabinet, as described in more detail in TR2608.

2.1.6 The Equipment and its operating software shall comply with TR1100 in respect of all characteristics and provisions that are not already covered under BS EN 12966. Supporting documentation shall be provided as part of a Technical File as described by TR1100.

2.1.7 Some Equipment may be used in conjunction with a Speed Enforcement System (HA Digital Enforcement and Compliance System Version 3 - HADECS3), which monitors Equipment settings using image processing techniques:

- Speed Enforcement Systems requires Home Office Type Approval in accordance with The Speedmeter Handbook
- Speed Enforcement Systems type testing includes tests carried out together with the Equipment covered by this specification
- Manufacturers shall ensure that any Display Equipment that is to be used in conjunction with Speed Enforcement Equipment is tested for compatibility with that Speed Enforcement Equipment before that Display Equipment is deployed.

2.1.8 The Equipment shall be compatible with the electrical, communications and structural interfaces provided, as described herein.

2.2 System Performance

2.2.1 Highways England requires that all Equipment installed at a given location shall operate simultaneously via the standard communications interfaces provided, as described further in section 2.4 and Appendix B, without degradation.

2.2.2 The system performance criteria is defined below, for the following Equipment limits:

- 16 No. single address devices operating via the Signals Sub-System

  PLUS

- 2 No. additional devices, which may be either:
  - Multiple address devices operating via the Signals Sub-System and Message Sign Sub-System OR
  - Single address devices operating via the Message Sign Sub-System

  PLUS

- 1 No. 'Externally Visible' Ambient Light Monitor (ALM), where required: this may be a physically separate device or use sensors within Display Equipment, if provided.

2.2.3 All Equipment installed at a given location shall be capable of simultaneously operating under the following conditions:

- Receiving control messages requiring the setting of their Aspect/ Text Message/ Pictograms/ Legend displays (as appropriate to their type), with any associated Lanterns displays, at a frequency of every five seconds

- Performing all background monitoring and testing tasks on a continual basis to enable all control source messages to be responded to correctly during the intervening periods
- Responding to requests for Ambient Light Monitor (ALM) sensor readings at a maximum frequency of once every five seconds
- Achieving the above with a minimum of 67% spare capacity in both processor cycles and memory, to allow for future upgrades.

Note: In case that a requested setting cannot be displayed as a result of a fault condition, the control source may request an alternative setting immediately.

2.2.4 The maximum 'response time' between the receipt of the final bit of control message requesting a setting being received at the main control interface and the requested display being set shall not exceed one second provided display cell faults remain within displayable thresholds.

2.2.5 Maximum permissible power consumption is specified for each Equipment type in the appendices. Whole-life energy consumption shall be competitively compared in supply tenders where reduced consumption may offer an advantage.

2.3 Performance Classes

2.3.1 Display Equipment shall meet the requirements of European Harmonised Standards BS EN 12966 in the following performance classes:

Table 2.3: BS EN 12966 Performance Classes

Visual Performance	Colour	C2
	Luminance (L_a)	L3
	Luminance Ratio (LR)	R3
	Beam Width	B3
Physical Performance	Temperature	T1
	Ingress Protection:	IP56
	Corrosion	D2/SP2
	Temporary Deflections Caused by Wind Load	WL8
	Temporary Deflections Caused by Bending	TBD1
	Permanent Deflections Caused by Dynamic Snow Load	DSL4

2.3.2 Equipment installed within roadside cabinets is not covered by BS EN 12966. However, Highways England Specification TR2130 describes additional physical Environmental testing for non-CE marked Equipment intended for service within a roadside cabinet as follows:

- Vibration, Random, Operational
- Drop and Topple

- Bump (packaged)
- Constant Low Temperature (Cold)
- Constant High Temperature (Heat)
- Damp Heat, Cyclic

Note: For the avoidance of doubt, clause 2.3.2 only applies to Equipment mounted within roadside cabinets and not to Display Equipment.

2.4 Standard Communications Interfaces - General

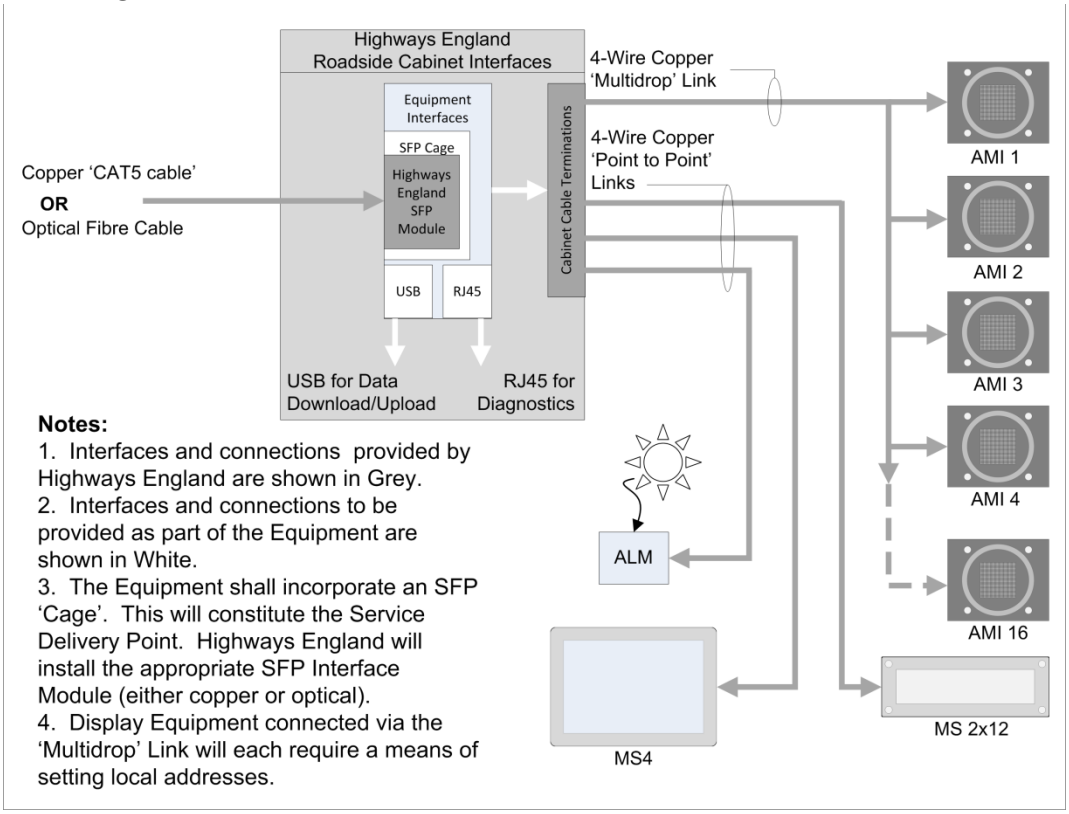
2.4.1 At each Equipment location, Highways England will provide a standard roadside cabinet (typically a Highways England Cabinet Type 600 as described in TR1153).

2.4.2 The system interfaces presented within the roadside cabinet will comprise:

- Upstream interface:
  - The Upstream interface shall consist of an integral Small Form-Factor Pluggable SFP 'Cage', into which Highways England will install either a copper or an optical SFP interface module.
- Downstream Interface(s):
  - Terminated 4-wire connection(s) to the Display Equipment and/or ALM locations, over standard Highways England cabling infrastructure, to a maximum distance of 250m, including the final data connector cable .
- See Appendix B for further details on system interfaces.

2.4.3 A typical site arrangement is represented in Figure 2.4 below.

Figure 2.4: Standard Communications Interfaces



2.4.4 Further details on system interfaces and connectors are described in Appendix B.

2.5 Electrical Interfaces

2.5.1 With the exception of any separate ALM device that may be provided, the Equipment shall operate via a nominal 230V a.c. mains supply within the maximum power consumption limits stated in the appendices.

2.5.2 Standard Highways England power connectors will be provided for Display Equipment as part of the standard Highways England cabling infrastructure. These may be either Type 1 or Type 2, depending upon the Equipment type, as described in Table 2.5 below:

Table 2.5: Infrastructure Power Supply Connectors

Type 1	TR2033 Connector Type:	R
	TR2033 Wiring Detail	K: - 1 - Live; N - Neutral; E - Earth
Type 2	TR2033 Connector Type:	P
	TR2033 Wiring Detail	D: - A - Earth; B - Neutral; C - Live

2.5.3 Where the Equipment supplied is not directly compatible with these power connectors, adapters may be provided. Alternatively, subject to agreement with Highways England in both equipment purchasing and scheme design functions, alternative Low Voltage power supply arrangements will not be precluded provided that clearly different connector types are used to avoid confusion.

2.5.4 The standard provisions within Highways Agency roadside cabinets include an electrical supply via a Power Distribution Unit or Consumer Unit or similar. Unless otherwise agreed, any Equipment installed within the roadside cabinet shall be supplied with a single 'flying' mains lead 2m long for direct connection to this supply. The total maximum power consumption should not exceed 100VA.

2.5.5 An equipotential bonding conductor terminated in an M8 ring terminal will provided at each Equipment location, including within the roadside cabinet, as part of the infrastructure.

2.5.6 All Equipment shall comply with the Power Factor requirements of TR1100.

2.5.7 Nuisance Tripping' (the unnecessary operation of automatic over-current protection devices e.g. RCDs; MCBs) due to external factors is a problem in a motorway environment, especially where it is not possible to readily access the Equipment to reset the device. Disconnection devices that require manual resetting shall not be used within Display Equipment enclosures for accessibility reasons.

2.6 Equipment Configuration

2.6.1 The types, electronic addresses, numbers and general configurations of Equipment installed at any site location shall be determined via data held within a single Equipment Configuration Plug (ECP) Type 9300 to MCE1137, as described further in TR2608.

- Due to nature of the multi-drop connections, individual, single address devices operating via the Signals Sub-System will each require a means of setting their local address from outside of the Signal enclosure. Additional standard ECPs may be used for this purpose, if preferred. However, legacy arrangements will not be precluded.

2.6.2 The Equipment shall be 'user-configurable' as defined in TR2608.

2.7 Initialisation

2.7.1 To ensure compatibility with the Highways England control system. the Equipment shall perform an Initialisation sequence on 'Power Up' and on 'Reset' in accordance with TR2608.

2.8 Display Setting

2.8.1 Displays (including any Lanterns and Red Rings) shall be set, synchronised and monitored by the Equipment when requested by the Signals or Message Sign Sub-Systems, in accordance with TR2608.

2.9 Flashing Lanterns

2.9.1 For Display Equipment which requires physically separate or discreet Lanterns (see appendices), Lanterns shall be capable of being displayed and cleared independently of other parts of the display.

2.9.2 Colours for physically separate or discreet Red and Amber (Yellow) Lanterns shall be as defined for Traffic Signals in BS EN 12368 (equivalent to colour performance class C2 in BS EN 12966)

2.9.3 The on-axis luminous intensity of physically separate or discreet Lanterns shall meet performance class 2/1 of BS EN 12368.

2.9.4 The luminous intensity distribution of physically separate or discreet Red Lanterns shall meet that defined in Table 4: Medium wide beam signal (Type M) as defined in BS EN 12368.

2.9.5 The luminous intensity distribution of physically separate or discreet Amber (Yellow) Lanterns shall meet TR2516 Performance Specification for Discontinuous Variable Message Signs.

2.9.6 The optical performance of Lanterns formed from display cells that are part of the main display shall meet the performance classes stated in section 2.3.

2.10 Red Rings

2.10.1 For Display Equipment which requires discreet Red Rings (see appendices), Red Rings shall be capable of being displayed and cleared independently of other parts of the display.

2.11 Luminance Control

2.11.1 Display Equipment shall adjust display Luminance to comply with the Luminance Ratio requirements by either:

- Using ambient luminance levels provided within control system messages
- Using ambient luminance levels measured locally by sensors included within the Display Equipment or a separate ALM.

2.11.2 A minimum of 5 levels of signal/sign display luminance shall be provided.

Note: It is anticipated that an increased number of levels would be required to achieve compliance with the luminance/luminance ratio requirements of BS EN 12966 with optimal energy efficiency.

2.11.3 For discreet Lanterns, a minimum of 2 levels of Lantern luminance shall be provided, with the 'Dim' level representing between 15-20% of the 'Bright' Luminance level.

2.11.4 Luminance levels shall be reconfigurable as described in TR2068.

2.11.5 Further details on luminance control are given in TR2608.

2.12 Background Tests (Monitoring) and Fault Reporting

2.12.1 The Equipment shall perform background testing (monitoring) and respond to fault conditions in accordance with TR2608.

- In future Highways England may competitively compare equipment fault reports in supply tenders and unreliable or spurious fault reporting may be disadvantageous.

2.12.2 Display cell tests shall not be visible to the casual observer, day or night.

2.12.3 Display cells shall be deemed to be faulty when the number of functional emitters in that display cell falls below 50%.

2.12.4 Operational and Fault logs shall be maintained and available for download via the interface facilities located in the roadside cabinet and remotely via the diagnostics available over the control network connection.

2.12.5 The Equipment shall additionally support SNMP-based fault alarm reporting in accordance with TR2608 and TR2597 Generic Roadside Device Requirements for Remote Access (Phase 2).

2.13 Reliability and Maintenance

2.13.1 All Equipment shall be designed for a minimum expected in-service life of 15 years without routine cleaning and with minimum routine maintenance to align with Highways England operation, maintenance and renewal programmes.

- However, to align with structural requirements and to provide flexibility in future renewal programming, Display Equipment enclosures shall be designed to retain full structural integrity for 30 years, without maintenance.
- It is accepted, however, that any prolonged period of service beyond the expected 15 year service life may be subject to extensive refurbishment, including maintenance of any paint system applied to the enclosure.

2.13.2 Some Display Equipment is required to be capable of being maintained to a 3rd Line Level in situ (i.e. in their place of installation), whereas others will be removed and returned to the manufacturer or other authorised 3rd party for repair, as defined for each Equipment type in the appendices.

2.13.3 All designs shall provide high reliability and the Mean Time Between Failure (MTBF) and the resulting availability figures shall be calculated in accordance with the PD IEC TR 62380.

2.13.4 MTBF/ availability may be competitively compared in supply tenders where higher availability may offer an advantage:

- Minimum MTBF requirements, Equipment 'Working Phases' and repair access assumptions may be defined within Highways England tender documentation.

2.13.5 Where optical designs use 'colour mixing' techniques to achieve colour class requirements, the 'colour mixes' shall be reconfigurable as described in TR2608 to ensure that compliance with the required colour classes can be maintained over the life of the product in the event of uneven colour degradation.

2.13.6 Maintenance (including any periodic testing and calibration) proposals shall be submitted as part of the Technical File and Highways England's cost for undertaking maintenance, including cost of deploying plant and traffic management, will be competitively compared as part of the whole life cost of ownership during the tender assessment process.

- Maintenance proposals shall include the frequency of visits and the time spent on site for each routine maintenance task
- Routine maintenance visits that coincide with Highways England's 6-yearly electrical inspections will attract the least whole-life cost during the tender assessment process.

2.13.7 While comprehensive remote diagnostics and reconfiguration facilities (including full software upgrades) are required (see TR2608 and TR2597), to prevent maintenance personnel having to work at height unnecessarily, the Equipment shall provide the same comprehensive diagnostics and reconfiguration facilities at the roadside and be capable of being fully reprogrammed with software updates from the roadside cabinet.

2.13.8 To prevent maintenance personnel having to work at height unnecessarily, Display Equipment shall also incorporate a visible means of indicating its status to maintenance personnel from the hardshoulder as follows:

Table 2.13: Visual Status Indication

Indication	Indicator Colour	On Status	Off Status
Power	Green	Power Present	No Power
Receive Data	White	Comms (Flashing)	
Transmit Data	Blue	Comms (Flashing)	
Fault Condition	Red	Fault	No Fault

Note: 'Fault condition' means any fault which is reportable (i.e. has achieved a fault reporting threshold) in accordance with Highways England control system and protocol and the current Equipment configuration.

2.13.9 The status indication shall:

- Vary in brightness with the ambient light level so it remains visible from the hardshoulder at a distance of 30m in all light conditions.
- Be positioned to minimise their visibility to all road traffic.

2.14 Construction - General

2.14.1 Display Equipment dimensions, optical design and display areas are defined for each Display Equipment type in the appendices.

2.14.2 Display Equipment shall provide a display which is free from reflections from likely external light sources (e.g. vehicle headlamps; street lighting).

2.14.3 Display Equipment shall maintain its optical performance characteristics to the stated BS EN 12966 performance classes over the expected 15 year operational life, based on an anticipated minimum overall daily 33% duty cycle.

2.14.4 To allow interchangeability with Equipment from various suppliers, Display Equipment, including any mounting brackets supplied, shall be compatible with the standard structural interface details as shown in the appendices: these assume the optical axis will be perpendicular to the front face.

2.14.5 The enclosure and its fixing arrangements shall allow for tolerance in member sizes due to fabrication and the differential expansion effects of the enclosure and support structure.

2.14.6 The arrangement shall ensure that the loads are applied to the mounting points on the supporting structure in proportion to their spacing using a sufficient number of fixings, such that there is sufficient capacity to support the sign equipment, whilst there is an associated failure of at least 50% of the proposed fixings, in whatever configuration provides the worst case loading scenario. The capacity of the remaining fixings shall also consider the capacity of the supporting framework elements, such that the remaining supporting elements and their connections are no over loaded in the above worse case configuration.

> **Note:** The above is intended to provide structural 'redundancy' such that the enclosure remains safely attached to the supporting structure, but not necessarily operational, in the event of a significant failure of the proposed fixings. This does not preclude the use of additional fixings or tethers to achieve this

2.14.7 To facilitate installation/ removal by 3rd parties, Display Equipment Enclosures shall incorporate permanent lifting points as shown in the appendices for each Display Equipment type.

2.14.8 Installation earthing methods for all Equipment shall comply with BS 7671 - 'Requirements for Electrical Installation IEE Wiring Regulations' and BS 7430 - 'Code of Practice for Earthing'.

2.14.9 Wiring between modules or within an enclosure shall comply with BS EN 60445.

2.14.10 All lightning Surge Arrestors fitted should be installed as close as possible to the point of cable entry to Equipment enclosures.

2.14.11 To facilitate safe and efficient maintenance. for items defined as 'maintained in situ',

- Display modules shall be removable without the use of any tools
- The size and weight of replaceable modules shall be kept to a minimum and suitable for easy and safe handling by one person using procedures that are compliant with the Manual Handling Operations Regulations 1992, with heavier replaceable modules located at low level within the enclosure, where possible
- Units shall be self-addressing, where unique internal addressing is required, and shall not require any address setting by maintenance staff.
- Replaceable modules shall be designed and organised to prevent incorrect installation during maintenance

2.14.12 Where active temperature and/or humidity regulation devices are used, their operating points should be carefully considered to avoid unnecessary energy consumption and shall be configurable as described in TR2068.

2.14.13 As a minimum, the Equipment shall include over-temperature protection to prevent damage resulting from operation outside of component specifications.

2.14.14 Ambient Light Monitors or Light Sensor Unit (where they are integral to Display Equipment) shall:

- Incorporate two independent light sensors and be designed to measure the ambient light level in all directions from the vertical to the horizon.
- Be designed to prevent the build-up of snow affecting their operation
- Be calibrated to cover the full range of light levels from bright sunlight to darkness
- Be accurate to within ± 2 Lux, ± 5%.

2.15 Construction - Display Equipment Enclosures

2.15.1 Enclosures shall comply with class WL8 in BS EN 12899-1.

Note: This performance class is stated so that standard Equipment is suitable at the majority of locations in England. However, where local specific wind conditions prove to be greater than the loads imposed by WL8, a higher performance class may be specified in tender documentation. It is the responsibility of the Scheme Designer to ensure that before Equipment supplied in accordance with this specification is installed, it is suitable for the intended location

2.15.2 The deflection class for the enclosures due to temporary loads shall be TDB1 in accordance with BS EN 12899-1.

2.15.3 The deflection class for the enclosures due to dynamic snow loads shall be DSL4 in accordance with BS EN 12899-1.

2.15.4 All other loads and combinations for the enclosures shall be calculated in accordance with BS EN 12966.

2.15.5 Wind force and pressure coefficients shall be calculated in accordance with BS EN 1991-1-4, Eurocode 1: Actions on Structures – Part 1-4: General Actions – Wind Actions.

2.15.6 Deformations in the serviceability limit state shall be limited such that they do not exceed the values given in BD51/14 Table 4.1 for the Characteristic combination of actions.

2.15.7 Enclosures may be manufactured from any material that will meet the performance requirements of this specification over the design life of the Equipment. Consideration should be given to reducing the effects of solar gain to minimise the effects of internal temperature rise.

2.15.8 Enclosures manufactured from aluminium or steel shall comply with BS EN 1090: Execution of steel structures and aluminium structures .

2.15.9 Front facing surfaces shall be Matt Black. Where Side and Rear facing surfaces are painted to achieve the required design life and/or reduce solar gain, these may be Grey 18B21 BS4800 (non-reflective) for consistency of appearance with other installed equipment. Unpainted surfaces shall be dulled. All finishes shall give a high quality aesthetic appearance and retain their colour and consistency of finish for the design life of the Equipment.

2.15.10 Access doors for 'maintain in situ' Products shall open to a minimum of 85° and a maximum of 90° and be fitted with a suitable `Stay' to retain the door in the open position for the safety of maintenance personnel and be fitted with suitable locks using the standard Highways England Key described in TR1100.

2.15.11 Enclosure dimensions and corner radiuses shall take account of the details given in the appendices for each equipment type to ensure compatibility with the gantry structures on which the equipment will be mounted, including the safe closure of apertures, where rear manned access is provided.

Notes:

1. Where manned access is provided and where indicated in the appendices, a closure system shall be provided as part of the Display Equipment supply to close any gaps between the Display Equipment and the gantry front face, up to the enclosed zone provided as part of the gantry, as required by BD51.
2. The closure system supplied shall take account of the full range of any adjustment provided by the mounting brackets.

2.16 Construction - Roadside Cabinet Equipment

2.16.1 The standard provisions within the roadside cabinet provided by Highways England for Equipment installation will include:

- A 230V a.c. single phase power source via a 6A MCB (Type C) within a distribution unit

- A standard 19-inch rack for Equipment mounting
- A heater typically set to operate when the internal temperature falls below 15°C

2.16.2 Because the roadside cabinet will frequently be required to accommodate other systems, the total space available for all installed Equipment covered by this specification is 4U, including lightning protection circuits.

2.16.3 Attention is drawn to the dimensions of the Highways England Equipment Configuration Plug (ECP) to MCE1137, which shall be accessible from the front panel of the Equipment installed:

- The minimum distance between the front of 19-inch rack and the inside surface of the Highways England Type 600 cabinet door is approximately 53mm.
- The ECP is a maximum length of 50mm (measured from the male connector front face)
- A minimum longitudinal clearance of 5mm is required.
- Designers should note that the diameter of the Highways England Address Plug can vary and the maximum dimension permissible under the specification should be determined and allowed for.

2.17 Equipment Connectors

2.17.1 All Equipment connectors provided, including any connector adapters, shall be fully compatible with Highways England' standard infrastructure provisions, as described further in sections 2.4 and 2.5 and TR2033.

- Galvanic corrosion between connector shells and pins/sockets and safety earth cables and terminals shall be avoided.

2.18 Provisions for Storage

2.18.1 Display Equipment above single operator limits for manual handling shall be supplied on a suitable transport framework incorporating wheels to enable the Equipment to be moved within the storage area without mechanical lifting equipment. Wheels shall be swivelled and rubberised, nylon or of a similar soft surface and two wheels shall have mechanical brakes.

2.18.2 Where required, Transport Stillages shall be designed and available to order with Display Equipment to facilitate safe transportation to site and safe installation and swap-out operations. Stillages shall envelope the Display Equipment to protect it from damage during handling and movement.

3 NORMATIVE AND INFORMATIVE REFERENCES

3.1 Normative References

3.1.1 Where undated references are listed, the latest issue of the publication applies.

British Standards

The British Standards Institution, London, publishes British Standards.

Contact: +44 (0) 1344 404 429

WEB: http://www.bsonline.bsi-global.com

BS 4800	Schedule of paint colours for building purposes
BS 5930	Site Investigations
BS 7430	Code of Practice for Earthing
BS 7671	Requirements for Electrical Installation IEE Wiring Regulations
BS EN 1090	Execution of steel structures and aluminium structures. Requirements for conformity assessment of structural components
BS EN 1991-1-4	Actions On Structures – General Actions – Wind Actions
BS EN 1993-1-1	Design of Steel Structures
BS EN 1999	Design of Aluminium Structures
BS EN 12368	Traffic control equipment. Signal heads
BS EN 12899-1	Fixed, Vertical Road Traffic Signs
BS EN 12966	Road Vertical Signs – Variable Message Traffic Signs
BS EN 62305-1-4	Protection Against Lightning
BS EN 60445	Basic And Safety Principles For Man-Machine Interface, Marking And Identification. Identification of Equipment Terminals, conductor Terminations and Conductors
BS EN 62471	Photobiological safety of lamps and lamp systems
PD IEC TR 62380	Reliability data handbook. Universal model for reliability prediction of electronics components, PCBs and equipment

Specifications and Drawings

Specifications and Drawings published by Highways England.

Contact: TSSPLANSREGISTRY@highwaysengland.co.uk

MCH1514	Code of Connection - Application process for Agency Project Sponsors, Suppliers and Maintainers
TR1100	General Technical Requirements for Motorway Communications Equipment
TR2516	Performance Specification for Discontinuous Variable Message Signs
TR2608	Control and Interface Specification for Motorway Signals and Message Signs
TR2597	Generic Roadside Device Requirements for Remote Access (Phase 2)

Standards and Advice Notes (TSO publications)

Other publications can be obtained from the Stationery Office.

Contact: +44 (0)20 7242 6393

WEB: http://www.tso.co.uk

Standards and Advice Notes contained in the Design Manual for Road and Bridges (DMRB) and the Manual of Contract Documents for Highway Works (MCHW) for UK Trunk Roads including Motorways, current at the time of the particular Structural Design Submission.

Document Reference	Title	Date of Issue	Decimal Reference
BA 57/01	Design for Durability	Aug 2001	1.3.8
BD 02/12	Technical Approval of Highway Structures	May 2012	1.1.1
BD 37/01	Loads for Highway Bridges	Aug 2001	1.3.14
BD 45/93	Identification Marking of Highway Structures	Aug 1993	3.1.1
BD 51/14	Portal and Cantilever Signs/Signal Gantries	May 2014	2.2.4
BD 57/01	Design for Durability	Aug 2001	1.3.7

Document Reference	Title	Date of Issue	Decimal Reference
BD 62/07	As Built, Operational and Maintenance Records for Highway Structures Amendment to Appendix D	Feb 2007	3.2.1
BD 63/07	Inspection of Highway Structures	Feb 2007	3.1.4
BD 94/07	Design of Minor Structures	Feb 2007	2.2.1
BE 7/04	Departmental Standard (Interim) Motorway Sign/Signal Gantries	Aug 2004	2.2
TD 33/05	The Use of Variable Message Signs on All Purpose and Motorway Trunk Roads	Nov 2005	8.2
IAN 69/05	Designing for Maintenance	Dec 2005	
IAN 124/11	Eurocodes: Implementation of Eurocodes for the design of new and existing highway structures	July 2011	

Other publications

IEEE 802.3 'Standard for Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications'

Small Form-factor Pluggable (SFP) Multisource agreement (INF-8074i Rev 1.0)

The Construction Products Regulations 2011 incorporating the requirements of The Construction Products Directive 89/106/EEC

The Manual Handling Operations Regulations 1992

3.2 Informative References

Specifications and Drawings

Specifications and Drawings published by Highways England.

Contact: TSSPLANSREGISTRY@highwaysengland.co.uk

MCE0107	NMCS2 Advanced Motorway Indicator (AMI) Equipment Requirements
MCE0110	NMCS2 Ambient Light Monitor (ALM) Equipment Requirements
MCX0043	X-Frame Type 212 Drawings
MCX0201	X-Frame Type 211 Drawings
MCX0202	X-Frame Type 213 Drawings
MCX0708	Lantern Type 73 or 82 Mk2 Drawings
MCX1031 sheet 5	NMCS2 Controlled Motorway - AMI Fixing Geometry (Legacy Drawing)
MCX1031 sheet 6	NMCS2 Controlled Motorway - AMI Interface Frame Drilling Details (Legacy Drawing)
MCX1031 sheet 8	NMCS2 Controlled Motorway - AMI Upper Fixing Bracket - Gantry Mounted (Legacy Drawing)
MCX1031 sheet 9	NMCS2 Controlled Motorway - AMI Lowering Fixing Bracket - Gantry Mounted (Legacy Drawing)
MCE1137	Equipment Configuration Plug - Type 9300: Hardware Requirements
MCE1157	Lantern Type 73 & 82
MCE2214	NMCS2 Motorway Signal Mk4 (MS4) Requirement for Signal Equipment (Display and Communication Electronics)
MCE2215	Motorway Signal MK4 (MS4) Requirement for Enclosures and Mounting Brackets, Cantilever Structures and Holding Down Arrangement
TR1000	Introduction to the Traffic Systems and Signing Registry
TR1153	Cabinet Type 600
TR2033	Weatherproof Cable Assemblies
TR2130	Environmental Tests for Communications Equipment and Portable and Permanent Road Traffic Control Equipment for use on Trunk Roads
TR2150	NMCS Non Armoured Copper Communications Cable

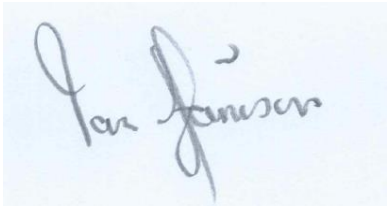
TR2158	NMCS Armoured Copper Communications Cable
TR2195	NMCS2 Message Signs and Motorway Signals Mk 3 (MS3) Requirement for Signal Equipment (Display and Communications Electronics)
TR2196	Message Signs and Motorway Signals MK3 (MS3) Requirement for Enclosures and Mounting Brackets
TR2519	Specification for Gantry-Mounted Signing Equipment (MS 2x12 Version 3)
TR2521	Gantry Mounted Signalling and Signing Equipment Interfacing Specification
TR2525	Specification for Gantry-Mounted Signalling and Signing Equipment (General Requirements)
TR2526	Specification for Gantry-Mounted Signalling Equipment (AMI Version 3)
TR2527	Specification for Gantry-Mounted Signing Equipment (MS3 Version 3)
TR2528	Specification for Gantry Mounted Signing Equipment (MS4 Version 3)
TR2529	Specification for Gantry Controller
TR2530	Specification for Ambient Light Sensor
TR2531	Specification for Cable Marshalling Unit
TRH2583	General Regulation Highways England Cables

Other publications

The Speedmeter Handbook (Fourth Edition) published by the Home Office Scientific Development Branch.

4 AUTHORITY

Checked by:



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This document was notified in draft to the European Commission in accordance with Directive 98/34/EC as amended by Directive 98/48/EC.

APPENDIX A GLOSSARY OF TERMS

A1 This appendix sets out the Glossary of Terms for Motorway Signal and Message Sign Products.

a.c.	Alternating current.
ADS	Advanced Direction Sign
AIP	Approval in Principle (of Structures).
ALM	Ambient Light Monitor
AMI	Advanced Motorway Indicator. A variable speed limit signal used to display Mandatory and other Motorway Signal Aspects.
Ancillary items	In the context of this specification, describes item that are not light emitting, but which are nonetheless an integral part of the overall system, for example light sensors and cable marshalling units.
Approving Agent	Agent that may be appointed to review/approve Structural Design Statements on behalf of the Purchaser.
Aspect	A defined recognisable optical output displayed by the AMI or other signal, triggered by a defined command message.
Aspect Display Area	The area of Display Equipment designated for the display of signal Aspects.
BD **/**	Highways England Department Standards - Bridges and Structures.
Character Module	A 5 x 7 matrix of light-emitting display cells used for the display of individual text characters.
CHARM	Common Highways England Rijkswaterstaat Model - future open standard for Electronic Motorway Display Equipment control.
Code of Connection (CoCo)	Application process relating to the connection of equipment to the Highways England communications network.
d.c.	Direct current.
DfT	Department for Transport.
Display Area	For the purposes of this specification, this shall simply be taken as the active area of the sign/ signal Equipment front face.
Display Cell	An individual light emitting cell forming part of the Display Area matrix. May comprise single or multiple light emitters.
Display Equipment	A term specifically relating to the Equipment related to the

	display and excludes any separate interface Equipment which may be installed within any roadside cabinet.
DoP	Declaration of Performance (BS EN 12966)
Dual Colour	Refers to lanterns designed to operate in either Amber or Red light emitting modes.
ECP	Equipment Configuration Plug - A programmable device which assigns the electronic address and various configuration data to the Gantry Controller.
Electronic Address	Digital Address of a device on the control system and appear at the 'head' on a control message.
Electronic Motorway Display Equipment	A generic terms for the broad range of Equipment that may be supplied in accordance with this specification.
Enforcement Equipment	Equipment required to detect and record evidence of vehicles failing to comply with mandatory speed limits, comprising speed measurement device, camera unit, control unit and AMI interface.
Ethernet	A Local Area Network (LAN) conforming to the IEEE 802.3 standard.
Equipment	When spelt with a leading capital 'E' means the Equipment to be supplied under the Contract and includes all electrical and mechanical hardware, optical, electronic and telecommunication equipment, mountings (as specified) and enclosures; computer software and all documentation as defined in the Contract.
Fixing Lugs	Permanent, fixed lugs on the rear of the gantry-mounted Equipment for the purposes of fixing it to the gantry structure (or Interface Frame), possibly via additional interfacing bracketry supplied by the Infrastructure Scheme, depending on the detailed design. The fixing lugs form part of the Enclosure structure.
GD**/**	Highways England Department Standards - General Guidance
HADECS	Highways England Digital Enforcement and Compliance System.
HA	Highways Agency. Predecessor of Highways England
HATMS	Highways England Traffic Management System. Term describing the overall control system. Incorporates the NMCS
IAN	Interim Advice Note (Highways England).
Interface Frame	Gantry interface structure supporting a Message Sign or

	signal.
Infrastructure Scheme	In the context of this specification, a generic term for the scheme providing the infrastructure to support the Equipment. Except in the case of items mounted on cantilever structures supplied by the sign/signal manufacturer, this generally includes the supporting structure.
IP	Internet Protocol.
Lantern	A flashing light source incorporated into a Variable Message Sign or Motorway Signal display which is designed to draw attention to the Display Equipment ("Conspicuity Device"). Depending on the Display Equipment type, Lanterns may be: • Physically separate units connected to the Display Equipment • Discreet module within the Display Equipment • Formed from display cells within the main display.
Luminance Control	The process by which the luminance of a Variable Message Sign or Motorway Signal display can be varied automatically to account for varying ambient lighting conditions.
MCB	Miniature Circuit Breaker.
Message Sign	A text-only variable Message Sign comprising 2 rows of 12 Characters and mounted on a Portal Gantry, sometimes via an Interface Frame. Also referred to as a MS 2x12.
MEWP	Mobile Elevated Work Platform
Module	An enclosed sub-assembly of the Equipment housing PCB(s), individual components etc. and designed to provide protection to such circuits and components etc. and to allow faulty modules to be easily removed and replaced for maintenance purposes.
Mounting Brackets	Bracketry used for mounting Signalling and Signing Equipment onto their mounting structure. Where required, these are part of the structural scope of supply and are not covered by this specification.
Mounting Points	Points on the gantry structure (or Interface Frame) to which the Equipment will be affixed, possibly via additional interfacing bracketry supplied by the Infrastructure Scheme, depending on the detailed design.
MS 2x12, MS3, MS4	Various Sign/Signal types – see appendices.
MTBF	Mean Time Between Failure
Multi-drop	A circuit which connects transceivers at more than two points.
N/A	Not Applicable.
NMCS	National Motorway Communications System.

Pictogram	Symbol or legend displayed on various Display Equipment types - see appaendices.
Portal Gantry	A portal structure design to support Signalling, and/or Signing Equipment and/or ADS.
Post	Means of mounting AMI or other Signals at a Motorway or Slip Road verge site.
Purchaser	Highways England or any other body authorised to purchase Equipment using this specification.
Red Ring	The part of the display which when emitting light renders the accompanying speed limit mandatory.
Sign	A generic term for a device capable of displaying text information messages and/or Pictograms or other Legends and which is connected to the Message Sign Sub-System. MS 2x12, MS3 and MS4 are designated as Signs, even though MS3 and MS4 also have a signal Aspect display capability.
Signal	A generic term for a device capable of displaying advisory or mandatory instructions, e.g. stop or 30 mph speed restriction, and connected to the Signal Sub-System. AMI are designated as a 'Signals', though MS3 and MS4 also have a signal Aspect display capability.
SFP	Small Form-factor Pluggable - Refers to industry standard modular interface types used for upstream connection.
SNMP	Simple Network Management Protocol
Speed Enforcement Equipment	Equipment designed to detect and record evidence of vehicles exceeding the speed limit. The combination of Speed Enforcement Equipment with an Enforcement Group of AMI units can be used to operate a Variable Mandatory Speed Limit Scheme.
Structural Design Statement	Design Statement issued by the manufacturer to verify the performance of the sign or signal enclosure with the structural requirements of the Specification.
Supporting Text	Text displayed on a sign to support an Aspect or Pictogram/ other Legend display.
TAA	Technical Approval Authority.
TD **/**	Department Departmental Standard - Traffic Engineering and Control.
Technical File	
Text Message	Message displayed on signs with a text content.

Visual Status Indicators	Illuminating indicators fitted to the sides of Display Equipment to indicate various key status issues for maintenance purposes.
VMS	Variable Message Sign displaying Text Messages and/or symbols typically using light emitting technology in more recent designs.
Working Phases	Definition of Equipment Operating cycles used in MTBF calculations
XML	Extensible Mark-up Language as defined by W3C
XML Schema	Defines the XML format configuration data held within the Equipment Configuration Plug.

APPENDIX B SYSTEM INTERFACES AND CONNECTORS

Upstream Interface

B1 Within the roadside cabinet, the Service Delivery Point shall be the integral SFP Cage which Highways England will populate with an appropriate SFP interface module.

B2 The Equipment shall incorporate an integral SFP 'Cage' meeting the requirements of the Small Form-factor Pluggable (SFP) Multisource agreement (INF-8074i Rev 1.0).

B3 SFP transceivers will be installed by Highways England and will currently be one of the following types:

- 10M/100M/1000M Electrical Ethernet (TX) complying with standard IEEE 802.3-2012 clause 28 and clause 40 (802.3z/802.3ab).
- 100M/1000M short haul single mode duplex optical Ethernet transceiver of type LX complying with standard IEEE 802.3-2012 clause 38
- 100M/1000M short haul single mode bi-directional optical Ethernet transceiver of type BX complying with standard IEEE 802.3-2012 clause 59 with transmit and receive wavelengths of 1310nm and 1490nm respectively.

B4 The equipment shall be tested with each transceiver type and compatibility shall be verified with each, prior to Equipment delivery

B5 Where an auto-negotiate function for Ethernet or Fibre interfaces is provided, it shall be enabled by default.

B6 To provide flexibility for future developments, the Equipment shall also be compatible with any other 3rd party provided SFP transceiver that fully complies with the Small Form-factor Pluggable (SFP) Multisource agreement (INF-8074i Rev 1.0).

B7 Dust/EMI cover plug shall be inserted into empty cage assembly bays.

B8 Regardless of the transceiver type in use, the operation of the Equipment via the upstream communications interface shall comply with TR2608.

- A single IP address will be assigned to the upstream interface.

Equipment Addressing and Configuration

B9 To align with the Highways England control system and equipment addressing architecture, all Display Equipment and any externally visible ALM at a site location will be defined using 'device instances', each with separate TCP/UDP port numbers, within the single IP address provided.

- Highways England define this within XML Schema held within a single Equipment Configuration Plug (ECP) Type 9300 to MCE1137.

- Each TCP/UDP port shall remain entirely visible to the control system
- The Equipment shall not require any network configuration procedure by maintenance personnel during maintenance or replacement activities, other than the fitting of the ECP
- The use of proprietary Ethernet Switches to 'share' the upstream connection between Display Equipment is therefore not permitted.

B10 Further details on configuration and addressing are given in TR2608.

Downstream Interfaces

B11 Multiple downstream interfaces will be provided between the roadside cabinet and the Display Equipment locations via 4-wire connections using standard Highways England cabling infrastructure, to a maximum distance of 250m, including the final data connector.

B12 Standard Highways England cabling infrastructure comprises cables to specification TR2150/TR2158 (legacy cables) or TRH2583. Cables will be terminated within the roadside cabinet in accordance with standard Highways England installation practice, ready for final connection during Equipment installation. The Equipment shall be supplied with suitable connection cables for this purpose.

B13 A single 4-wire, multi-drop connection will be provided to all single address devices operating via the Signals Sub-System to be controlled at that location.

- However, it should be noted that the close proximity of Display Equipment on the gantry may effectively present more of a 'Star' arrangement than the distributed load arrangement that the term 'multi-drop' infers.

B14 Individual 4-wire, 'point-to-point' connections will be provided to:

- Each device operating via the Message Sign Sub-System to be controlled at that location
- Any 'externally visible' ALM where this is a separate device which does not use sensors fitted within the Display Equipment.

B15 To prevent a single data communications fault from causing continuous transmission and hence affecting the operation of other devices connected to the same communications link, interfaces shall be protected from ‘Anti-Streaming’.

B16 Interfaces shall be protected against lightning as described in TR1100, with protection provided at both ends of the circuit.

Final Connector

B17 The final connector provided at each Display Equipment and any separate ALM location will be a common Highways England data connector cable assembly provided as part of the standard Highways England cabling infrastructure. The provision of adapters for this purpose is not precluded.

Table B.17: Infrastructure Communications Connector

TR2033 Connector Type:	B
Contact Information	A - Comms A B- Comms B C -Comms C D - Comms D E - Not Used SHELL - Cable Screen

Notes:

1. Equipment which does not have directly compatible connectors shall be supplied with suitable adapters.
2. Due to nature of multi-drop connections, single address devices operating via the Signals Sub-System will each require a means of setting their local address from outside of the Display Equipment enclosure. Highways England can provide standard ECPs Type 9300 to MCE1137 that may be used for this purpose, if preferred, but legacy arrangements will not be precluded.
3. When used for separate ALMs, as no separate power cable is provided. the arrangement is required to incorporate any ELV power source that may be required and this shall be compatible with the standard Highways England cabling infrastructure provided.

User Interfaces

B18 The arrangement provided within the roadside cabinet shall also include the following interfaces accessible from the front of the cabinet (when open):

- At least one USB Interfaces (USB1/2/3 compatible) for data upload/download purposes
- A diagnostic interface via a female RJ45 Ethernet connector (or acceptable alternative).

APPENDIX C STRUCTURAL DESIGN STATEMENT

General

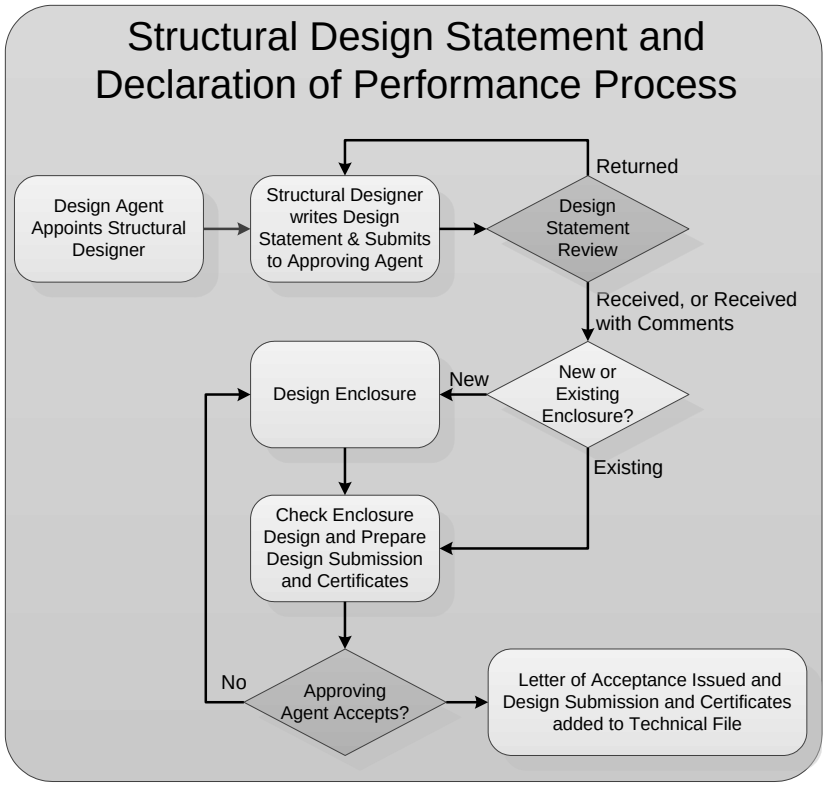
C1 The Declaration of Performance process under BS EN 12966 and the Construction Products Directive (89/106/EEC) requires manufacturers to ensure and declare the structural integrity and performance and of their Product (including any mounting brackets and closure system supplied) and its compatibility with the mounting structure and to declare that all contract, technical and legislative requirements have been met.

C2 Highways England requires that Display Equipment (including any mounting brackets and closure system supplied) is subject to Approval in Principle (AIP), detailed design and design check submissions in accordance with BD02/12 for Highways England Technical Approval Authority (TAA) approval.

C3 The design and review process shall follow the principles laid down in BD02/12, as shown in flowchart form in Figure C1 below, and the Declaration of Performance submission shall retain the format of previous AIP-style submissions. The remaining sections of this appendix provide a model format.

C4 Once a design has achieved Highways England TAA approval, provided the Product manufactured in strict accordance that approval, the Product may be supplied with a 'Construction Compliance Certificate' declaration by the manufacturer.

Figure C1: Overview of the Structural Design Statement Process



Additional informational Notes for the Attention of Scheme Designers Referring to this Specification

C5 Equipment supplied to this specification will be certified to the performance classes stated herein and in particular WL8 given in table 8 of BS EN 128991.

C6 This renders the Equipment suitable for installation at the majority of locations in England where the design peak velocity pressure calculated in accordance with the procedures in BS EN 1991-1-4, Eurocode 1: Actions on Structures – Part 1-4: General Actions – Wind Actions does not exceed the value for WL8 given in table 8 of BS EN 128991.

C7 There are some locations in England where this wind loading value may be exceeded. It is the responsibility of the Scheme Designer to ensure that before Equipment supplied in accordance with this specification is installed, it is suitable for the intended location.

Structural Design Statement: xxxxx Enclosure
Manufacturer: xxxxx
Reference: xxxxx

Note: xxxxx = to be completed by manufacturer

0 Scope

0.1 This Structural Design Statement relates specifically to the development of the Design Specifications detailed in Highways England specifications TR2607, for the various "Hardware" components of the xxxxx system.

0.2 This design statement is intended to cover the installation of xxxxxs at the majority of locations in England where the design peak velocity pressure calculated in accordance with the procedures in BS EN 1991-1-4, Eurocode 1: Actions on Structures – Part 1-4: General Actions – Wind Actions does not exceed the value for WL8 given in table 8 of BS EN 128991. The wind pressure for an individual site will be determined by the infrastructure designers. In addition, xxxxxs should be mounted on portal or cantilever gantry structures designed in accordance with BD 51/14, or Posts, in some cases.

1 Highway Details

1.1 Type of Highway

1.1.1 Motorways and All-Purpose Trunk Roads.

1.2 Permitted Traffic Speed

1.2.1 70 mph / 112kph maximum

1.3 Existing Restrictions

Not Applicable.

2 Site Details

2.1 Obstacle Crossed/Retained

2.1.1 Various Motorways and All-Purpose Trunk Roads.

3 Proposed Structure

3.1 Description of Structure and Design Working Life

3.1.1 **xxxxx** Enclosure to be mounted on portal or cantilever gantry structures designed in accordance with BD 51/14.

Structural Design Statement: xxxxx Enclosure
Manufacturer: xxxxx
Reference: xxxxx

Note: xxxxx = to be completed by manufacturer

(Manufacturer to provide summary design details)

3.2 Structural Type

3.2.1 The structural type shown on the General Arrangement drawing is:

(**Manufacturer to state, e.g. Rib-stiffened Box, support details**)

3.2.2 The size of the structure is:

4.1 (Manufacturer to complete table)

Manufacturer to state actual sizes	**Dimensions [m]**		
	width	height	depth
xxxxx			

3.3 Foundation Type

Not applicable.

3.4 Span Arrangements

Manufacturer to state, if applicable.

3.5 Articulation Arrangements

Manufacturer to state, if applicable.

3.6 Classes and Levels

3.6.1 Consequence class

Manufacturer to state, if applicable.

Note: By reference to IAN 124 Table A.2, it will be noted that gantries are generally Category II. Manufacturers should match or exceed the levels specified in this table.

3.6.2 Reliability Class

Manufacturer to state, if applicable.

Structural Design Statement: xxxxx Enclosure
Manufacturer: xxxxx
Reference: xxxxx

Note: xxxxx = to be completed by manufacturer

3.6.3 Inspection Level

Manufacturer to state, if applicable.

3.7 Road Restraint Systems Requirements

Not applicable.

3.8 Proposed Arrangements for Inspection and Maintenance

3.8.1 Traffic Management

3.8.1.1 Typically hard shoulder and Lane 1 closure required, but site-specific and to be determined by Scheme Designers.

3.8.2 Access Arrangements for future maintenance and inspection of structure. Access arrangements to structure

3.8.2.1 See 3.8.1.1.

3.8.2.2 Maintenance proposals shall take full account of BD63 Inspection of Highway Structures. Access to the **xxxxx** is the responsibility gantry designer.

3.9 Environment and Sustainability

Manufacturer to state, if applicable.

3.10 Durability, Materials and Finishes

3.10.1 Materials and Finishes

3.10.1.1 **Manufacturer to state, with reference to BD 51/14 and Specification TR2607:**

- **Materials of construction for external panels and internal supports, windows doors, structural fasteners and non-structural fasteners having metallic contact with the structure.**
- **Specific measures for prevention of bimetallic corrosion.**

Structural Design Statement: xxxxx Enclosure
Manufacturer: xxxxx
Reference: xxxxx

Note: xxxxx = to be completed by manufacturer

- **Paint Colour, Finish & Surface Preparation for internal and external surfaces. For coatings on aluminium give details of any supporting testing/certification.**
- **Whether any structural elements will be subjected to heat during fabrication, erection commissioning, service or under planned maintenance**
- **Details of any post fabrication heat treatment.**

3.11 Risks and Hazards Considered for design, execution, maintenance and demolition. Consultation with and/or agreement from CDM Coordinator.

3.11.1 The risks to the public from failure of the structure have been mitigated through the design and independent check procedure in accordance with the principles of BD02.

Manufacturer to state mitigating actions considered.

3.11.2 The safety of maintenance personnel, working at heights and working adjacent to carriageways, has been considered.

Manufacturer to state risks, hazards and mitigating actions considered, for example retention/securing of tools and replacement parts. Such details will be documented in the appropriate place.

3.11.3 CDM consultations and/or agreements

Manufacturer to state

3.12 Estimated Cost of Proposed Structure Together with Other Structural Forms Considered (including where appropriate proprietary manufactured structure) and the Reasons for their Rejection Including Comparative Whole Life Costs with Dates of their Estimates

3.12.1 Consideration to whole life cost is a requirement of this contract.

Manufacturer to provide details, but limited to items solely associated with the Sign. This shall include, but not be limited to:

- **Initial purchase cost**
- **Installation cost (excluding traffic management)**

Structural Design Statement: xxxxx Enclosure
Manufacturer: xxxxx
Reference: xxxxx

Note: xxxxx = to be completed by manufacturer

- **Maintenance and repair costs (based on MTBF calculations and maintenance proposals).**

3.13 Proposed Arrangements for Construction

3.13.1 Construction of structure

Contractor to propose proposed method of construction and/or installation.

3.13.2 Traffic Management

Contractor to propose generic traffic management arrangements for typical installations.

3.13.3 Service Diversions

Not applicable, site-specific.

3.13.4 Interface with Existing Structures

Not applicable, site-specific.

4 Design Criteria

4.1 Actions

4.1.1 Permanent actions

4.1.1.1 All loading shall be in accordance with BS EN 12966. Nominal super imposed dead loading due to self-weight shall be within the range indicated in note 1 (c) of Annex B.

4.1.2 Snow, Wind and Thermal actions

Manufacturer to state the loading classes by completing the following table:

Load or Deflection Limit	Class
Wind Load	
Point Load	
Dynamic Snow Load	
Deflection under temporary loading	

As the enclosures could be used almost anywhere on the highway network in England, a value of wind load class, WL8, in accordance with BS EN 12899-1, shall be used.

4.1.2.1 Where the enclosure is to be manufactured from aluminium, it shall be designed in accordance with BS EN 1999 Design of aluminium structures. The wind loads on the enclosure should be calculated using the tabulated class WL8 pressure using the necessary force coefficients derived in accordance with BS EN 1991-1-4, Eurocode 1: Actions on Structures – Part 1-4: General Actions – Wind Actions.

Manufacturer to state the material and main codes/standards used in the design. Only recognised and published standards which offer equivalence may be considered in the event that alternatives to those stated above are proposed.

4.1.3 Actions relating to normal traffc under AW reglations and C&U regulations

4.1.3.1 Live loading shall be as stated in BS EN 12966.

4.1.4 Actions relating to General Order traffic under STGO regulations

4.1.4.1 Not applicable

4.1.5 Footway or footbridge variable actions

4.1.5.1 Not applicable

4.1.6 Actions relating to Special Order traffic, provision for exceptional abnormal indivisible loads including location of vehicle track on deck cross section

Not applicable

4.1.7 Accidental Actions

Manufacturer to state, if applicable

4.1.8 Action during construction

Structural Design Statement: xxxxx Enclosure
Manufacturer: xxxxx
Reference: xxxxx

Note: xxxxx = to be completed by manufacturer

Manufacturer to state

4.1.9 Any special action not covered above

Manufacturer to state, if applicable

4.2 Heavy or high load route requirements and arrangements being made to preserve the route, including any provision for future heavier loads or future widening

Not applicable

4.3 Minimum headroom provided

Manufacturer to state, if applicable

4.4 Authorities consulted and any special conditions required

Manufacturer to state, if applicable

4.5 Standards and documents listed in the Technical Approval Schedule

See attached schedule.

4.6 Proposed Departures relating to departures from standards given in 4.5

Manufacturer to add details of any departures to be sought against performance specifications and standards given in 4.5 .

4.7 Proposed Departures relating to methods for dealing with aspects not covered by standards in 4.5

Manufacturer to add details of any departures to be sought against aspects not covered by performance specifications and standards in 4.5 .

5 Structural Analysis

5.1 Methods of Analysis Proposed for Superstructure: (Gantry structure and foundations covered elsewhere)

Structural Design Statement: xxxxx Enclosure
Manufacturer: xxxxx
Reference: xxxxx

Note: xxxxx = to be completed by manufacturer

Manufacturer to state; - for example static analysis, computer frame or finite element analysis. State names, versions & originators of any structural analysis computer programs intended to be used.

Structural Design Statement: xxxxx Enclosure
Manufacturer: xxxxx
Reference: xxxxx

Note: xxxxx = to be completed by manufacturer

5.2 Description and Diagram of Idealised Structure to be used for Analysis

Manufacturer to describe method of analysis and attach diagram as figure B. Diagram should:

- **indicate whether nodes are fixed/pinned**
- **illustrate support points and directions of restraint**
- **illustrate external loading**
- **identify any non-participating panels and identify their means of support**

A diagram showing deflections and a statement on front face deflection should be included.

5.3 Assumptions Intended for Calculation of Structural Element Stiffness

Manufacturer to state

5.4 Proposed range of soil parameters to be used in the design of earth retaining elements

Not applicable. Substructure and foundations covered elsewhere.

6 Geotechnical Conditions

6.1 Acceptance of recommendations of the Geotechnical Design Report to be used in the design and reasons for any proposed changes.

Not applicable.

6.2 Summary of design for highway structure in the Geotechnical Design Report

Not applicable.

6.3 Differential Settlement To Be Allowed For In The Design Of The Structure

Not applicable.

Structural Design Statement: xxxxx Enclosure
Manufacturer: xxxxx
Reference: xxxxx

Note: xxxxx = to be completed by manufacturer

6.4 If the Geotechnical Design Report is not yet available, state when the results are expected and list the sources of information used to justify the preliminary choice of foundations

Not applicable.

7 Checking

7.1 Proposed Category and Design Supervision Level

7.1.1 Category 2 with Independent check by manufacturer's appointed Consultant.

7.2 If Category 3, name of proposed Independent Checker

Not applicable under Category 2 Check.

7.3 Erection Proposals or Temporary Works for which Type S and P Proposals will be required, listing structural parts of the permanent structure affected with reasons

Manufacturer to state, if applicable

Structural Design Statement: xxxxx Enclosure
Manufacturer: xxxxx
Reference: xxxxx

Note: xxxxx = to be completed by manufacturer

8 Drawings And Documents

8.1 List of Drawings (Included Numbers) and Documents Forming Part of the Design Statement

Figure A Signal Enclosures
Figure B Structure Idealisation Diagram, Diagram of Deflections and Statement on Front Face Deflection
Annex A Extracts from the TAS Schedule
Annex B Maximum Loads to be applied to supporting structures.
Annex C General Arrangement Drawings- Manufacturer to State Drawing Number(s) of attached drawing(s).
Annex D Sample Design/Check Certificate
Annex E Sample Construction Compliance Certificate
Annex F Materials Specification

Manufacturer to add details of any other documents or drawings forming part of the Design Statement.

xxxxx Documents And Drawings

TR2607 (issue A 2015) Performance Specification for Electronic Motorway Display Equipment

TR2608 (Issue A 2015) Control and Interface Specification for Electronic Motorway Display Equipment

Highways England Manual of Contract Documents for Highways Works (MCHW), Volume 3, Section 3, "National Motorway Communications System - Installation Drawings".

No.	Title	Sheet	Issue Letter	Issue Date
	Installation Drawings	*	*	*

*** Manufacturer to complete table listing all sheets and issue letters/dates**

Structural Design Statement: xxxxx Enclosure
Manufacturer: xxxxx
Reference: xxxxx

Note: xxxxx = to be completed by manufacturer

THE ABOVE IS SUBMITTED AS A TRUE STATEMENT OF THE STRUCTURAL DESIGN AND DEMONSTRATES COMPLIANCE WITH THE STANDARDS DEFINED HEREIN.

Signed:	
Name:	
Position: *(Designer or Design Team Leader)*	
Engineering Qualifications:	
Name of Organisation:	
Date:	

Signed:	
Name:	
Position: *(Checker or Check Team Leader)*	
Engineering Qualifications:	
Name of Organisation:	
Date:	

Signed:	
Name:	
Position: *(Highways England or Approving Agent Team Leader)*	
Engineering Qualifications:	
Name of Organisation:	
Date:	

Structural Design Statement: xxxxx Enclosure
Manufacturer: xxxxx
Reference: xxxxx

Note: xxxxx = to be completed by manufacturer

Figure A Enclosures

Manufacturer to add figure - Details of lifting lugs/ mounting brackets/ closure systems shall be included to assist gantry designers.

Structural Design Statement: xxxxx **Enclosure**
Manufacturer: xxxxx
Reference: xxxxx

Note: xxxxx = to be completed by manufacturer

Figure B Structure Idealisation Diagram, Diagram of Deflections and Statement on Front Face Deflection

Manufacturer to add figure and statement as referred to in section 5.2 of this Appendix.

Structural Design Statement: xxxxx Enclosure
Manufacturer: xxxxx
Reference: xxxxx

Note: xxxxx = to be completed by manufacturer

Annex A Extracts From The Technical Approval Schedule "TAS" (November 2009)

(Date to be confirmed by the manufacturer)

Schedule Of Design Documents Relating To Highway Bridges And Structures

(All documents are taken to include revisions current at date of this TAS).

1. British Standards (TSO publications)

BS 5930	Site Investigations
BS EN 1090	Design of Steel Structures
BS EN 1991	Actions on Structures Part 1-4: General Actions – Wind Actions
BS EN 1993-1-1	Design of Steel Structures
BS EN 1999	Design of aluminium structures * ***(To be confirmed by the manufacturer if the enclosure is manufactured from aluminium)***
BS EN 12899 Part 1:	Fixed, Vertical Road Traffic Signs. Fixed Signs
BS EN 12966:	Road Vertical Signs. Variable Message Traffic Signs.
BS EN 62305 Pts 1-4:	Protection against lightning

2. DfT Publications (TSO publications)

To be completed by the manufacturer.

3. Miscellaneous (TSO publications)

Traffic Management Act 2004

Health and Safety at Works etc Act 1974

Structural Design Statement: xxxxx **Enclosure**
Manufacturer: xxxxx
Reference: xxxxx

Note: xxxxx **=** to be completed by manufacturer

4. Standards and Advice Notes (TSO publications)

List all relevant Standards and Advice Notes contained in the Design Manual for Road and Bridges (DMRB) and the Manual of Contract Documents for Highway Works (MCHW) for UK Trunk Roads including Motorways, current at the time of the particular Structural Design Statement.

Document Reference	Title	Date of Issue	Decimal Reference
BA 57/01	Design for Durability	Aug 2001	1.3.8
BD 02/12	Technical Approval of Highway Structures	May 2012	1.1.1
BD 37/01	Loads for Highway Bridges	Aug 2001	1.3.14
BD 45/93	Identification Marking of Highway Structures	Aug 1993	3.1.1
BD 51/14	Portal and Cantilever Signs/Signal Gantries	May 2014	2.2.4
BD 57/01	Design for Durability	Aug 2001	1.3.7
BD 62/07	As Built, Operational and Maintenance Records for Highway Structures Amendment to Appendix D	Feb 2007	3.2.1
BD 63/07	Inspection of Highway Structures	Feb 2007	3.1.4
BD 94/07	Design of Minor Structures	Feb 2007	2.2.1
BE 7/04	Departmental Standard (Interim) Motorway Sign/Signal Gantries	Aug 2004	2.2
TD 33/05	The Use of Variable Message Signs on All Purpose and Motorway Trunk Roads	Nov 2005	8.2
IAN 69/05	Designing for Maintenance	Dec 2005	
IAN 124/11	Eurocodes: Implementation of Eurocodes for the design of new and existing highway structures	July 2011	

Structural Design Statement: xxxxx Enclosure
Manufacturer: xxxxx
Reference: xxxxx

Note: xxxxx = to be completed by manufacturer

Annex B Maximum Loads To Be Applied From Signal Enclosures

xxxxx ENCLOSURE

Force (kN)	Loadcase 1 (Self Weight Only)		Loadcase 2 (SWT + Wind(ii))		Loadcase 3 (SWT + Wind(iv) + Snow)	
	SLS	ULS	SLS	ULS	SLS	ULS
Px	*	*	*	*	*	*
Py	*	*	*	*	*	*
Pz	*	*	*	*	*	*

NOTES

1. The Loads are based on the following assumptions

a	Enclosure maximum breadth.	*
b	Enclosure maximum height.	*
c	Enclosure maximum weight (to be confirmed by weighing).	*
d	Enclosure minimum weight (to be advised by manufacturer).	
e	Wind gust speed.	49m/s
f	Forward tilt of Enclosure (∞)	0
g	ULS load factor on self weight (to be established by weighing).	1.2
h	γ_{f3} has not been applied.	
i	Point of load application is at the volumetric centre of Enclosure.	
j	Load supports are symmetrically and evenly disposed about the Enclosure centre.	
k	Forces calculated in accordance with BD 51/14 and to be used in the design of the supporting structure and any bracketry. The design of the Enclosure and fixing lugs shall be in accordance with BS EN 12966 for wind class WL8 (BS EN 12899) and BE EN 1991-4.	

2. The table above is to be read in conjunction with Enclosure Mounting diagram.
3. Wind combinations referred to are in accordance with clause 5.20 of BD 51/14.
4. Wind buffeting effects in accordance with clauses 5.36 to 5.38 of BD51/14 shall be evaluated for the maximum enclosure area indicated in note 1

Note: xxxxx **=** to be completed by manufacturer

Annex C General Arrangement Drawing(s)

Manufacturer to attach in a plastic folder bound into the document.

Structural Design Statement: xxxxx Enclosure
Manufacturer: xxxxx
Reference: xxxxx

Note: xxxxx = to be completed by manufacturer

Annex D Sample Design/Check Certificate

1. We certify that reasonable professional skill and care has been used in the preparation of the design and/or check[1] of **Name of Structure** with a view to securing that: *(see note 2)*

   i) It has been designed and/or checked[1] in accordance with

      The following Standards;

      or

      The Structural Design Statement dated (***date***) including the following: (see note 3)

         List any Departures and additional methods or criteria

         For the certification of M&E functions for Highway Structures, include here the reference number and date of the relevant Safety Consultation.

   ii) It has been checked for compliance with the relevant standards in i)

   iii) It has been accurately translated into construction drawings (all of which have been checked). The unique numbers of these drawings and schedules are:

2. The Departures from Standards and additional criteria given in paragraph 1 are agreed.

Structural Design Statement: xxxxx Enclosure
Manufacturer: xxxxx
Reference: xxxxx

Note: xxxxx = to be completed by manufacturer

Signed:	**Function:** Design/Checking[1] Team Leader
Name: For:	**Date:**
Engineering Qualifications[4]	
Signed:	**Title:** Contractors Representative[5]
Name: For:	**Date:**
Professional Qualifications	
Signed:	**Title:** (Approving Agent Team Leader)
Name: For:	**Date:**
Engineering Qualifications[4]	

Notes

1. Delete if not required.
2. Where several Category 0 or 1 structures occur in a project, they may be listed on one certificate.
3. Insert date of the Structural Design Statement including the dates of any addenda. Note the Structural Design Statement is valid for three years after the date of signature. If the construction has not yet commenced within this period, the Structural Design Statement should be re-submitted.
4. CEng, MICE, MIStructE or equivalent.
5. A Principal of the organisation responsible for the design or checking.

Structural Design Statement: xxxxx Enclosure
Manufacturer: xxxxx
Reference: xxxxx

Note: xxxxx = to be completed by manufacturer

Annex E Sample Construction Compliance Certificate

1. We certify that **(insert name of structure)**

   i) Has been constructed in accordance with
      a) Design Statement dated **(date)**
      b) The Design/Check certificates dated **(date)**
      c) The Certificates of Conformity for the Signal Enclosure **(dates)**

2. The construction of the Works has been accurately translated into AS Constructed drawings. The unique numbers of these drawings and schedules are:

Signed:	**Title:** Contractors Representative[5]
Name: For:	**Date:**
Engineering Qualifications	
Signed:	**Title:** (Approving Agent Team Leader)
Name: For:	**Date:**
Engineering Qualifications[4]	

Notes
1. Delete if not required.
2. Where several Category 0 or 1 structures occur in a project, they may be listed on one certificate.
3. Insert date of the Structural Design Statement including the dates of any addenda. Note the Structural Design Statement is valid for three years after the date of signature. If the construction has not yet commenced within this period, the Structural Design Statement should be re-submitted.
4. CEng, MICE, MIStructE or equivalent.
5. A Principal of the organisation responsible for the design or checking.

Structural Design Statement: xxxxx Enclosure
Manufacturer: xxxxx
Reference: xxxxx

Note: xxxxx = to be completed by manufacturer

Annex F Material Specifications

Manufacturer to identify all materials used in the manufacture of the Motorway Signal/ Message Sign and their specifications.

APPENDIX D REQUIREMENTS FOR AMI

General

D1 AMI Signals used to present traffic control centre-governed displays to the road will:

- Be installed directly on to new gantry infrastructure, which will be provided by others and, at some locations, may include provisions for manned access to the rear of the AMIs
- Replace legacy (Version 2 and earlier) AMIs installed on existing infrastructure which generally will not include provisions for manned access
- For installations where rear manned access is provided, the AMI shall be capable of being fully maintained and repaired safely whilst remaining installed on its mounting structure, without the need for lane closures
- For installations where rear manned access is not provided:
    - The AMI shall be capable of being safely removed from the structure and replaced with a working unit within a period of 30 minutes, for subsequent repair off-site, OR
    - Be capable of being safely maintained and repaired safely from a MEWP within a period of 30 minutes.

D2 This appendix sets out the requirements for functionally compliant and infrastructure-compatible AMIs.

Function

D3 AMIs are required to display Aspects (together with/without a steady-illuminated Red Ring and/or flashing Lanterns) as required by TR2608.

Optical Design

D4 The AMI Aspect Display Area shall have a display resolution to comply with the Aspect formats prescribed TR2608. The arrangements shown assume a 32x32 matrix with a nominal 20mm display cell pitch but compliant alternatives will not be precluded.

D5 The Aspect Display Area and 'Red Ring' shall meet the performance classes of BS EN 12966 as stated in section 2 for colours:

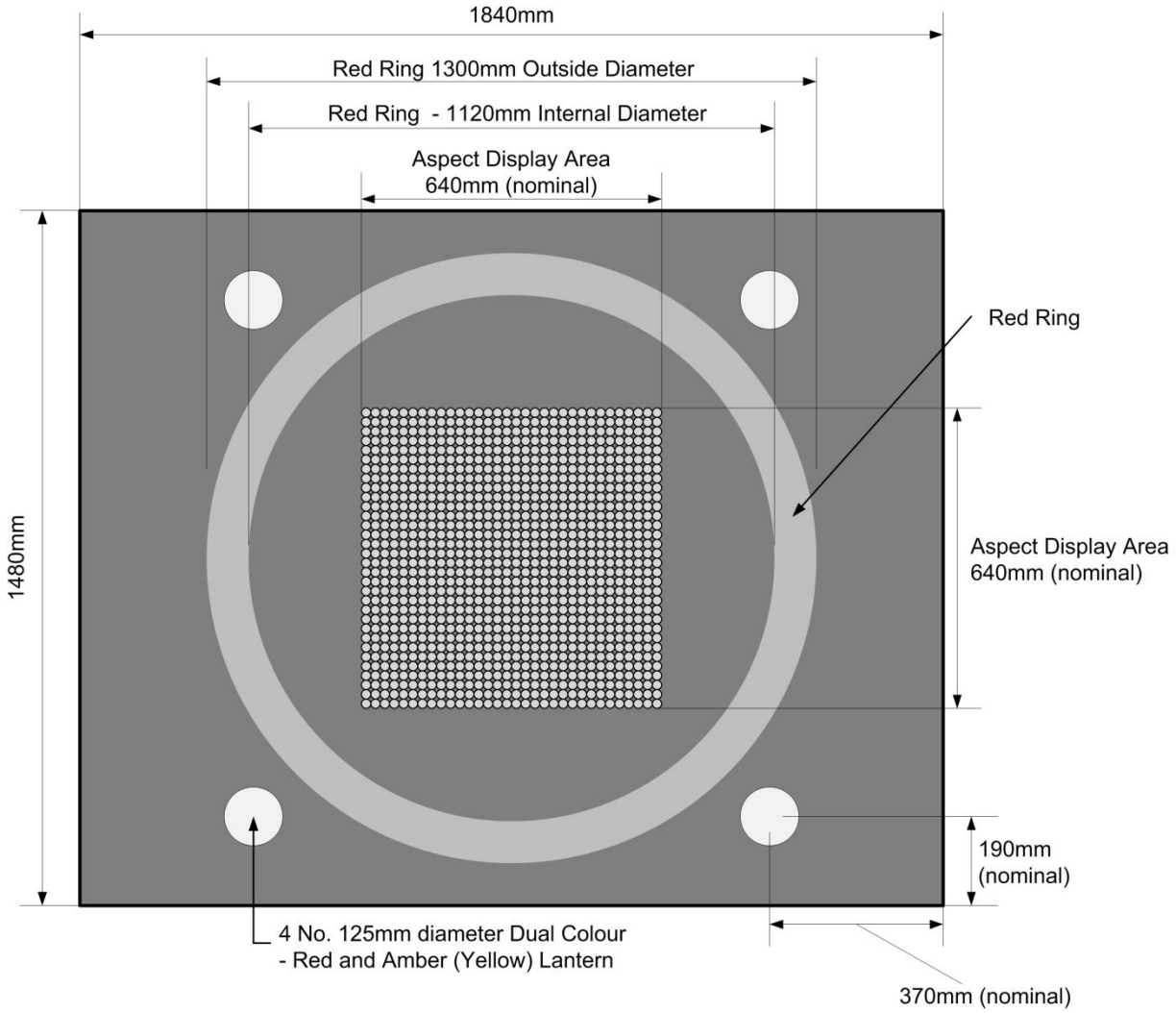
- White
- Red.

D6 The optical performance requirements for the dual colour Red/Amber (Yellow) Lanterns are described in Section 2.

General Appearance and Dimensions

D7 For the purposes of replacing legacy equipment on existing fully equipped gantries the AMI shall constrained by the maximum dimensions in Figure D7 below.

Figure D7: General Appearance and Dimensions



Infrastructure Electrical Interface

D8 Power will be supplied to the AMI location via a connector Type 1 (see section 2.8).

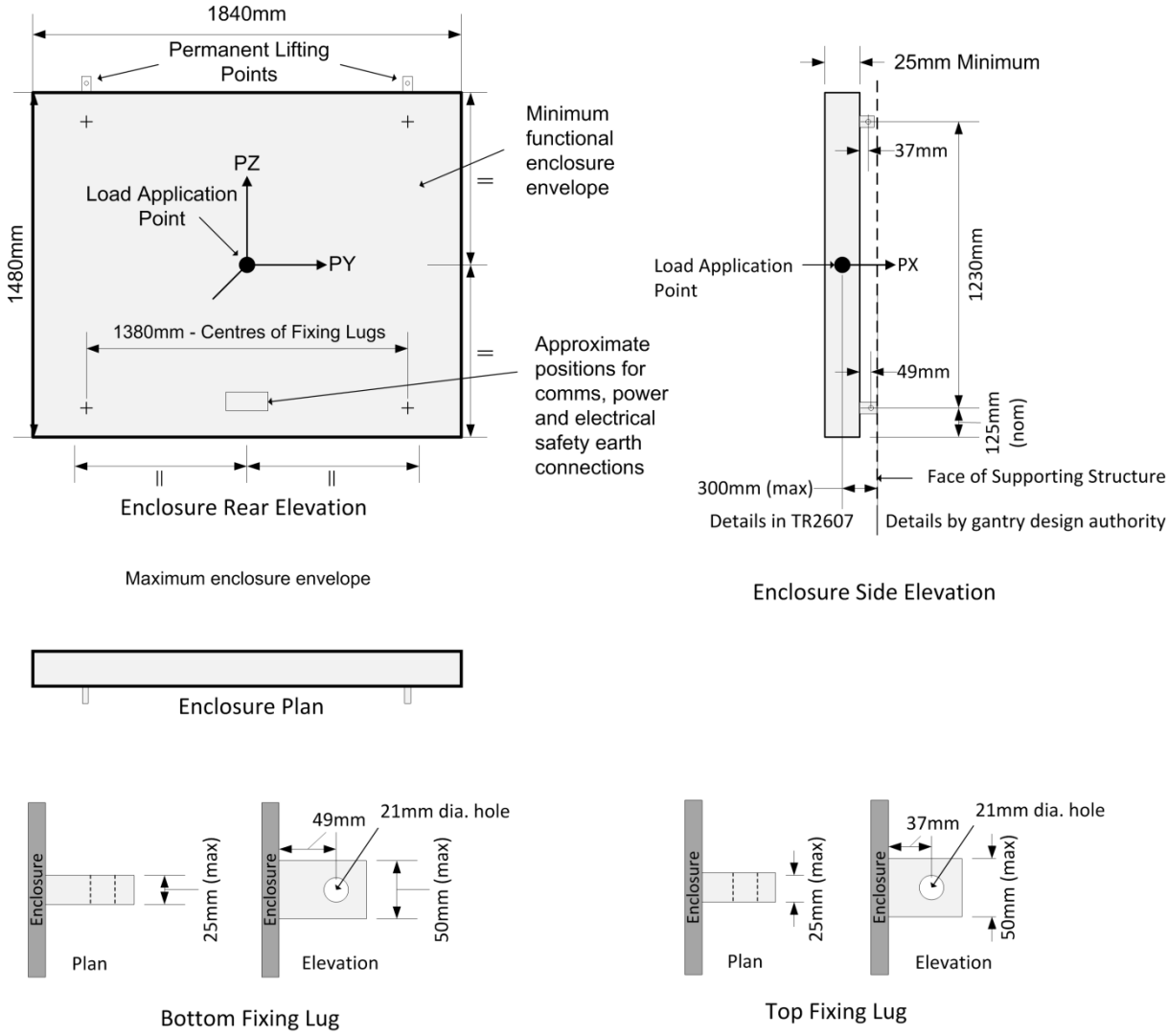
D9 The AMI maximum power consumption shall not exceed 350VA when displaying 60R aspect at maximum brightness with any temperature control devices fully operating.

> **Note:** Whole-life energy consumption shall be competitively compared in supply tenders where reduced consumption may offer an advantage.

Enclosure Rear and Standard Structural Interface

D10 To ensure compatibility with current mounting structures the AMI shall comply functionally with the dimensional constraints of Figure D10 below, which shows the standard 4-point mounting system based on defined 'fixing lugs' at defined positions. Current structural interface designs accommodate this arrangement, so any alternative designs shall be functionally equivalent.

Figure D10: Enclosure Rear and Standard Structural Interface



Notes:

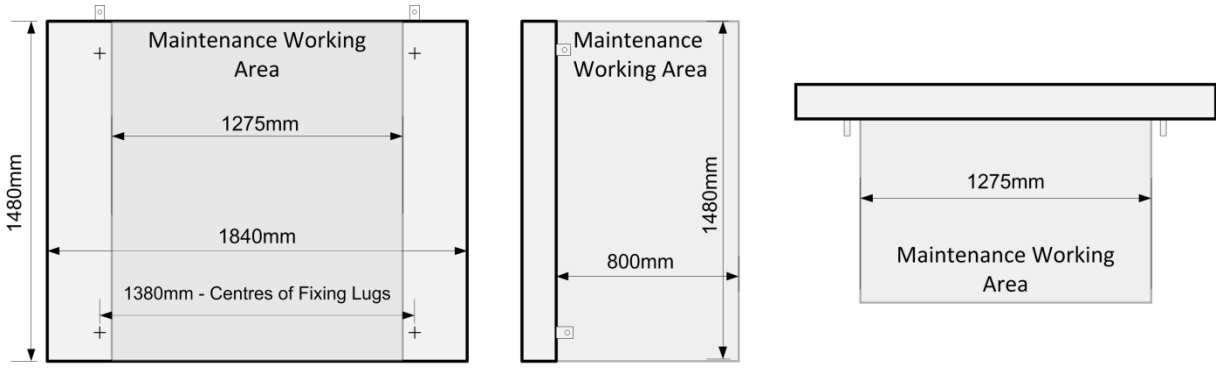
1. When vertical, Centre of Gravity of Enclosure shall not be more than 300mm from the face to the supporting structure i.e. dimension “e”<300mm.
2. The precise positions of the permanent lifting points are not specified but shall be detailed by the manufacturer to assist gantry designers.
3. The maximum dimensional tolerance between any two individual (NOT NECESSARILY ADJACENT) mounting points (Fixing Lugs) shall be 0.1%, subject to a absolute tolerance of 1mm (i.e. 1mm maximum per 1000mm dimension, but subject to a maximum of 1mm).

4. The arrangement shall provide protection against bimetallic corrosion at the contact points with the gantry structure.

Maintenance Working Area

D11 Where manned access is provided for, the infrastructure design will provide the AMI with a maintenance working area of 1275mm Wide x 800mm Deep x 1480mm High as shown in Figure D11 below. The AMI design should optimise internal maintenance access within this working are defined.

Figure D11: Maintenance Working Area



Enclosure Rear Elevation | Enclosure Side Elevation | Enclosure Plan

Legacy Structural Interface

D12 An alternative mounting arrangement, which need not provide rear maintenance access into the AMI enclosure, shall be available for use on legacy gantry structures, where legacy version of AMIs are to be replaced.

D13 Details of the legacy AMI mounting arrangement are described in the MCX1031 suite of drawings.

D14 The failure of any single mounting point on the AMI or any Adapter/Interface Frame provided between the AMI and the gantry interface shall not result in any part becoming detached from the gantry structure.

Maximum Loads to be Applied to Supporting Structure

D15 To ensure compatibility with mounting structures the maximum load applied by the AMI on to its mounting structure (including any additional interface required for legacy structures) shall not exceed the values stated in Table D15 below.

Table D15: Load Table

Force (kN)	Loadcase 1 (Self Weight Only)		Loadcase 2 (SWT + Wind(ii))		Loadcase 3 (SWT + Wind(iv) + Snow)	
	SLS	ULS	SLS	ULS	SLS	ULS
Px			42.43	74.76	42.43	74.76
Py			21.22	37.38	21.22	37.38
Pz	-1.23	-1.48	1.23	2.34	0.69	1.55

Notes:

1. The Loads above are based on the following assumptions:

a	Enclosure breadth.	1.840m
b	Enclosure height.	1.480m
c	Enclosure maximum weight (to be confirmed by weighing).	125kg
d	Enclosure minimum weight (to be advised by manufacturer).	
e	Wind gust speed.	49m/s
f	Forward tilt of Enclosure (∞)	0
g	ULS load factor on self weight (to be established by weighing).	1.2
h	γ_{f3} has not been applied.	
i	Point of load application is at the volumetric centre of Enclosure.	
j	Load supports are symmetrically and evenly disposed about the Enclosure centre.	
k	Forces calculated in accordance with BD 51/14 and to be used in the design of the supporting structure and any bracketry. The design of the Enclosure and fixing lugs shall be in accordance with BS EN 12966 for wind class WL8 (BS EN 12899) and BE EN 1991-4.	

2. The table above is to be read in conjunction with Enclosure Mounting diagram.
3. Wind combinations referred to are in accordance with clause 5.20 of BD 51/14.
4. Wind buffeting effects in accordance with clauses 5.36 to 5.38 of BD51/14 shall be evaluated for the maximum enclosure area indicated in note 1 above.

APPENDIX E REQUIREMENTS FOR MS 2X12

General

E1 The MS 2x12 retains the name of legacy display equipment of its size based on an array of 2x12 characters. The MS 2x12 is used to present traffic control centre-governed messages to the road user and shall:

- Be installed directly on to new gantry infrastructure, which will be provided by others and, at some locations, may include provisions for manned access to the rear of the MS 2x12s
- Replace legacy (Version 2 and earlier) MS 2x12s installed on existing infrastructure which may or may not include provisions for manned access to the rear of the MS 2x12s
- For installations where rear manned access is provided, the MS 2x12s shall be capable of being fully maintained and repaired safely whilst remaining installed on its mounting structure, without the need for lane closures
- For installations where rear manned access is not provided:
    - The MS 2x12s shall be capable of being safely removed from the structure and replaced with a working unit within a period of 30 minutes, for subsequent repair off-site, OR
    - Be capable of being safely maintained and repaired safely from a MEWP within a period of 30 minutes:

E2 This appendix sets out the requirements for functionally compliant and infrastructure-compatible MS 2x12s.

Function

E3 While the current usage is limited to the display of Text Messages, MS 2x12s are required to display the following to provide future operational flexibility:

- Text Messages in a proportional font described in TR2608
- Aspects (advisory or mandatory), as described in TR2608
- Pictograms (e.g. roadworks symbol) or other Symbols, with or without supporting Text Messages, as described in TR2608
- Other Legends, with or without additional text content or supporting Text Messages, as described in TR2608
- OR a combination of the above (together with/ without flashing Lanterns) as described in TR2608.

Optical Design

E4 The BS EN 12966 array is based on a 192x48 cell continuous matrix with a display cell pitch of 20mm, but compliant alternatives will not be precluded.

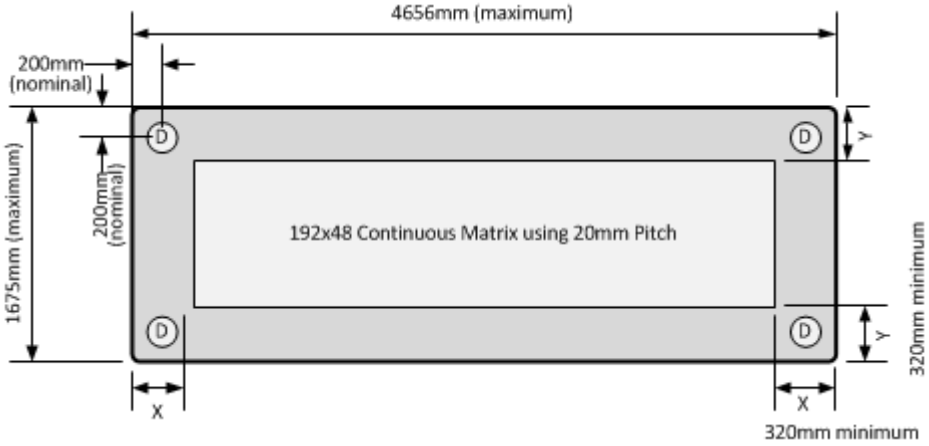
E5 The Display Area shall meet the performance classes of BS EN 12966 as stated in section 2, for all defined colours.

E6 The optical performance requirements for the dual colour Red/Amber (Yellow) Lanterns are described in Section 2.

General Appearance and Dimensions

E7 For the purposes of replacing legacy equipment on existing fully equipped gantries the MS 2x12 shall be constrained by the maximum dimensions in Figure E7 below.

Figure E7: General Appearance and Dimensions



Notes

1. Overall dimensions may be reduced provided that compliance with BS EN 12966 is maintained.
2. Dimensions 'X' are an equal distance from the edge of the enclosure.
3. Dimensions 'Y' are an equal distance from the edge of the enclosure.
4. D = Dual Colour Lanterns 200 mm diameter (+/- 50mm).

Infrastructure Electrical Interface

E8 Power will be supplied to the MS 2x12 location via a connector Type 1 (see section 2.8).

E9 In order to operate within the infrastructure power cable design allowances, the MS 2x12 maximum power consumption shall not exceed 750VA under the following conditions:

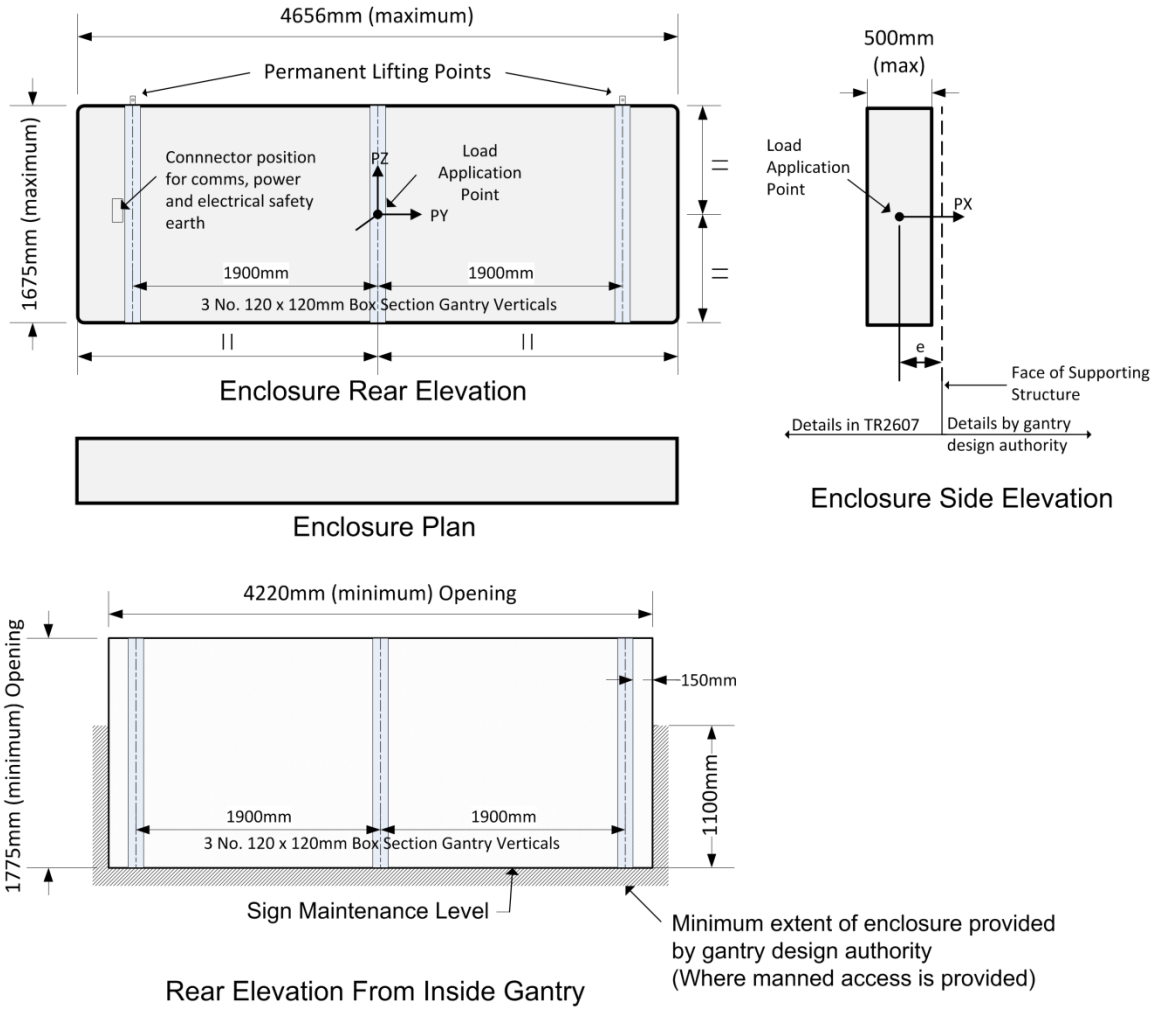
- When displaying Test Bitmap No. 13 (9CH - all display cells ON - White) at maximum brightness with all Lanterns ON and with any temperature control devices fully operating.

Note: Whole-life energy consumption shall be competitively compared in supply tenders where reduced consumption may offer an advantage.

Enclosure Rear and Standard Structural Interface

E10 To ensure compatibility with existing mounting structures which provide fixed vertical structural members for MS 2x12 mounting, the MS 2x12 shall comply with the dimensional constraints and mounting arrangements described in Figure E10 below. Alternative designs will not be precluded provided they are functionally equivalent.

Figure E10: Enclosure Rear and Standard Structural Interface



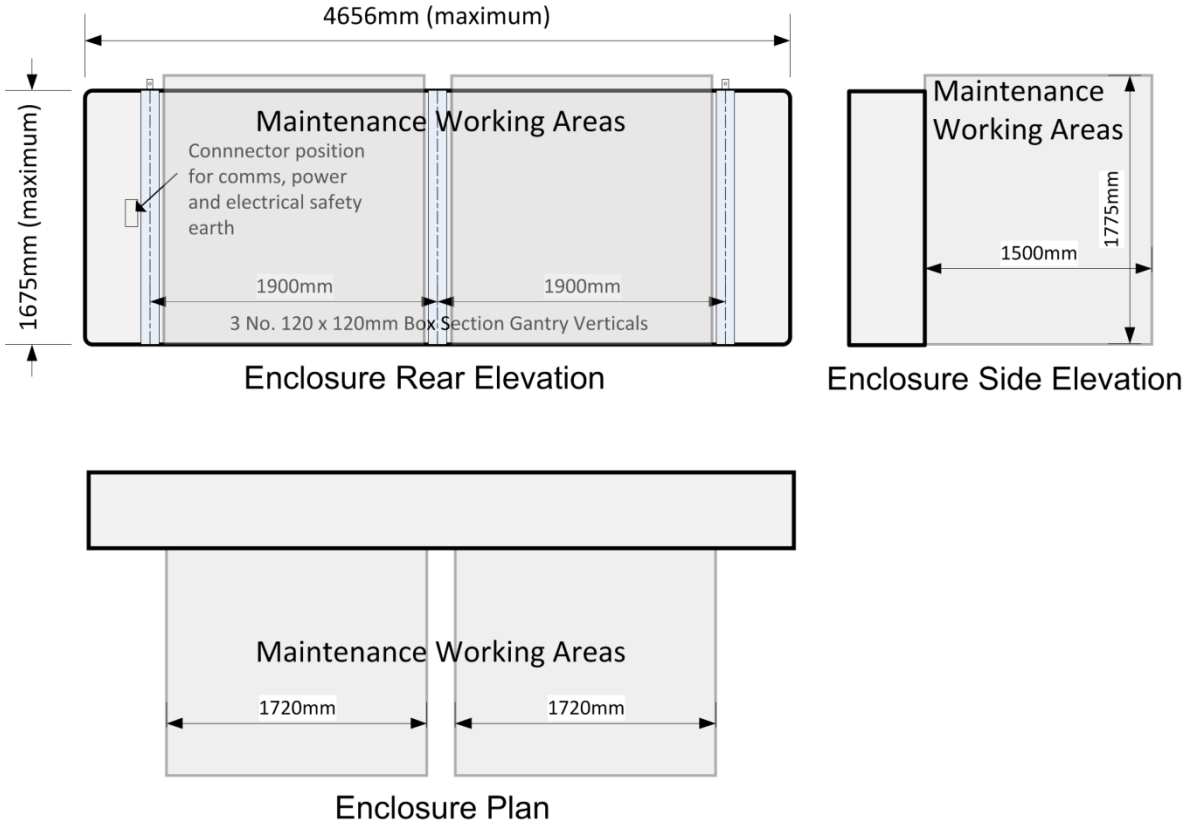
Notes:

1. The structural interface for the purposes of Equipment mounting is the front face of the 3 No. vertical gantry members provided as part of the gantry structure. The Equipment supplier is responsible for:
   - The provision of approved brackets to mount the Equipment
   - Where manned access is provided, the closure of any gaps between the Equipment and the gantry front face up to the enclosed zone provided as part of the gantry, as indicated above, as required by BD51.
2. When vertical, Centre of Gravity of Enclosure shall not be more than 300mm from the face to the supporting structure i.e. dimension “e”<300mm.
3. The precise positions of the permanent lifting points are not specified but shall be detailed by the manufacturer to assist gantry designers.
4. The arrangement shall provide protection against bimetallic corrosion at the contact points with the gantry structure.

Maintenance Working Area

E11 Where manned access is provided, the infrastructure design will provide the MS 2x12 with a maintenance working areas of 1720mm Wide x 1500mm Deep x 1775mm High as shown in Figure E11 below. The MS 2x12 design should optimise internal maintenance access within this working area defined.

Figure E11: Maintenance Working Areas



Note: Free access will also be provided to the connector positions.

Maximum Loads to be Applied to Supporting Structure

E12 To ensure compatibility with existing mounting structures, the maximum load applied by the MS 2x12 on to its mounting structure shall not exceed the values stated in Table E12 below.

Table E12: Load Table

Force (kN)	Loadcase 1 (Self Weight Only)		Loadcase 2 (SWT + Wind(ii))		Loadcase 3 (SWT + Wind(iv) + Snow)	
	SLS	ULS	SLS	ULS	SLS	ULS
Px			105.02	162.77	105.02	162.77
Py			52.51	81.39	52.51	81.39
Pz	-2.45	-2.94	13.15	21.24	9.82	16.25

Notes:

1. The Loads are based on the following assumptions:

a	Enclosure maximum breadth.	4.656m
b	Enclosure maximum height.	1.675m
c	Enclosure maximum weight (to be confirmed by weighing).	250kg
d	Enclosure minimum weight (to be advised by manufacturer).	
e	Wind gust speed.	49m/s
f	Forward tilt of Enclosure (∞)	0
g	ULS load factor on self weight (to be established by weighing).	1.2
h	γ_{f3} has not been applied.	
i	Point of load application is at the volumetric centre of Enclosure.	
j	Load supports are symmetrically and evenly disposed about the Enclosure centre.	
k	Forces calculated in accordance with BD 51/14 and to be used in the design of the supporting structure and any bracketry. The design of the Enclosure and fixing lugs shall be in accordance with BS EN 12966 for wind class WL8 (BS EN 12899) and BE EN 1991-4.	

2. The table above is to be read in conjunction with Enclosure Mounting diagram.
3. Wind combinations referred to are in accordance with clause 5.20 of BD 51/14.
4. Wind buffeting effects in accordance with clauses 5.36 to 5.38 of BD51/14 shall be evaluated for the maximum enclosure area indicated in note 1 above.

APPENDIX F REQUIREMENTS FOR MS3 2X16

General

F1 The MS3 2x16 retains the name of legacy display equipment of its size based on an array of 2x16 characters. The MS3 2x16 is used to present traffic control centre-governed messages to the road user and shall:

- Be installed directly on to new gantry infrastructure, which will be provided by others and, at some locations, may include provisions for manned access to the rear of the MS3 2x16s
- Replace legacy (Version 2 and earlier) MS3 2x16s installed on existing infrastructure which may or may not include provisions for manned access to the rear of the MS3 2x16s
- For installations where rear manned access is provided, the MS3 2x16s shall be capable of being fully maintained and repaired safely whilst remaining installed on its mounting structure, without the need for lane closures
- For installations where rear manned access is not provided the MS3 2x16s shall be capable of being safely maintained and repaired safely from a MEWP within a period of 30 minutes:

F2 This appendix sets out the requirements for functionally compliant and infrastructure-compatible MS3 2x16s.

Function

F3 While the current usage is limited to the display of Text Messages and Aspects, MS3 2x16s are required to display the following to provide future operational flexibility:

- Text Messages in a proportional font described in TR2608
- Aspects (advisory or mandatory), as described in TR2608
- Pictograms (e.g. roadworks symbol) or other Symbols, with or without supporting Text Messages, as described in TR2608
- Other Legends, with or without additional text content or supporting Text Messages, as described in TR2608
- OR a combination of the above (together with/ without flashing Lanterns) as described in TR2608.

Optical Design

F4 The BS EN 12966 array is based on a 352x64 cell continuous matrix with a display cell pitch of 20mm, but compliant alternatives will not be precluded.

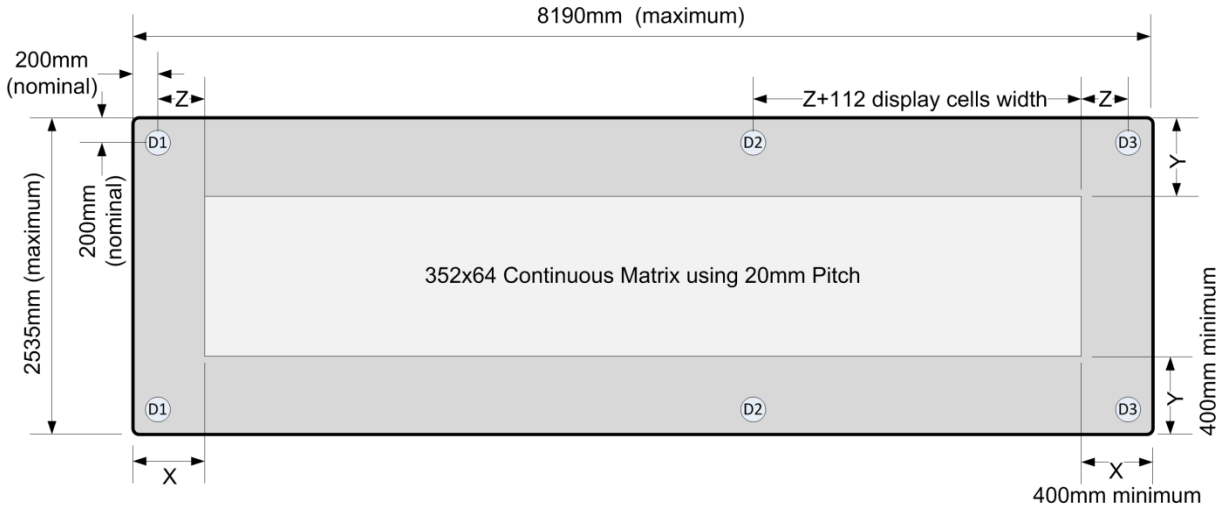
F5 The Display Area shall meet the performance classes of BS EN 12966 as stated in section 2, for all defined colours.

F6 The optical performance requirements for the dual colour Red/Amber (Yellow) Lanterns are described in Section 2.

General Appearance and Dimensions

F7 For the purposes of replacing legacy equipment on existing fully equipped gantries the MS3 2x16 shall be constrained by the maximum dimensions in Figure F7 below.

Figure F7: General Appearance and Dimensions



Notes:

1. Overall dimensions may be reduced provided that compliance with BS EN 12966 is maintained.
2. Dimensions 'X' are an equal distance from the edge of the enclosure. Dimensions 'Y' are an equal distance from the edge of the enclosure. Each is subject to a minimum distance of 400mm.
3. Dimensions 'Z' are an equal horizontal distance between the edge of the active Display Area and the centre line of the Lanterns.
4. D1/D2/D3 = Dual Colour Lanterns 200mm diameter (+/- 50mm).

Infrastructure Electrical Interface

F8 Power will be supplied to the MS3 2x16 location via a connector Type 2 (see section 2.8).

F9 In order to operate within the infrastructure power cable design allowances the maximum MS3 2x16 power consumption shall not exceed 1.5kVA under the following conditions

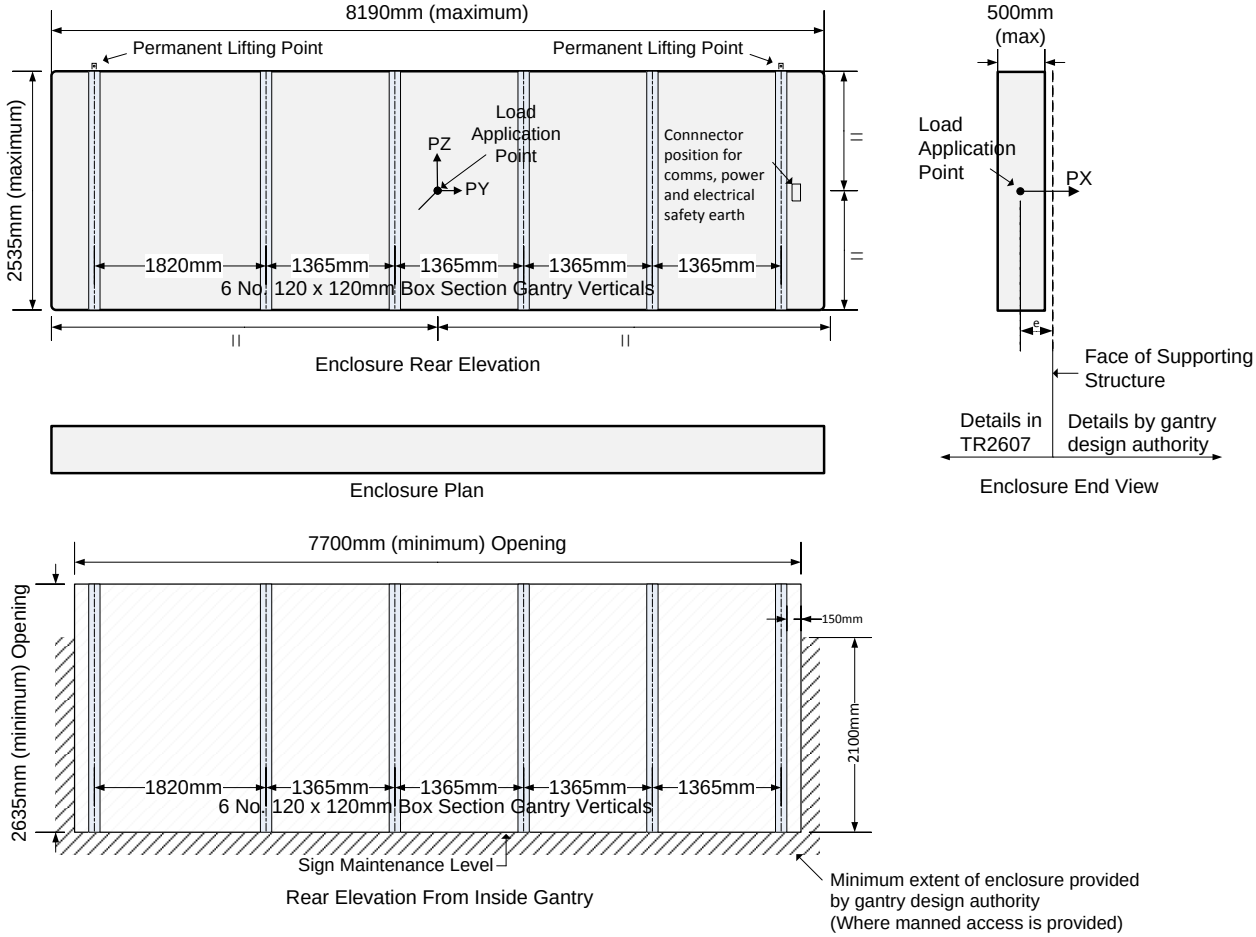
- When displaying Test Bitmap No. 13 (9CH - all display cells ON - White) at maximum brightness with all Lanterns ON and with any temperature control devices fully operating.

Note: Whole-life energy consumption shall be competitively compared in supply tenders where reduced consumption may offer an advantage.

Enclosure Rear and Standard Structural Interface

F10 To ensure compatibility with existing mounting structures which provide fixed vertical structural members for MS3 2x16 mounting, the MS3 2x16 shall comply with the dimensional constraints and mounting arrangements described in Figure F10 below. Alternative designs will not be precluded provided they are functionally equivalent.

Figure F10: Enclosure Rear and Standard Structural Interface



Notes:

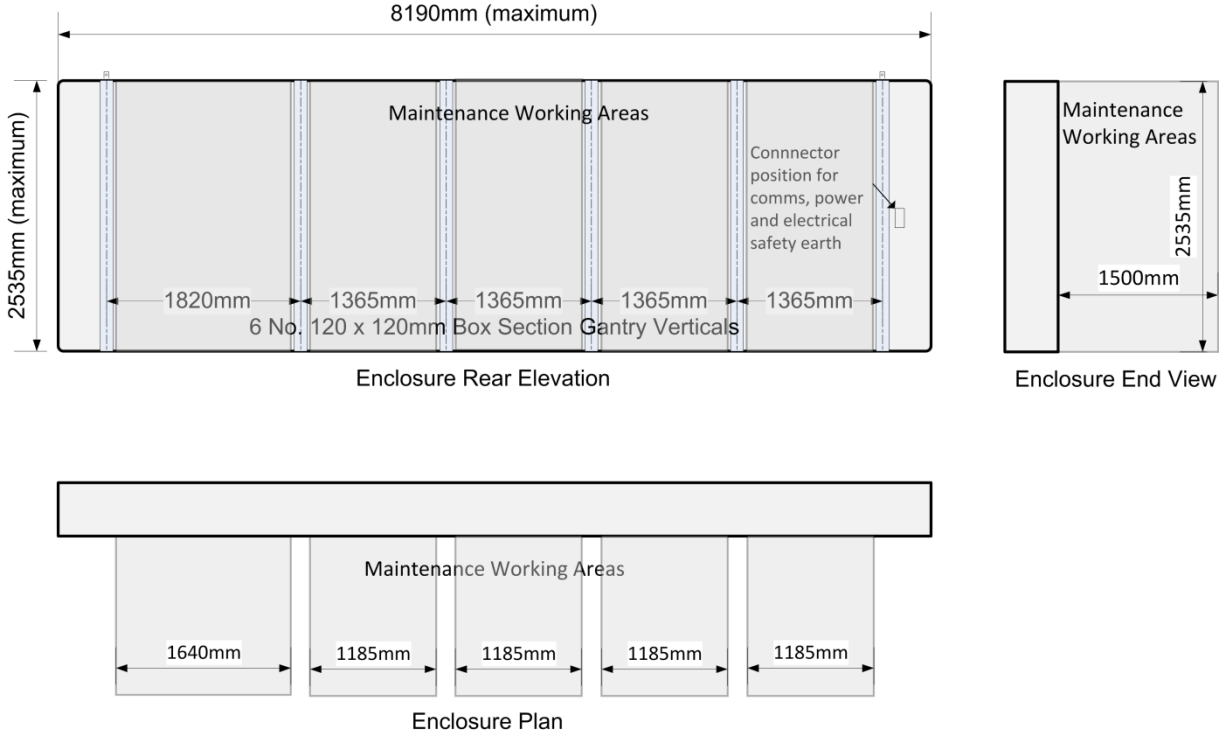
1. The structural interface for the purposes of Equipment mounting is the front face of the 6 No. vertical gantry members provided as part of the gantry structure. The Equipment supplier is responsible for:
   - The provision of approved brackets to mount the Equipment
   - Where manned access is provided, the closure of any gaps between the Equipment and the gantry front face up to the enclosed zone provided as part of the gantry, as indicated above, as required by BD51.
2. When vertical, Centre of Gravity of Enclosure shall not be more than 300mm from the face to the supporting structure i.e. dimension “e”<300mm.

3. The precise positions of the permanent lifting points are not specified but shall be detailed by the manufacturer to assist gantry designers.
4. The arrangement shall provide protection against bimetallic corrosion at the contact points with the gantry structure.

Maintenance Working Area

F11 Where manned access is provided for, the infrastructure design will provide the MS3 2x16 with a maintenance working areas of 1185/1640mm Wide x 1500mm Deep x Full Enclosure Height as shown in Figure F11 below. The MS3 2x16 design should optimise internal maintenance access within this working area defined.

Figure F11: Maintenance Working Areas



Note: Free access will also be provided to the connector positions.

Maximum Loads to be Applied to Supporting Structure

F12 To ensure compatibility with existing mounting structures the maximum load applied by the MS3 2x16 on to its mounting structure shall not exceed the values stated in Table F12 below.

Table F12: Load Table

Force (kN)	Loadcase 1 (Self Weight Only)		Loadcase 2 (SWT + Wind(ii))		Loadcase 3 (SWT + Wind(iv) + Snow)	
	SLS	ULS	SLS	ULS	SLS	ULS
Px			233	361.15	233	361.15
Py			116.5	180.6	116.5	180.6
Pz	-13.73	-16.48	13.67	25.99	7.87	17.29

Notes:

1. The Loads are based on the following assumptions:

a	Enclosure maximum breadth.	8.190m
b	Enclosure maximum height.	2.235m
c	Enclosure maximum weight (to be confirmed by weighing).	1400kg
d	Enclosure minimum weight (to be advised by manufacturer).	
e	Wind gust speed.	49m/s
f	Forward tilt of Enclosure (∞)	0
g	ULS load factor on self weight (to be established by weighing).	1.2
h	γf3 has not been applied.	
i	Point of load application is at the volumetric centre of Enclosure.	
j	Load supports are symmetrically and evenly disposed about the Enclosure centre.	
k	Forces calculated in accordance with BD 51/14 and to be used in the design of the supporting structure and any bracketry. The design of the Enclosure and fixing lugs shall be in accordance with BS EN 12966 for wind class WL8 (BS EN 12899) and BE EN 1991-4.	

2. The table above is to be read in conjunction with Enclosure Mounting diagram.
3. Wind combinations referred to are in accordance with clause 5.20 of BD 51/14.
4. Wind buffeting effects in accordance with clauses 5.36 to 5.38 of BD51/14 shall be evaluated for the maximum enclosure area indicated in note 1 above.

APPENDIX G REQUIREMENTS FOR MS3 3X18

General

G1 The MS3 3x18 retains the name of legacy display equipment of its size based on an array of 3x18 characters. The MS3 3x18 is used to present traffic control centre-governed messages to the road user and shall:

- Be installed directly on to new gantry infrastructure, which will be provided by others and, at some locations, may include provisions for manned access to the rear of the MS3 3x18s
- Replace legacy (Version 2 and earlier) MS3 3x18s installed on existing infrastructure which may or may not include provisions for manned access to the rear of the MS3 3x18s
- For installations where rear manned access is provided, the MS3 3x18s shall be capable of being fully maintained and repaired safely whilst remaining installed on its mounting structure, without the need for lane closures
    - For installations where rear manned access is not provided the MS3 3x18s shall be capable of being safely maintained and repaired safely from a MEWP within a period of 30 minutes:.

G2 This appendix sets out the requirements for functionally compliant and infrastructure-compatible MS3 3x18s.

Function

G3 While the current usage is limited to the display of Text Messages and Aspects, MS3 3x18s are required to display the following to provide future operational flexibility:

- Text Messages in a proportional font described in TR2608
- Aspects (advisory or mandatory), as described in TR2608
- Pictograms (e.g. roadworks symbol) or other Symbols, with or without supporting Text Messages, as described in TR2608
- Other Legends, with or without additional text content or supporting Text Messages, as described in TR2608
- OR a combination of the above (together with/ without flashing Lanterns) as described in TR2608.

Optical Design

G4 The BS EN 12966 array is based on a 400x96 cell continuous matrix with a display cell pitch of 20mm, but compliant alternatives will not be precluded.

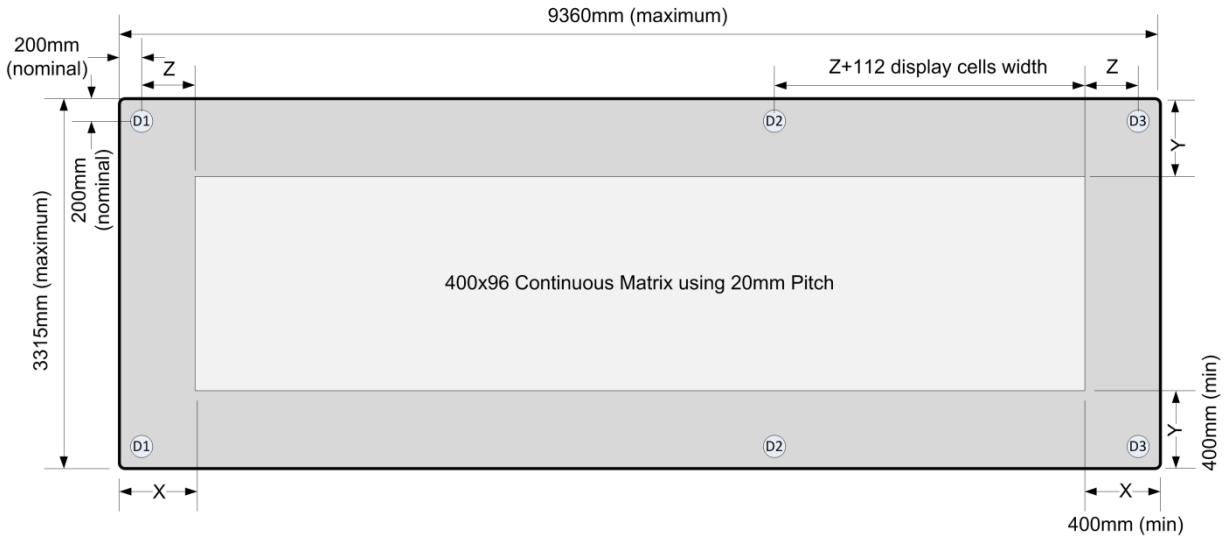
G5 The Display Area shall meet the performance classes of BS EN 12966 as stated in section 2, for all defined colours.

G6 The optical performance requirements for the dual colour Red/Amber (Yellow) Lanterns are described in Section 2.

General Appearance and Dimensions

G7 For the purposes of replacing legacy equipment on existing fully equipped gantries the MS3 3x18 shall be constrained by the maximum dimensions in Figure G7 below.

Figure G7: General Appearance and Dimensions



Notes:

1. Overall dimensions may be reduced provided that compliance with BS EN 12966 is maintained.
2. Dimensions 'X' are an equal distance from the edge of the enclosure. Dimensions 'Y' are an equal distance from the edge of the enclosure.
3. Dimensions 'Z' are an equal horizontal distance between the edge of the active Display Area and the centre line of the Lanterns.
4. D1/D2/D3 = Dual Colour Lanterns 200mm diameter (+/- 50mm).

Infrastructure Electrical Interface

G8 Power will be supplied to the MS3 3x18 location via a connector Type 2 (see section 2.8.

G9 In order to operate within the infrastructure power cable design allowances the maximum MS3 3x18 power consumption shall not exceed 2.0kVA under the following conditions

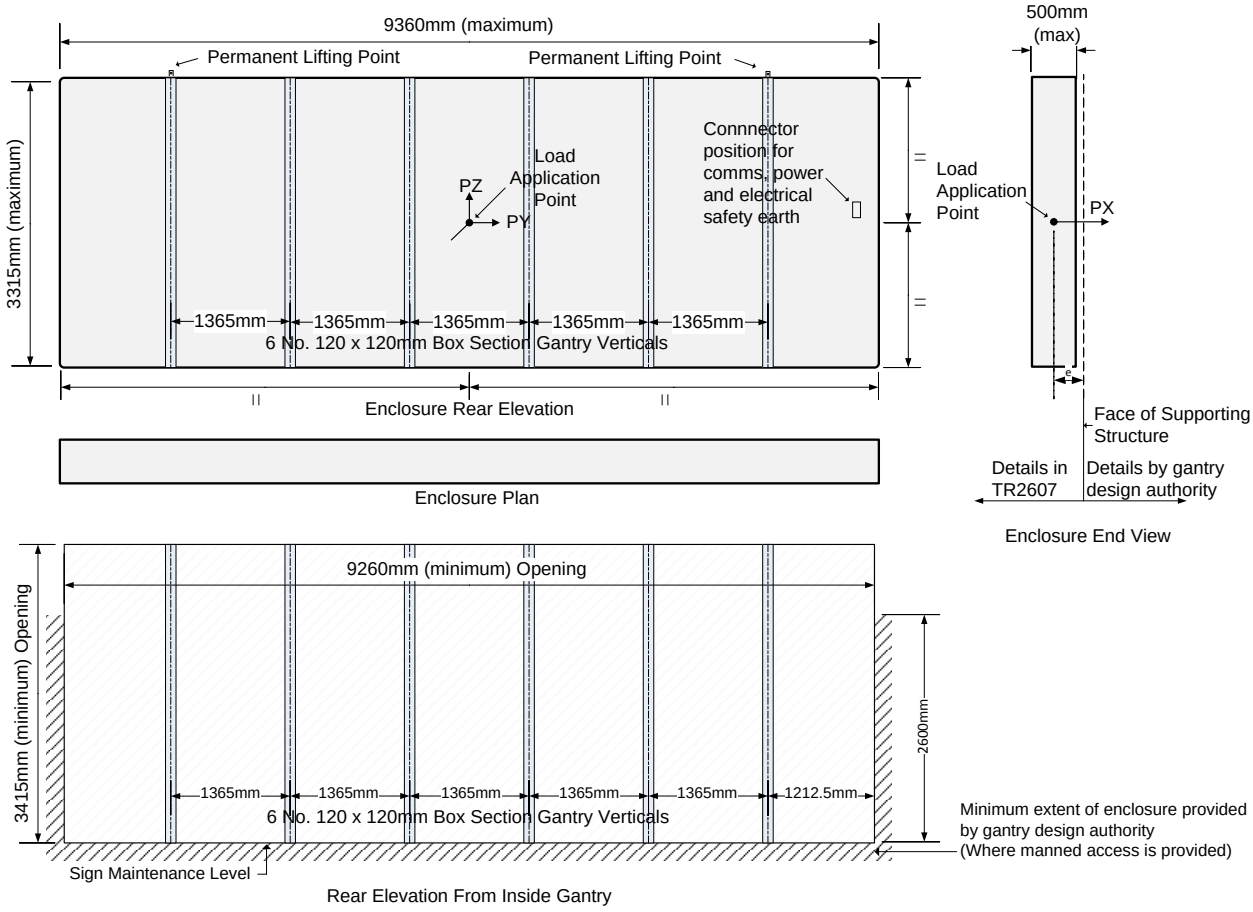
- When displaying Test Bitmap No. 13 (9CH - all display cells ON - White) at maximum brightness with all Lanterns ON and with any temperature control devices fully operating.

Note: Whole-life energy consumption shall be competitively compared in supply tenders where reduced consumption may offer an advantage.

Enclosure Rear and Standard Structural Interface

G10 To ensure compatibility with existing mounting structures which provide fixed vertical structural members for MS3 3x18 mounting, the MS3 3x18 shall comply with the dimensional constraints and mounting arrangements described in Figure G10 below. Alternative designs will not be precluded provided they are functionally equivalent

Figure G10: Enclosure Rear and Standard Structural Interface



Notes:

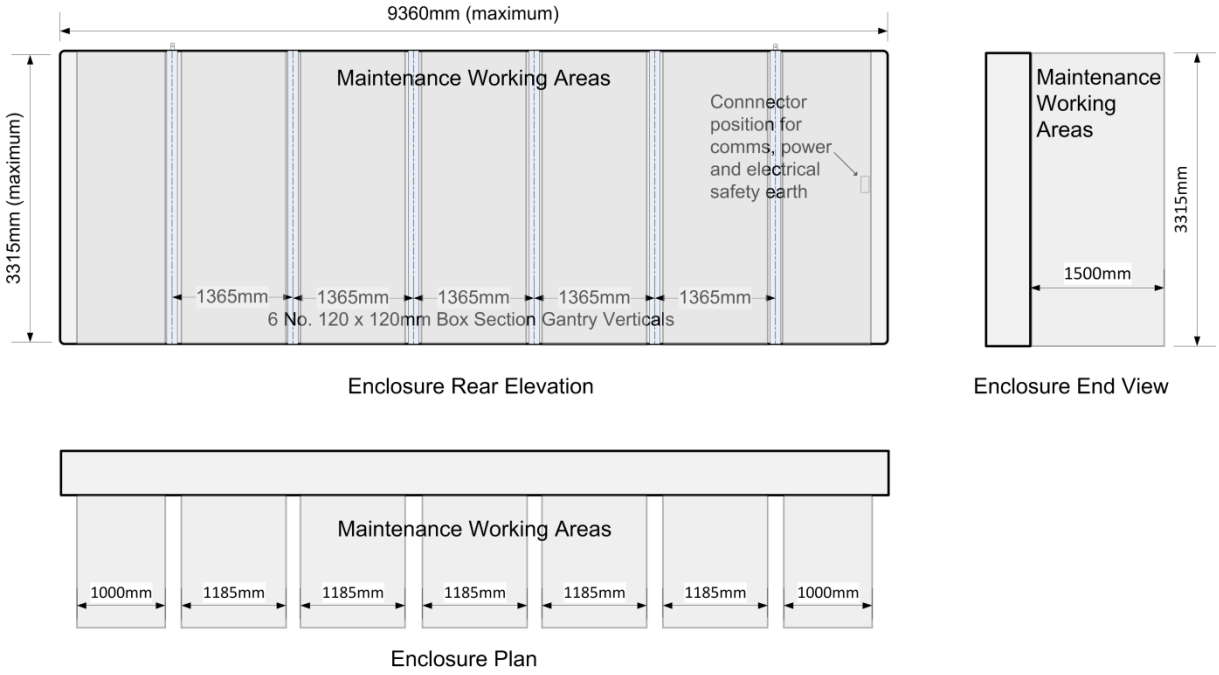
1. The structural interface for the purposes of Equipment mounting is the front face of the 6 No. vertical gantry members provided as part of the gantry structure. The Equipment supplier is responsible for:
   - The provision of approved brackets to mount the Equipment
   - Where manned access is provided, the closure of any gaps between the Equipment and the gantry front face up to the enclosed zone provided as part of the gantry, as indicated above, as required by BD51.
2. When vertical, Centre of Gravity of Enclosure shall not be more than 300mm from the face to the supporting structure i.e. dimension “e”<300mm.
3. The precise positions of the permanent lifting points are not specified but shall be detailed by the manufacturer to assist gantry designers.

4. The arrangement shall provide protection against bimetallic corrosion at the contact points with the gantry structure.

Maintenance Working Area

G11 Where manned access is provided for, the infrastructure design will provide the MS3 3x18 with a maintenance working areas of 1185mm Wide x 1500mm Deep x Full Enclosure Height, with a nominal width reduction to 1000mm in the end bays, as shown in Figure G11 below. The MS3 3x18 design should optimise internal maintenance access within this working are defined.

Figure G11: Maintenance Working Areas



Maximum Loads to be Applied to Supporting Structure

G12 To ensure compatibility with existing mounting structures the maximum load applied by the MS3 3x18 on to its mounting structure shall not exceed the values stated in Table G12 below.

Table G12: Load Table

Force (kN)	Loadcase 1 (Self Weight Only)		Loadcase 2 (SWT + Wind(ii))		Loadcase 3 (SWT + Wind(iv) + Snow)	
	SLS	ULS	SLS	ULS	SLS	ULS
Px			387	600	387	600
Py			193	300	193	300
Pz	-15.7	-18.84	16.3	31.16	9.6	21.16

Notes:

1. The Loads are based on the following assumptions:

a	Enclosure maximum breadth.	9.360m
b	Enclosure maximum height.	3.315m
c	Enclosure maximum weight (to be confirmed by weighing).	1600kg
d	Enclosure minimum weight (to be advised by manufacturer).	
e	Wind gust speed.	49m/s
f	Forward tilt of Enclosure (∞)	0
g	ULS load factor on self weight (to be established by weighing).	1.2
h	γf3 has not been applied.	
i	Point of load application is at the volumetric centre of Enclosure.	
j	Load supports are symmetrically and evenly disposed about the Enclosure centre.	
k	Forces calculated in accordance with BD 51/14 and to be used in the design of the supporting structure and any bracketry. The design of the Enclosure and fixing lugs shall be in accordance with BS EN 12966 for wind class WL8 (BS EN 12899) and BE EN 1991-4.	

2. The table above is to be read in conjunction with Enclosure Mounting diagram.
3. Wind combinations referred to are in accordance with clause 5.20 of BD 51/14.
4. Wind buffeting effects in accordance with clauses 5.36 to 5.38 of BD51/14 shall be evaluated for the maximum enclosure area indicated in note 1 above.

APPENDIX H REQUIREMENTS FOR MS4

General

H1 The MS4 is used to present traffic control centre-governed messages to the road user and shall:

- Be installed directly on to new infrastructure, which will be provided by others and built to new, maintenance-friendly designs:
  - In this situation, the MS4 shall be capable of being fully maintained and repaired safely whilst remaining installed on its mounting structure, without the need for lane closures.
- Replace legacy (Version 2 and earlier) MS4s installed on existing infrastructure which will not include provisions for manned access:
  - In this situation, the MS4 shall be capable of being safely maintained and repaired safely from an MEWP within a period of 30 minutes.

H2 This appendix sets out the requirements for functionally compliant and infrastructure-compatible MS4s.

Function

H3 MS4s are required to display:

- Text Messages in a proportional font described in TR2608
- Aspects (advisory or mandatory), as described in TR2608
- Pictograms (e.g. roadworks symbol), or other Symbols with or without supporting Text Messages, as described in TR2608
- Other Legends, with or without additional text content or supporting Text Messages, as described in TR2608
- OR combinations of the above, (together with/without 'integral' flashing Lanterns), as described in TR2608.

Optical Design

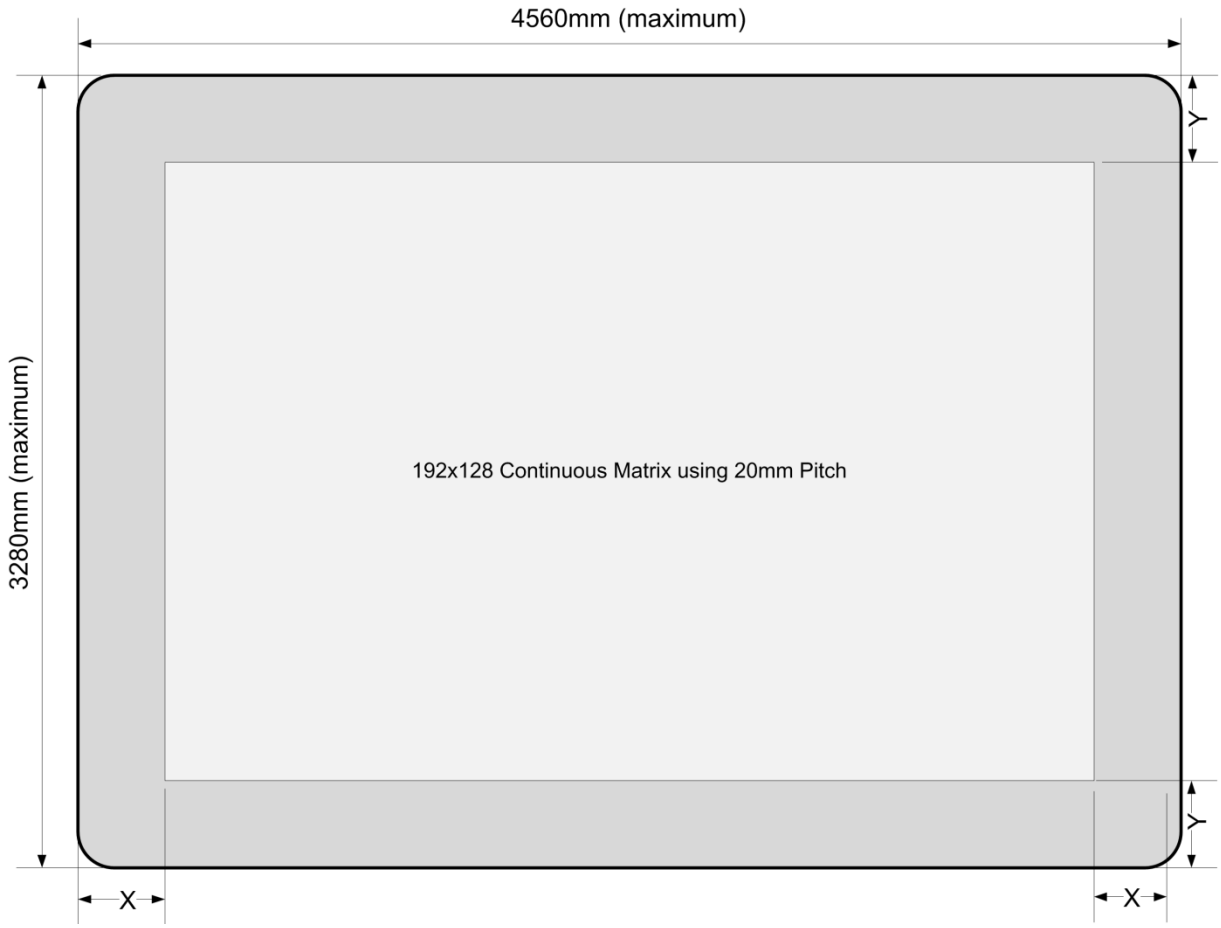
H4 The BS EN 12966 array is based on a 192x128 cell continuous matrix with a display cell pitch of 20mm, but compliant alternatives will not be precluded.

H5 The Display Area shall meet the performance classes of BS EN 12966 as stated in section 2 for all defined colours.

General Appearance and Dimensions

H6 For the purposes of replacing legacy equipment on existing fully equipped gantries the MS4 shall be constrained by the maximum dimensions in Figure I6 below.

Figure I6: General Appearance and Dimensions



Notes:

1. Dimensions 'X' are an equal distance from the edge of the enclosure.
2. Dimensions 'Y' are an equal distance from the edge of the enclosure.

Infrastructure Electrical Interface

H7 Power will be supplied to the MS4 location via a connector Type 2 (see section 2.8.

H8 In order to operate within the infrastructure power cable design allowances the maximum MS4 power consumption shall not exceed 2.5kVA under the following conditions:

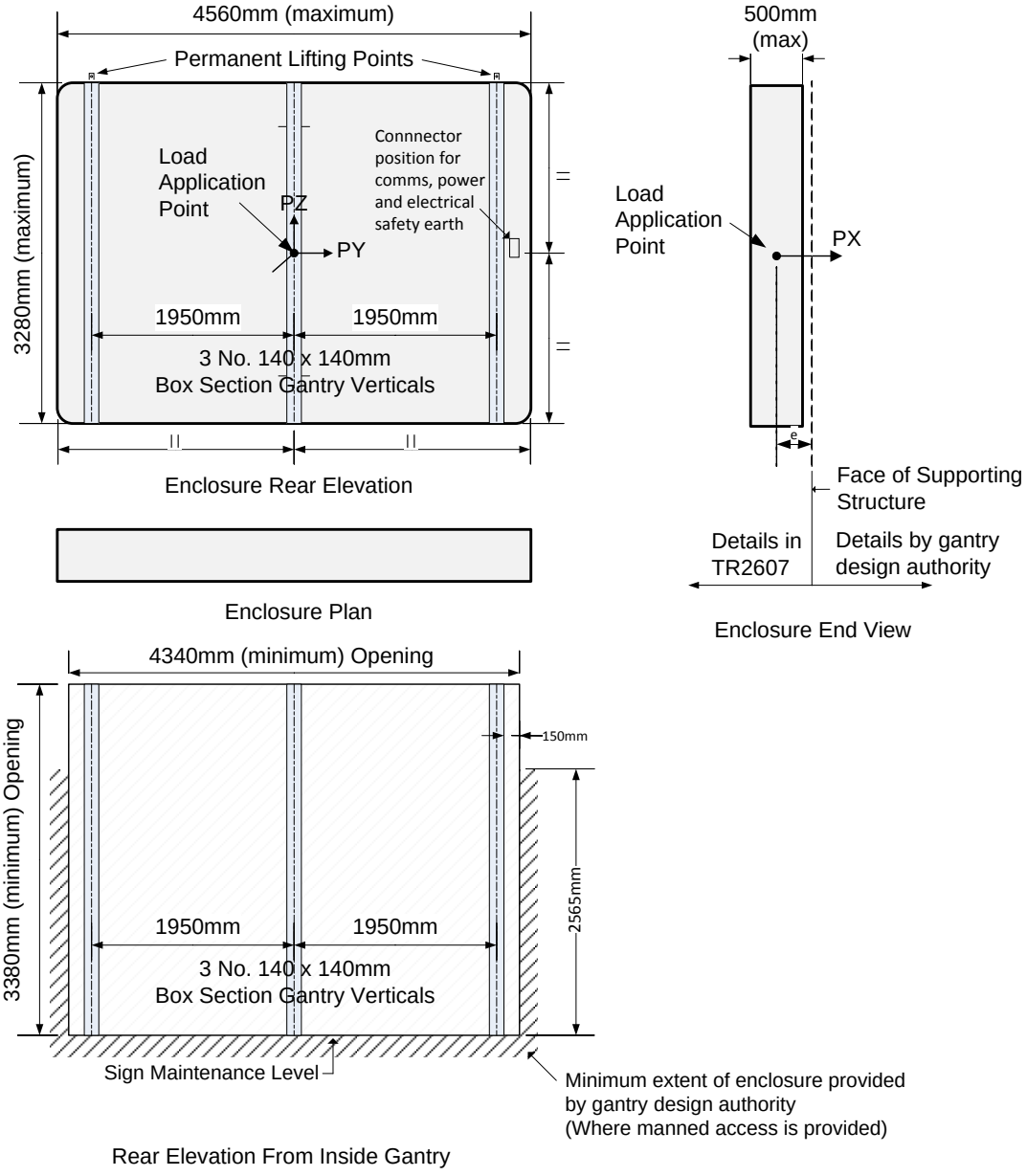
- When displaying Test Bitmap No. 13 (9CH - all display cells ON - White) across the full display area at maximum brightness with any temperature control devices fully operating.

Note: Whole-life energy consumption shall be competitively compared in supply tenders where reduced consumption may offer an advantage.

Enclosure Rear and Standard Structural Interface

H9 To ensure compatibility with existing mounting structures which provide fixed vertical structural members for MS4 mounting, the MS4 shall comply with the dimensional constraints and mounting arrangements described in Figure H9 below. Alternative designs will not be precluded provided they are functionally equivalent.

Figure H9: Enclosure Rear and Standard Structural Interface



Notes:

1. The structural interface for the purposes of Equipment mounting is the front face of the 3 No. vertical gantry members provided as part of the gantry structure. The Equipment supplier is responsible for:
   - The provision of approved brackets to mount the Equipment

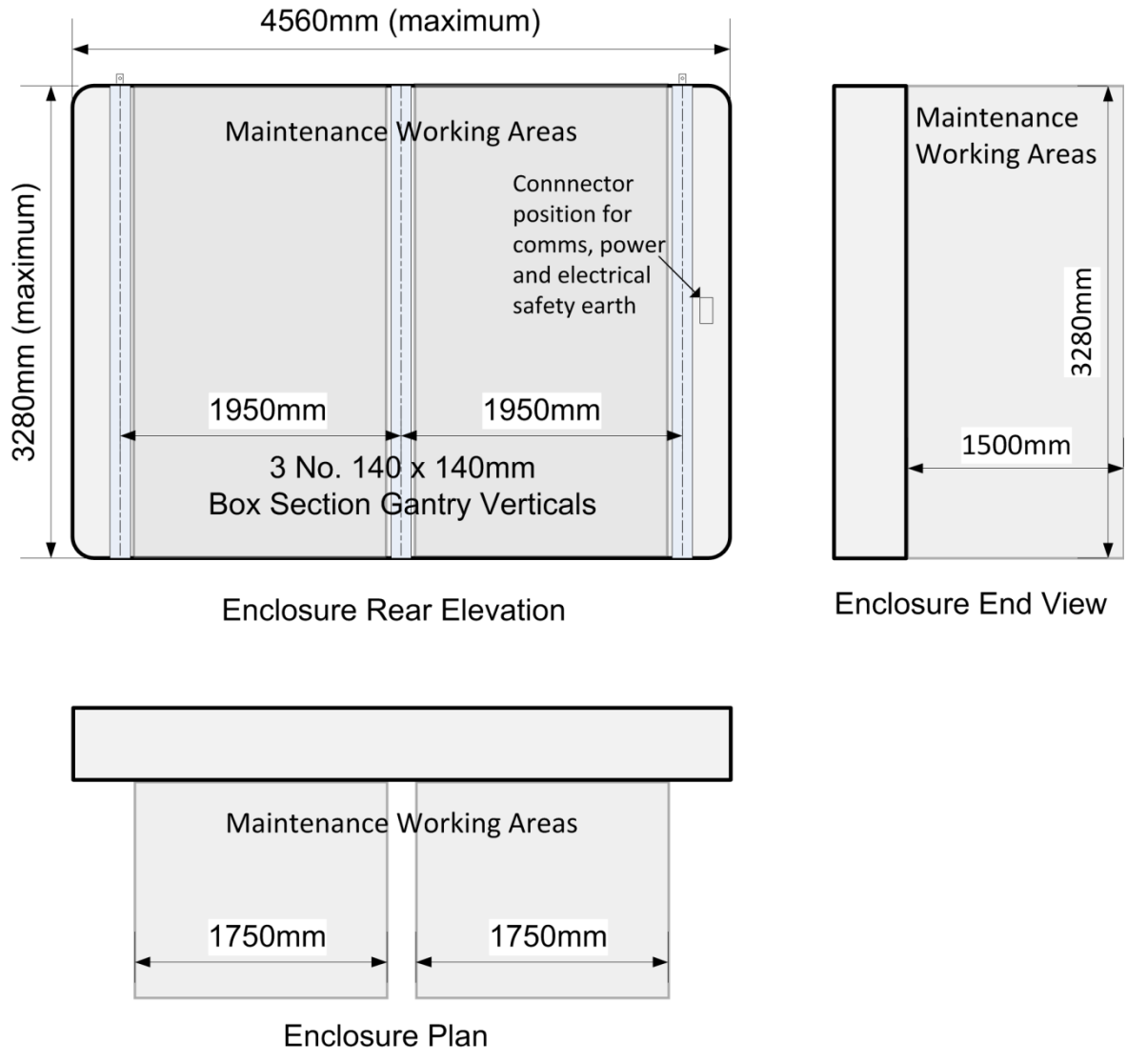
- Where manned access is provided, the closure of any gaps between the Equipment and the gantry front face up to the enclosed zone provided as part of the gantry, as indicated above, as required by BD51.

2. When vertical, Centre of Gravity of Enclosure shall not be more than 300mm from the face to the supporting structure i.e. dimension “e”<300mm.
3. The precise positions of the permanent lifting points are not specified but shall be detailed by the manufacturer to assist gantry designers.
4. The arrangement shall provide protection against bimetallic corrosion at the contact points with the gantry structure.

Maintenance Working Area

H10 Where manned access is provided for, the infrastructure design will provide the MS4 with a maintenance working areas of 1750mm Wide x 1500mm Deep x Full Enclosure Height High as shown in Figure H10 below. The MS4 design should optimise internal maintenance access within this working are defined.

Figure H10: Maintenance Working Areas



Note: Free access will also be provided to the connector positions.

Maximum Loads to be Applied to Supporting Structure

H11 To ensure compatibility with existing mounting structures the maximum load applied by the MS4 on to its mounting structure shall not exceed the values stated in Table H11 below.

Table H11: Load Table

Force (kN)	Loadcase 1 (Self Weight Only)		Loadcase 2 (SWT + Wind(ii))		Loadcase 3 (SWT + Wind(iv) + Snow)	
	SLS	ULS	SLS	ULS	SLS	ULS
Px			268.6	416.33	268.6	416.33
Py			134.29	208.15	134.29	208.15
Pz	-8.7	-10.44	6.65	13.29	3.35	8.34

Notes:

1. The Loads are based on the following assumptions:

a	Enclosure maximum breadth.	4.560m
b	Enclosure maximum height.	3.280m
c	Enclosure maximum weight (to be confirmed by weighing).	890kg
d	Enclosure minimum weight (to be advised by manufacturer).	
e	Wind gust speed.	49m/s
f	Forward tilt of Enclosure (∞)	0
g	ULS load factor on self weight (to be established by weighing).	1.2
h	γ_{f3} has not been applied.	
i	Point of load application is at the volumetric centre of Enclosure.	
j	Load supports are symmetrically and evenly disposed about the Enclosure centre.	
k	Forces calculated in accordance with BD 51/14 and to be used in the design of the supporting structure and any bracketry. The design of the Enclosure and fixing lugs shall be in accordance with BS EN 12966 for wind class WL8 (BS EN 12899) and BE EN 1991-4.	

2. The table above is to be read in conjunction with Enclosure Mounting diagram.
3. Wind combinations referred to are in accordance with clause 5.20 of BD 51/14.
4. Wind buffeting effects in accordance with clauses 5.36 to 5.38 of BD51/14 shall be evaluated for the maximum enclosure area indicated in note 1 above.

APPENDIX I REQUIREMENTS FOR MS4R

General

I1 The MS4R (i.e. MS4 Reduced Size) is used to present traffic control centre-governed messages to the road user and shall:

- Be installed directly on to new infrastructure, which will be provided by others and built to new, maintenance-friendly designs:
  - In this situation, the MS4R shall be capable of being fully maintained and repaired safely whilst remaining installed on its mounting structure, without the need for lane closures.
- Replace legacy (Version 2 and earlier) MS4Rs installed on existing infrastructure which will not include provisions for manned access:
  - In this situation, the MS4R shall be capable of being safely maintained and repaired safely from an MEWP within a period of 30 minutes.

I2 This appendix sets out the requirements for functionally compliant and infrastructure-compatible MS4Rs.

Function

I3 While the current usage is limited to the display of Pictograms and Text Messages (including Supporting Text Messages), MS4Rs are required to display the following to provide future operational flexibility:

- Text Messages in a proportional font described in TR2608
- Aspects (advisory or mandatory), as described in TR2608
- Pictograms (e.g. roadworks symbol), or other Symbols with or without supporting Text Messages, as described in TR2608
- Other Legends, with or without additional text content or supporting Text Messages, as described in TR2608
- OR combinations of the above, (together with/without 'integral' flashing Lanterns), as described in TR2608.

Optical Design

I4 The BS EN 12966 array is based on a 192x80 cell continuous matrix with a display cell pitch of 20mm, but compliant alternatives will not be precluded.

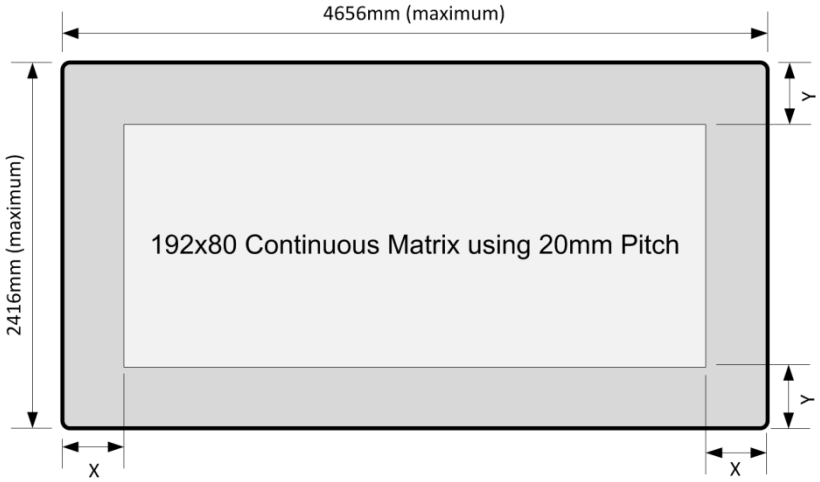
I5 The Display Area shall meet the performance classes of BS EN 12966 as stated in section 2, for all defined colours.

I6 The optical performance requirements for the integral flashing Lanterns are the same as for the main display.

General Appearance and Dimensions

I7 For the purposes of replacing legacy equipment on existing fully equipped gantries the MS4R shall comply functionally with the dimensional constraints of Figure I7 below.

Figure I7: General Appearance and Dimensions



Notes:

1. Dimensions 'X' are an equal distance from the edge of the enclosure.
2. Dimensions 'Y' are an equal distance from the edge of the enclosure.

Infrastructure Electrical Interface

I8 Power will be supplied to the MS4 location via a connector Type 2 (see section 2.8.

I9 In order to operate within the infrastructure power cable design allowances the maximum MS4R power consumption shall not exceed 2.0kVA under the following conditions:

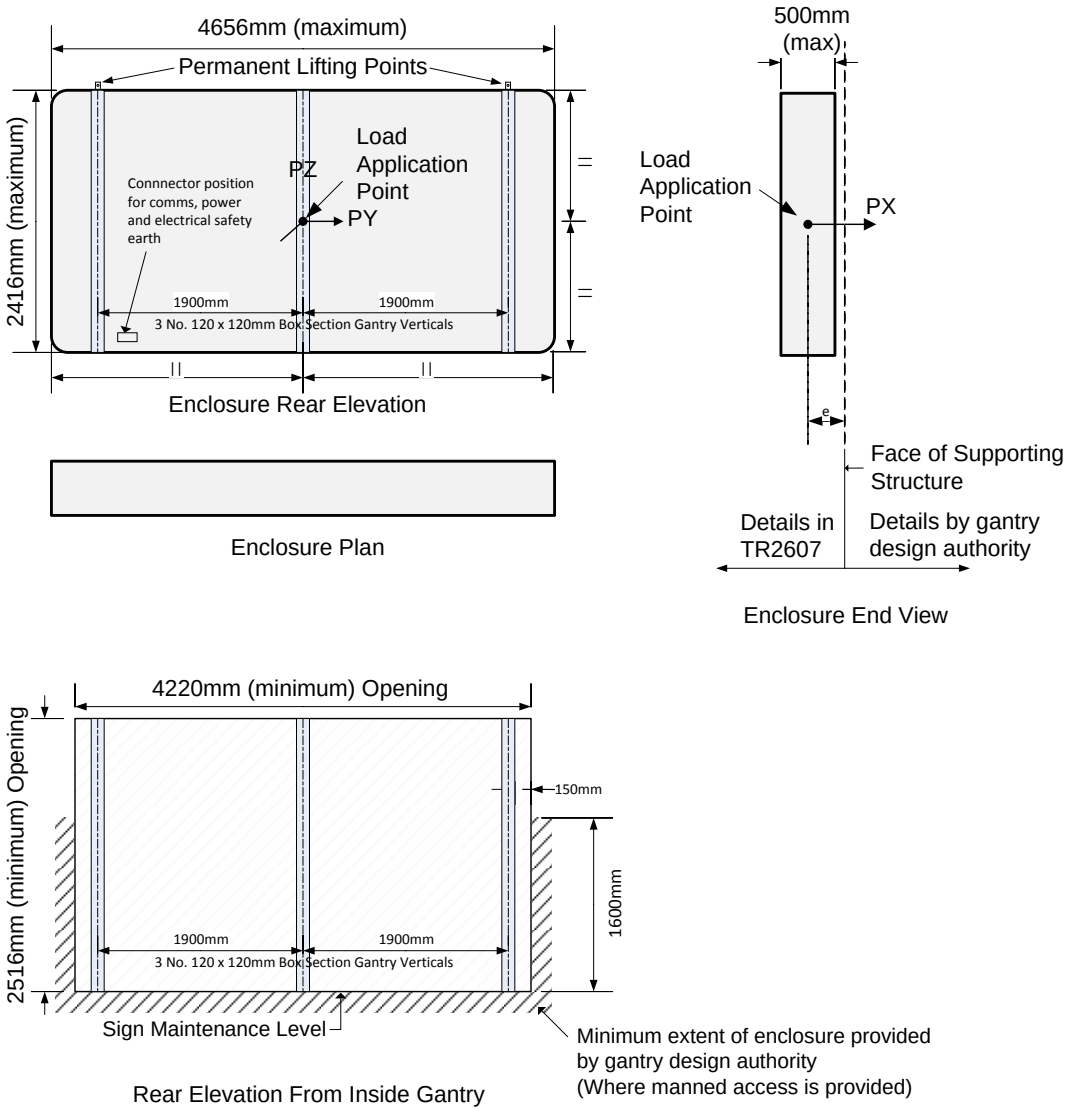
- When displaying Test Bitmap No. 13 (9CH - all display cells ON - White) at maximum brightness with any temperature control devices fully operating.

Note: Whole-life energy consumption shall be competitively compared in supply tenders where reduced consumption may offer an advantage.

Enclosure Rear and Standard Structural Interface

I10 To ensure compatibility with existing mounting structures which provide fixed vertical structural members for MS4R mounting, the MS4R shall comply with the dimensional constraints and mounting arrangements described in Figure I10 below. Alternative designs will not be precluded provided they are functionally equivalent.

Figure I10: Enclosure Rear and Standard Structural Interface



Notes:

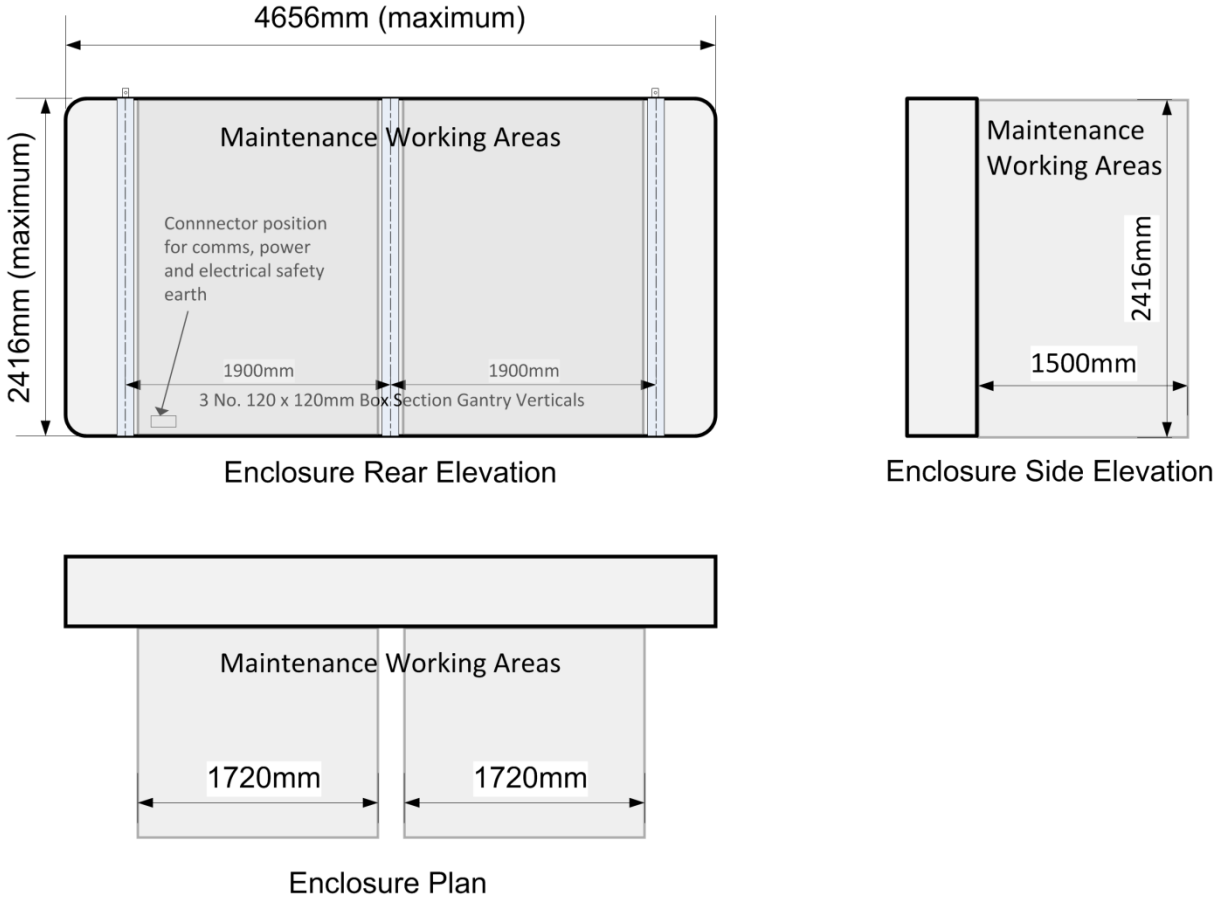
1. The structural interface for the purposes of Equipment mounting is the front face of the 3 No. vertical gantry members provided as part of the gantry structure. The Equipment supplier is responsible for:
   - The provision of approved brackets to mount the Equipment
   - Where manned access is provided, the closure of any gaps between the Equipment and the gantry front face up to the enclosed zone provided as part of the gantry, as indicated above, as required by BD51.

2. When vertical, Centre of Gravity of Enclosure shall not be more than 300mm from the face to the supporting structure i.e. dimension “e”<300mm.
3. The precise positions of the permanent lifting points are not specified but shall be detailed by the manufacturer to assist gantry designers.
4. The arrangement shall provide protection against bimetallic corrosion at the contact points with the gantry structure.

Maintenance Working Area

I11 Where manned access is provided for, the infrastructure design will provide the MS4R with a maintenance working areas of 1720mm Wide x 1500mm Deep x Full Enclosure Height as shown in Figure I11 below. The MS4R design should optimise internal maintenance access within this working are defined.

Figure I11: Maintenance Working Areas



Maximum Loads to be Applied to Supporting Structure

I12 To ensure compatibility with existing mounting structures the maximum load applied by the MS4R on to its mounting structure shall not exceed the values stated in Table I12 below.

Table I12: Load Table

Force (kN)	Loadcase 1 (Self Weight Only)		Loadcase 2 (SWT + Wind(ii))		Loadcase 3 (SWT + Wind(iv) + Snow)	
	SLS	ULS	SLS	ULS	SLS	ULS
Px			164	254.2	164	254.2
Py			82	127.1	82	127.1
Pz	-6.87	-8.24	8.8	16.04	5.47	11.05

Notes:

1. The Loads are based on the following assumptions:

a	Enclosure maximum breadth.	4.656m
b	Enclosure maximum height.	2.320m
c	Enclosure maximum weight (to be confirmed by weighing).	700kg
d	Enclosure minimum weight (to be advised by manufacturer).	
e	Wind gust speed.	49m/s
f	Forward tilt of Enclosure (∞)	0
g	ULS load factor on self weight (to be established by weighing).	1.2
h	γf3 has not been applied.	
i	Point of load application is at the volumetric centre of Enclosure.	
j	Load supports are symmetrically and evenly disposed about the Enclosure centre.	
k	Forces calculated in accordance with BD 51/14 and to be used in the design of the supporting structure and any bracketry. The design of the Enclosure and fixing lugs shall be in accordance with BS EN 12966 for wind class WL8 (BS EN 12899) and BE EN 1991-4.	

2. The table above is to be read in conjunction with Enclosure Mounting diagram.
3. Wind combinations referred to are in accordance with clause 5.20 of BD 51/14.
4. Wind buffeting effects in accordance with clauses 5.36 to 5.38 of BD51/14 shall be evaluated for the maximum enclosure area indicated in note 1 above.

APPENDIX J OTHER EQUIPMENT VARIATIONS

J1 This appendix sets out the information to be defined by Purchasers in order to procure Equipment variations based on the general requirements and Equipment 'templates' provided in the appendices of this specification and TR2068.

General

J2 A general description is required to cover where the Equipment will be installed and the expected maintenance access provisions.

Function

J3 A summary description is required to cover what the Sign or Signal is required to display, for example:

- Aspects (advisory or mandatory)
- Text Messages
- Pictograms (e.g. roadworks symbol)
- Junction layout legends
- Other ' legends.
- OR combinations of the above, (together with/without 'integral' flashing Lanterns) as required by TR2608.

J4 Where the required function is not already covered in TR2608 then this will also need to be specified, along with any special control requirements.

Optical Design

J5 A description is required to cover the required optical design, ideally expressed in performance terms with reference to the appropriate classes of BS EN 12966.

J6 Examples within this specification include the description of:

- Character modules (if this is the required design), their sizes and display cell pitches
- The size of continuous matrix areas and their display pitches.
- Whether physically separate or discreet lanterns are required or whether these are to be formed from display cells within the main display area.
- The BS EN 12966 colour classifications required

J7 The description should be supported with a simple drawing and permit compliant alternatives to be offered.

General Appearance and Dimensions

J8 A simple drawing should be provided to illustrate the overall dimensions of the Sign or Signal and its display area.

Infrastructure Electrical Interface

J9 This specification assumes that a standard communications infrastructure interface is required.

J10 This specification provides two options for the electrical interface and each Equipment appendix identifies which is required for the particular Sign or Signal type.

Enclosure Rear and Standard Structural Interface

J11 A simple drawing should be provided to illustrate the mounting arrangements that will be compatible with the structural interface.

Maintenance Working Area

J12 Where manned maintenance access is provided for, a simple drawing should be provided to illustrate the working area available and to inform the location of access doors or similar.

Maximum Loads to be Applied to Supporting Structure

J13 The maximum load applied by the Sign or Signal on to its mounting structure shall be specified using the template given in Table J13 below.

Table J13: Load Table

Force (kN)	Loadcase 1 (Self Weight Only)		Loadcase 2 (SWT + Wind(ii))		Loadcase 3 (SWT + Wind(iv) + Snow)	
	SLS	ULS	SLS	ULS	SLS	ULS
Px	tbc	tbc	tbc	tbc	tbc	tbc
Py	tbc	tbc	tbc	tbc	tbc	tbc
Pz	tbc	tbc	tbc	tbc	tbc	tbc

Notes:

1. The Loads are based on the following assumptions:

a	Enclosure maximum breadth.	tbc
b	Enclosure maximum height.	tbc
c	Enclosure maximum weight (to be confirmed by weighing).	tbc
d	Enclosure minimum weight (to be advised by manufacturer).	
e	Wind gust speed.	49m/s
f	Forward tilt of Enclosure (∞)	0
g	ULS load factor on self weight (to be established by weighing).	1.2
h	γf3 has not been applied.	
i	Point of load application is at the volumetric centre of Enclosure.	
j	Load supports are symmetrically and evenly disposed about the Enclosure centre.	
k	Forces calculated in accordance with BD 51/14 and to be used in the design of the supporting structure and any bracketry. The design of the Enclosure and fixing lugs shall be in accordance with BS EN 12966 for wind class WL8 (BS EN 12899) and BE EN 1991-4.	

2. The table above is to be read in conjunction with Enclosure Mounting diagram.
3. Wind combinations referred to are in accordance with clause 5.20 of BD 51/14.
4. Wind buffeting effects in accordance with clauses 5.36 to 5.38 of BD51/14 shall be evaluated for the maximum enclosure area indicated in note 1 above.

Special or Additional Requirements

J14 The above template should cover most situation but any special or additional requirements will need to be considered and specified.

APPENDIX K LIST OF AMENDMENTS FROM PREVIOUS VERSIONS

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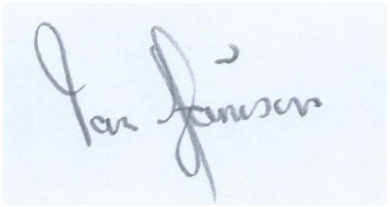
Reviewed by Ian Harrison:



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End of Specification