

Superseded

Technical Specification

**Transport and Main Roads Specifications
MRTS14 Road Furniture**

July 2020

Copyright

© The State of Queensland (Department of Transport and Main Roads) 2020.

Licence



This work is licensed by the State of Queensland (Department of Transport and Main Roads) under a Creative Commons Attribution (CC BY) 4.0 International licence.

CC BY licence summary statement

In essence, you are free to copy, communicate and adapt this work, as long as you attribute the work to the State of Queensland (Department of Transport and Main Roads). To view a copy of this licence, visit: <https://creativecommons.org/licenses/by/4.0/>

Translating and interpreting assistance



The Queensland Government is committed to providing accessible services to Queenslanders from all cultural and linguistic backgrounds. If you have difficulty understanding this publication and need a translator, please call the Translating and Interpreting Service (TIS National) on 13 14 50 and ask them to telephone the Queensland Department of Transport and Main Roads on 13 74 68.

Disclaimer

While every care has been taken in preparing this publication, the State of Queensland accepts no responsibility for decisions or actions taken as a result of any data, information, statement or advice, expressed or implied, contained within. To the best of our knowledge, the content was correct at the time of publishing.

Feedback

Please send your feedback regarding this document to: tmr.techdocs@tmr.qld.gov.au

Contents

1 Introduction1

2 Definition of terms1

3 Referenced documents1

3.1 Standards..... 1

3.2 Standard Drawings 3

4 Standard test methods4

5 Quality system requirements4

5.1 Hold Points, Witness Points and Milestones 4

5.2 Construction procedures..... 5

6 Surplus material.....5

7 Demolition of road furniture and roadside structures6

7.1 General 6

7.2 List of items to be demolished 6

7.3 Construction..... 6

8 Removal and salvage of road furniture6

8.1 General 6

8.2 List of items to be salvaged 6

8.3 Storage site..... 6

8.4 Construction..... 6

9 Removal and re-erection of road furniture7

9.1 General 7

9.2 List of items to be removed and re-erected 7

9.3 Construction..... 7

10 Road edge guide posts8

10.1 General 8

10.2 Material requirements 8

 10.2.1 Rigid timber posts.....8

 10.2.2 Rigid posts other than timber8

 10.2.3 Flexible posts.....9

 10.2.4 Delineators 11

10.3 Construction..... 11

 10.3.1 Location 11

 10.3.2 Installation 12

 10.3.3 Delineators 12

10.4 Guide post warranty..... 12

11 Fencing 12

11.1 General 12

11.2 Scope..... 12

11.3 Material requirements 12

 11.3.1 General..... 12

11.3.2	Hardwood timber posts	12
11.3.3	Softwood timber posts (excluding Cypress Pine).....	12
11.3.4	Cypress pine.....	13
11.3.5	Steel posts, stays and rails.....	13
11.3.6	Galvanised fencing wire (plain and barbed).....	13
11.3.7	Galvanised chainwire	13
11.3.8	Galvanised wire netting	13
11.3.9	Welded mesh.....	13
11.3.10	Steel posts (Y-Section).....	13
11.4	Construction.....	13
12	Gates	13
12.1	General	13
12.2	Scope.....	13
12.3	Material requirements	14
12.3.1	Gate frame.....	14
12.3.2	Mesh.....	14
12.3.3	Other fittings	14
12.4	Construction.....	14
13	Supply of road sign faces	14
13.1	General	14
13.2	Sign face layout	14
13.3	Material requirements	14
13.3.1	Sign substrate.....	14
13.3.2	Stiffener rails.....	15
13.3.3	Coatings	15
13.4	Fabrication	18
13.4.1	General.....	18
13.4.2	Message, shape, size, layout, colours	18
13.4.3	Substrate preparation	18
13.4.4	Sheeting application	18
13.4.5	Sign panel size and joints.....	19
13.4.6	Provision for mounting signs	19
13.4.7	Stiffener rails.....	19
13.4.8	Square holes for mounting signs.....	21
13.4.9	Panel sheet joints	21
13.4.10	Reference marking	22
13.4.11	Packing.....	23
13.4.12	Warranty.....	23
14	Installation of road signs	24
14.1	General	24
14.2	Materials and fabrication.....	24
14.2.1	Fabrication.....	24
14.2.2	Materials general.....	25
14.2.3	Posts.....	26
14.2.4	Connection straps.....	26
14.2.5	Brackets.....	26
14.2.6	Fixings	26
14.2.7	Sign frames	26
14.2.8	Anchor bolts.....	27
14.2.9	Handling, transport and storage.....	27
14.3	Construction of footings	27

14.4	Erection of signs	28
14.4.1	General.....	28
14.4.2	Location	28
14.4.3	Posts.....	28
14.4.4	Frames	28
14.4.5	Sign faces.....	28
15	Project signs	29
15.1	Introduction	29
15.2	Scope	29
15.3	Materials	29
15.4	Erection of project signs	29
15.5	Maintenance of project signs	29
15.6	Removal of signs	29
16	Contractor's information signs	29
17	Grids.....	30
17.1	General	30
17.2	Fabrication	30
17.3	Precast concrete.....	30
17.4	Material requirements	30
17.4.1	Steel plate and sections	30
17.4.2	Bolts, nuts and washers	30
17.4.3	Included road furniture	30
17.4.4	Concrete	30
17.4.5	Steel reinforcing.....	30
17.4.6	Cement mortar.....	31
17.5	Construction.....	31
17.5.1	General.....	31
17.5.2	Excavation and backfilling.....	31
17.5.3	Concrete work	31
17.5.4	Precast components.....	31
17.5.5	Installation of grid frame	31
17.5.6	Installation of fencing.....	31
17.5.7	Installation of road furniture.....	32
17.5.8	Reinstatement	32
17.5.9	Trafficking of grid.....	32
18	Road safety barrier systems.....	32
18.1	General	32
18.2	Public domain road safety barriers and end treatments	32
18.3	Proprietary road safety barriers and end treatments	32
19	Concrete road safety barrier (public domain).....	33
19.1	General	33
19.2	Material	33
19.2.1	Concrete.....	33
19.2.2	Steel reinforcing.....	33
19.2.3	Prestressing strand.....	33
19.2.4	Cement mortar.....	33
19.2.5	Steel plate and sections	33

19.2.6	<i>Bolts, nuts and washers</i>	33
19.2.7	<i>Electrical conduit and pits</i>	33
19.2.8	<i>Compressible filler</i>	33
19.2.9	<i>Joint sealant</i>	34
19.2.10	<i>Delineators</i>	34
19.3	Fabrication	34
19.4	Construction	34
19.4.1	<i>General</i>	34
19.4.2	<i>Surface preparation</i>	34
19.4.3	<i>Conduits and pits</i>	34
19.4.4	<i>Formwork</i>	34
19.4.5	<i>Steel reinforcing</i>	35
19.4.6	<i>Extruded of concrete barriers</i>	35
19.4.7	<i>Placed concrete barriers</i>	35
19.4.8	<i>Cover plate assemblies</i>	36
19.4.9	<i>Tolerances</i>	36
19.4.10	<i>Delineator spacing</i>	36
19.4.11	<i>Precast concrete</i>	36
20	Steel beam guardrail and end treatments (public domain)	37
20.1	General	37
20.2	Manufacture	37
20.2.1	<i>Registered manufacturer</i>	37
20.2.2	<i>Registered manufacturer in Australia</i>	37
20.2.3	<i>Registered manufacturer – outside Australia</i>	38
20.3	Supplier	38
20.3.1	<i>Registered supplier</i>	38
20.4	Material requirements	39
20.4.1	<i>Steel components</i>	39
20.4.2	<i>Panels</i>	39
20.4.3	<i>Steel posts and blockouts</i>	41
20.4.4	<i>Steel plate, strip, bar and attachments</i>	41
20.4.5	<i>Material conformance</i>	41
20.4.6	<i>Material audit testing</i>	42
20.4.7	<i>Fasteners</i>	42
20.4.8	<i>Delineators</i>	43
20.4.9	<i>Cable and Cable assembly</i>	43
20.5	Fabrication of guardrail components	43
20.5.1	<i>Fabrication standard</i>	43
20.5.2	<i>Welding personnel in Australia</i>	43
20.5.3	<i>Welding personnel outside Australia</i>	44
20.6	Installation	44
20.6.1	<i>General</i>	44
20.6.2	<i>Posts for Longitudinal Barrier (excluding public domain end treatments)</i>	44
20.6.3	<i>Posts for public domain end treatments</i>	45
20.6.4	<i>Anchor cables</i>	46
20.6.5	<i>Delineator spacing</i>	46
20.6.6	<i>Tolerances</i>	46
20.6.7	<i>Acceptance of installation</i>	47
21	Proprietary barrier systems and end treatments	49
21.1	General	49
21.2	Manufacture	49
21.2.1	<i>Precast concrete barriers</i>	49
21.2.2	<i>Plastic block outs</i>	49

21.3 Design of Proprietary Barrier Systems	50
21.4 Installation.....	51
21.4.1 General.....	51
21.4.2 Excavation.....	51
21.4.3 Placed concrete.....	51
21.4.4 Tensioned wire rope.....	51
21.4.5 Delineation.....	51
21.4.6 Measurement.....	52
21.4.7 Quality Records.....	52
22 Supplementary requirements	53

Superseded

1 Introduction

This Technical Specification applies to the supply, construction, demolition, removal, salvage and re-erection of road signs, grids, steel beam guardrail, tensioned wire ropes barrier systems, steel traffic barriers, concrete traffic barriers, road edge guide posts, fencing and gates.

This Technical Specification shall be read in conjunction with MRTS01 *Introduction to Technical Specifications*, MRTS50 *Specific Quality System Requirements* and other Technical Specifications as appropriate.

This Technical Specification forms part of the Transport and Main Roads Specifications Manual.

The requirements for the manufacture and supply of steel components for guardrail components and signs as listed in Table 1 that are registered by Transport and Main Roads.

Table 1 – Items requiring use of registered suppliers and approved products

Clause	Category of Work
14.2.1.1	Fabrication of sign posts
20.2	Public Domain Guardrail Manufacturer
20.3	Public Domain Guardrail Supplier

For information regarding registered suppliers and approved products refer to the departmental website, www.tmr.qld.gov.au.

2 Definition of terms

The terms used in this Technical Specification are as defined in Clause 2 of MRTS01 *Introduction to Technical Specifications*.

Additional terms used in this Technical Specification shall be as defined in Table 2.

Table 2 – Definition of terms

Term	Definition
Manufacturer	Any organisation or legal person who manufactures guardrail components under a company name or trademark.
Supplier	Any organisation or legal person in the supply chain who imports guardrail components and/or distributes the guardrail components to guardrail installers.
Fabricator	Any organisation or legal person who fabricates components via welding sections together.
Installers	Any organisation or legal person in the supply chain who installs road safety barrier systems which are sourced from a departmental approved guardrail manufacturer and or supplier.
Contractor	Any organisation or legal person who constructs infrastructure.

3 Referenced documents

3.1 Standards

Table 3 lists documents referenced in this Technical Specification.

Table 3.1 – Referenced documents

Reference	Title
AS 1111	ISO metric hexagon bolts and screws

Reference	Title
AS 1112	<i>ISO metric hexagon nuts</i>
AS 1214	<i>Hot-dip galvanized coatings on threaded fasteners (ISO metric coarse thread series)</i>
AS 1237	<i>Plain washers for metric bolts, screws and nuts for general purposes</i>
AS 1391	<i>Metallic materials – Tensile testing at ambient temperature</i>
AS 1397	<i>Continuous hot-dip metallic coated steel sheet and strip – Coatings of zinc and zinc alloyed with aluminium and magnesium</i>
AS 1743	<i>Road signs – Specifications</i>
AS 1744	<i>Standard alphabets for road signs</i>
AS 2082	<i>Timber - Hardwood - Visually stress-graded for structural purposes</i>
AS 2423	<i>Coated steel wire fencing products for terrestrial, aquatic and general use</i>
AS 2858	<i>Timber - Softwood – Visually stress graded for structural purposes</i>
AS 3569	<i>Steel wire ropes – Product specification</i>
AS 3730.10	<i>Guide to the properties of paints for buildings - Latex - Exterior – Gloss</i>
AS 3730.13	<i>Guide to the properties of paints for buildings - Primer - Wood - Solvent-borne -interior/exterior</i>
AS/NZS 1163	<i>Cold-formed structural steel hollow sections</i>
AS/NZS 1252	<i>High strength steel fastener assemblies for structural engineering – Bolts, nuts and washers</i>
AS/NZS 1390	<i>Cup head bolts with ISO metric coarse pitch threads</i>
AS/NZS 1554.1	<i>Structural steel welding - Welding of steel structures</i>
AS/NZS 1580.481.1	<i>Paints and related materials - Methods of test - Coatings - Exposed to weathering - Degree of flaking and peeling</i>
AS/NZS 1580.602.2	<i>Paints and related materials - Methods of test - Measurement of specular gloss of non-metallic paint films at 20 degrees, 60 degrees and 85 degrees</i>
AS/NZS 1594	<i>Hot-rolled steel flat products</i>
AS/NZS 1734	<i>Aluminium and aluminium alloys - Flat sheet, coiled sheet and plate</i>
AS/NZS 1906.1	<i>Retroreflective materials and devices for road traffic control purposes – Part 1: Retroreflective sheeting</i>
AS/NZS 1906.2	<i>Retroreflective materials and devices for road traffic control purposes - Retroreflective devices (non-pavement application)</i>
AS/NZS 3678	<i>Structural steel - Hot-rolled plates, floorplates and slabs</i>
AS/NZS 3679.1	<i>Structural steel - Hot-rolled bars and sections</i>
AS/NZS 3679.2	<i>Structural steel - Welded I sections</i>
AS/NZS 3845	<i>Road safety barrier systems</i>
AS/NZS 4600	<i>Cold-formed steel structures</i>
AS/NZS 4680	<i>Hot-dip galvanized (zinc) coatings on fabricated ferrous articles</i>

Reference	Title
AS/NZS ISO 9001	<i>Quality management systems - Requirements</i>
BCM-P-011	Registration Procedure: Approved Suppliers for Steel Fabricated Products
MRTS01	<i>Introduction to Technical Specifications</i>
MRTS04	<i>General Earthworks</i>
MRTS07A	<i>Insitu Stabilised Subgrades using Quicklime or Hydrated Lime</i>
MRTS07B	<i>Insitu Stabilised Pavements using Cement or Cementitious Blends</i>
MRTS07C	<i>Insitu Stabilised Pavements using Foamed Bitumen</i>
MRTS08	<i>Plant-Mixed Stabilised Pavements using Cement or Cementitious Blends</i>
MRTS50	<i>Specific Quality System Requirements</i>
MRTS70	<i>Concrete</i>
MRTS71	<i>Reinforcing Steel</i>
MRTS72	<i>Manufacture of Precast Concrete Elements</i>
MRTS73	<i>Manufacture of Prestressed Concrete Members and Stressing Units</i>
MRTS78	<i>Fabrication of Structural Steelwork</i>
MRTS91	<i>Conduits and Pits</i>
MUTCD	Queensland Manual of Uniform Traffic Control Devices, Transport and Main Roads
-	Building Timbers: <i>Properties and Recommendations for their Use in Queensland</i> (Queensland Department of Primary Industries)
-	<i>Design Guide for Roadside Signs</i> - published by Transport and Main Roads
-	Queensland <i>Timber Utilisation and Marketing Act 1987</i>

3.2 Standard Drawings

Table 3.2 lists the Standard Drawings referenced in this document.

Table 3.2 – Referenced Standard Drawings

Standard Drawing Number	Title
1295	<i>Sign - Fingerboard, Geographical Feature and Street Name Signs Bracket Details</i>
1353	<i>Road Furniture - Vermin and Dog Fencing at Motor Grid</i>
1356	<i>Road Edge Guide Posts - Post and Installation Details</i>
1363	<i>Traffic Sign - Multiple Traffic Sign Support – Standard and Breakaway posts – Drawing 1 of 2 and 2 of 2</i>
1364	<i>Traffic Sign - Connection Strap and Erection Cleat Details</i>
1365	<i>Traffic Sign - Traffic Sign Support Breakaway Post Details (two or more supports)</i>
1368	<i>Traffic Sign - Single Traffic Sign Support</i>
1369	<i>Traffic Sign - Details of Sign Stiffening Extrusion</i>
1452	<i>Traffic Sign – Sight Board Installation Details</i>
1458	<i>Single Slope Concrete Barrier - Precast Concrete Barrier Fabrication Details – Drawing 1 of 2 and 2 of 2</i>

Standard Drawing Number	Title
1466	<i>Concrete Barriers - Delineator Bracket Details</i>
1467	<i>Concrete Barrier/Bridge Parapet - Cast-In Anchor Assembly for W and Thrie Beam Guardrail Connection</i>
1468	<i>Single Slope Concrete Barrier – Extruded Median Barrier – Barrier, Reinforcing and Expansion Joint Details</i>
1469	<i>Single Slope Concrete Barrier – Extruded Median Barrier – Details of Road Lighting Pole Cover Plates</i>
1470	<i>Single Slope Concrete Barrier – Concrete Terminal for Median Barrier with Thrie Beam Guardrail Connection – General Arrangement and Details – Drawing 1 of 2 and Reinforcement Details – Drawing 2 of 2</i>
1473	<i>Single Slope Concrete Barrier – Precast Concrete Barrier installation details</i>
1474	<i>Steel Beam Guardrail – Installation and Setout</i>
1475	<i>Steel Beam Guardrail – Installation on Bridge and Barrier Approaches</i>
1476	<i>Steel Beam Guardrail – Terminal Components</i>
1477	<i>Steel Beam Guardrail – Posts and Blockouts, Soil and Bearing Plates, Slip Base Plate</i>
1478	<i>Steel Beam Guardrail – W Beam Anchor Bracket Delineation Unit Post on Base Plate Abraham Blockout</i>
1479	<i>Steel Beam Guardrail – Bolts, Nuts, Screws and Washers Cable Assembly with Fasteners</i>
1480	<i>Steel Beam Guardrail – Fabrication Details for W Beam Rails and Rail Components</i>
1481	<i>Steel Beam Guardrail – Fabrication Details for Thrie Beam Rails and Rail Components</i>
1482	<i>Steel Beam Guardrail – W Beam and Thrie Beam Assemblies</i>
1486	<i>Single Slope Concrete Barrier – Concrete Terminal for Barrier with Thrie Beam Guardrail Connection – General Arrangement – Drawing 1 of 1 and Reinforcement details – Drawing 2 of 2</i>
1491	<i>Steel Beam Guardrail – Guardrail Attachments to Existing Box – Assembly and Fabrication Details</i>
1565	<i>Road Furniture - Motor Grid - Steelworks</i>
1600	<i>Fencing – Rural Fence and Gates - Timber Posts and Stays</i>
1601	<i>Fencing – Rural Fence and Gates - CHS Posts and Stays</i>
1602	<i>Fencing – Chainwire Fences and Gates</i>
1603	<i>Fencing – Koala Proof Fence and Gate</i>
1604	<i>Fencing – Galvanized Welded Mesh Fencing</i>

4 Standard test methods

There are no standard test methods referenced by this Technical Specification.

5 Quality system requirements

5.1 Hold Points, Witness Points and Milestones

General requirements for Hold Points, Witness Points and Milestones are specified in Clause 5 of MRTS01 *Introduction to Technical Specifications*.

The Hold Points, Witness Points and Milestones applicable to this Technical Specification are summarised in Table 5.1.

Table 5.1 – Hold Points, Witness Points and Milestones

Clause	Hold Point	Witness Point	Milestone
8.2	1. Dismantling of items to be salvaged		Submission of schedule of items to be salvaged (seven days)
9.2	2. Dismantling of items to be re-erected		Submission of schedule of items to be re-erected (seven days)
13.3.1.1	3. Alternative sign face material		
14.2.1.3	4. Welding Personnel		
14.4.1		1. Erection of road signs	
16	5. Contractor's information signs		Submission of details of information signs (14 days)
19.4.6	6. Test section of extruded concrete traffic barrier		
20.4.5	7. Material Conformance	2. Test of steel where test certificates are not available	
20.4.6.1		3. Selection of posts and panels for audit testing	
20.4.6.3	8. Acceptance of materials prior to installation		
20.5.2	9. Welding Personnel in Australia		
20.6.7	10. Acceptance of Installation		
21.2	11. Manufacture of Proprietary steel barrier		
21.4.1	12. Acceptance of Installation		
21.4.4	13. Acceptance of Tension Report	4. Verification testing	

5.2 Construction procedures

Construction procedures which are required to be submitted in accordance with Clause 6 of MRTS50 *Specific Quality System Requirements* are listed in Clause 2 of Annexure MRTS14.1.

These procedures are critical. Note that the receipt of these procedures is often seen as a de facto approval. In every case a response should be made to the Contractor acknowledging receipt of the procedures.

6 Surplus material

Surplus excavated, removed or demolished material shall be utilised or disposed of in accordance with the requirements of Clause 10 of MRTS01 *Introduction to Technical Specifications*.

7 Demolition of road furniture and roadside structures

7.1 General

Clause 7 describes the work to be carried out where existing road furniture or roadside structures are required to be demolished.

7.2 List of items to be demolished

The items of road furniture to be demolished and disposed of are listed in Clause 3 of Annexure MRTS14.1.

7.3 Construction

Where necessary, excavations shall be carried out to permit demolition and removal of existing road furniture.

Existing road furniture shall be demolished and removed in a manner which avoids damaging any adjacent work. All existing footings shall be removed.

Resulting excavations shall be backfilled and finished so as to reinstate the area to a safe and free-draining state. Backfilling shall be carried out in accordance with the requirements of MRTS04 *General Earthworks*.

8 Removal and salvage of road furniture

8.1 General

Clause 8 describes the work to be carried out where existing road furniture is required to be removed and salvaged under the Contract.

8.2 List of items to be salvaged

Broadly, the items of road furniture to be salvaged are listed in Clause 1.1 of Annexure MRTS14.1.

Not less than seven days prior to the commencement of dismantling and removal of any existing road furniture, the Contractor shall submit a schedule of items of existing road furniture to be salvaged in accordance with the provisions of the design documentation. **Milestone**

Dismantling and removal shall not commence until expiration of the seven day period. **Hold Point 1**

8.3 Storage site

Salvaged items shall be transported to the storage site nominated in Clause 1.2 of Annexure MRTS14.1.

8.4 Construction

Where necessary, excavations shall be carried out to permit removal of existing road furniture.

Existing road furniture to be salvaged shall be dismantled and removed with minimum damage to the items.

Where possible, fittings shall be undone, components disassembled and supports removed without any damage and/or cutting of the components. Where this is not possible, the method of dismantling shall be included in the schedule mentioned in Clause 8.2.

Any part of the existing installation which is not to be salvaged shall be demolished and removed in a manner which avoids damaging any adjacent work. All existing footings shall be removed.

Resulting excavations shall be backfilled and finished so as to reinstate the area to a safe and free-draining state. Backfilling shall be carried out in accordance with the requirements of MRTS04 *General Earthworks*.

Salvaged materials shall be carefully transported to the storage site nominated in Clause 8.3.

Salvaged materials shall be neatly stacked at the storage site on appropriate timber packers.

Where salvaged items are damaged during dismantling, transport or storage, steps may be taken to recover the value of such items from the Contractor.

9 Removal and re-erection of road furniture

9.1 General

Clause 9 describes the work to be carried out where existing road furniture is required to be removed and re-erected under the Contract.

9.2 List of items to be removed and re-erected

The items of road furniture to be removed and re-erected shall be as listed in Clause 4 of Annexure MRTS14.1.

Not less than seven days prior to commencement of dismantling and removal of any road existing furniture, the Contractor shall submit a schedule of items of existing road furniture to be dismantled for re-erection in accordance with the provisions of the design documentation. **Milestone**

Dismantling and removal shall not commence until expiration of the seven day period. **Hold Point 2**

9.3 Construction

Where necessary, excavations shall be carried out to permit removal of existing road furniture.

Existing road furniture to be salvaged and re-erected shall be dismantled and removed with minimum damage to the items.

Where possible, fittings shall be undone, components disassembled and supports removed without any damage and/or cutting of the components. Where this is not possible, the method of dismantling shall be included in the schedule mentioned in Clause 9.2.

Any part of the existing installation which is not to be salvaged for re-erection shall be demolished and removed in a manner which avoids damaging any adjacent work. All existing footings shall be removed.

Resulting excavations shall be backfilled and finished so as to reinstate the area to a safe and free-draining state. Backfilling shall be carried out in accordance with the requirements of MRTS04 *General Earthworks*.

Salvaged materials shall be safely stored on appropriate timber packers until they can be re-erected.

Salvaged material shall be re-erected in accordance with the appropriate clauses of this Technical Specification. New incidental materials that may be necessary to re-erect the road furniture shall be supplied (e.g. bolts, nuts, concrete, etc.).

Where salvaged items, recovered in accordance with Clause 9, are damaged during dismantling, transport, storage or re-installation, such items shall be replaced by the Contractor.

10 Road edge guide posts

10.1 General

Clause 10 describes the work to be carried out where road edge guide posts are required to be installed under the Contract. Road edge guide posts shall fall into one of the following categories:

- Rigid: posts either incapable of returning to their original state post impact or requiring assistance by hand or mechanical means to return to, or within a margin of 5 degrees, of their original state. This category shall include all timber road edge guide posts and any other posts not meeting the requirements of Clause 10.2.3 of this document.
- Flexible: posts capable of returning to, or within a margin of 5 degrees, of their original state post impact without assistance. See Clause 10.2.3.7 of this document for more information.

10.2 Material requirements

10.2.1 Rigid timber posts

10.2.1.1 Hardwood

Hardwood posts shall be durability Class 1, 2 or 3 and have a stress grade of F5 or better, in accordance with AS 2082.

10.2.1.2 Softwood

Softwood posts shall be durability Class 1, 2, 3 or 4. Durability Class 4 softwood shall be preservative-treated to an H5 level in accordance with the *Timber Utilisation and Marketing Act 1987*, and any untreated heartwood shall not exceed 20% of the cross-sectional area. Softwood posts shall have a stress grade of F5 or better in accordance with AS 2858.

10.2.1.3 All timber

Timber guide posts shall be graded under the authority of a recognised timber quality assurance program and be branded with the registered trade mark of the program.

All timber which is prone to excessive shrinkage and/or distortion shall have a moisture content less than 18%. All other timber may be unseasoned.

All posts shall be cut to the dimensions shown on Standard Drawing 1356. Spring and bow in all posts shall not exceed 15 mm.

The above-ground section of posts shall be painted as follows:

- a) the timber surface shall be cleaned
- b) the surface shall receive one coat of pink solvent-borne wood primer in accordance with the requirements of AS 3730.13 and two coats of gloss latex paint in accordance with the requirements of AS 3730.10 with a gloss level in excess of 85 gloss units in accordance with the requirements of AS/NZS 1580.602.2.

10.2.2 Rigid posts other than timber

10.2.2.1 Materials

Road edge guide posts shall be composed of material which is heat resistant and fire retardant and which is capable of retaining 85% of its colour, appearance and physical properties for at least five years when exposed to weather conditions existing in Queensland. The materials shall be durable and resistant to mould growth and mildew and shall not be affected by hydrocarbon solvents. All materials shall be corrosion resistant or treated to resist corrosion. The post materials shall also be resistant to ultraviolet light.

10.2.2.2 Colour

The surface of road edge guide posts shall be a durable gloss or semi-gloss opaque white colour.

10.2.2.3 Surface finish

Road edge guide posts shall be free of sharp edges, burrs, discolouration or other defects which may affect appearance and/or serviceability.

10.2.2.4 Dimensions

The cross-sectional area of road edge guide posts is not critical but shall not differ from post to post by more than 3%. The following dimensional requirements shall, however, be satisfied:

- a) rigid posts shall have a minimum width of 80 mm facing traffic over at least the top 250 mm of their length
- b) posts shall be of such length to provide a height of 1000 mm above the ground surface and minimum anchoring depths of approximately 500 mm for buried posts and 350 mm for driven posts respectively.

10.2.2.5 Bending strength

The minimum bending strength, at yield, at the weakest point of the road edge guide post (on a partially flattened section) shall be 0.3 kNm.

10.2.2.6 Weathering resistance

If a warranty for a minimum period of five years is not available for the guidepost, then a sample of the guide post shall be subject to artificial weathering for a period of 1000 hours in either:

- a) Atlas Twin Sunshine Carbon Arc Weatherometer, or
- b) Xeon Arc Weatherometer at 0.55 watts/m² irradiance level with Boro / Boro filters.

During the weathering of the sample it shall be subject to:

- a) light and dark alternating cycles 20% of the testing time
- b) temperature during light cycles shall be a minimum of 32 degrees
- c) humidity temperatures shall be cyclic and be 20% of the testing time.

After exposure the surface shall be free from crazing or blistering. The degree of chalking and colour change shall not fall below a rating of five and the loss of gloss shall not exceed 20 gloss units (egg shell gloss) when evaluated in accordance with AS 1580 Methods 481.1 and 602.2 (Specular Gloss).

10.2.3 Flexible posts

10.2.3.1 General

The requirements of Clause 10.2.2 above shall apply to flexible posts except as modified by Clauses 10.2.3.2 to 10.2.3.7.

10.2.3.2 Dimensions

Flexible posts shall have a minimum width facing traffic of 100 mm.

10.2.3.3 Bending strength

No minimum bending strength shall apply to flexible posts.

10.2.3.4 Additional testing

Evidence to confirm that the post has been subject to and passed the following tests shall be included in the quality records:

- a) heat resistance in accordance with the requirements of Clause 10.2.3.5
- b) cold resistance in accordance with the requirements of Clause 10.2.3.6
- c) vehicle impact in accordance with the requirements of Clause 10.2.3.7.

10.2.3.5 Heat resistance

The following procedure shall be followed for heat resistance tests:

- a) Condition two of the sampled posts at $60 \pm 2^{\circ}\text{C}$ for a minimum of two hours in an oven.
- b) Remove one post from the oven, and clamp the base of the post at the installation mark. The post shall be clamped in a vertical position, aligned with the mark on the backboard. Inserts shaped to suit the profile of the post shall be used to ensure even clamping.
- c) Bend the post to 90 degrees in the anticipated direction of traffic and immediately release. This process should be completed within five seconds.
- d) The post should return to within five degrees of the vertical position within 30 seconds.
- e) Testing as detailed in b) to d) shall be completed within two minutes of removal from the oven.
- f) Repeat steps b) to e) a further three times, conditioning the post in the oven for two minutes between each test.
- g) Repeat steps b) to f) with the other post.

10.2.3.6 Cold resistance

The post shall be conditioned at $0^{\circ}\text{C} \pm 2^{\circ}\text{C}$ (ice bath) for two hours prior to testing. Flexible posts shall be subjected to both the resilience and brittleness tests as detailed below. Semi flexible posts are only required to be tested to the brittleness test.

The following tests shall then be performed:

Resilience

- a) Remove one post from the bath, and clamp the base of the post at the installation mark. The post shall be clamped in a vertical position, aligned with the mark on the backboard. Inserts shaped to suit the profile of the post shall be used to ensure even clamping.
- b) Bend the post to 90 degrees in the anticipated direction of traffic and immediately release. This bending process shall be completed within five seconds.
- c) The post shall return to within five degrees of the vertical position within 30 seconds.
- d) Testing as detailed in a) to c) shall be completed within two minutes of removal from the ice bath.
- e) Repeat steps a) to d) a further three times, conditioning the post in the bath for two minutes between each test.
- f) Repeat steps a) to e) with the other post.

Brittleness

- a) Place the tested post used for the resilience test in the ice bath for a further two minutes.

- b) Remove the guidepost from bath and place horizontally between two supports, clamping each end securely. The front face of the post shall face upwards, and there shall be 1 ± 0.05 m between the two supports.
- c) Drop a steel ball of 1 ± 0.05 kg from a height of 1.5 ± 0.05 m through a vertical guide so that it impacts on the centre of the unsupported area of the post.
- d) Testing as detailed in b) to c) shall be completed within two minutes.
- e) Repeat steps b) to d) an additional four times (a total of five impacts) conditioning the post in the bath for two minutes between each test.

10.2.3.7 Vehicle impact

The guide post shall be capable of self-erecting and remaining serviceable after being subjected to a series of direct impacts by a typical passenger vehicle at temperatures between 15°C and 30°C. The guide posts to be tested shall be installed in accordance with the recommendations of the manufacturer and shall be furnished complete with delineators. The guide post shall be capable of withstanding a series of 10 bumper bar impacts at a speed of 60 km/h and five bumper bar impacts at a speed of 100 km/h directed at 90 degrees to the front face of the guide post.

The impacting vehicle shall suffer little or no damage during the impact tests. The guide post shall return to within five degrees of vertical within 30 minutes of impact. Test results which show the guide posts are capable of withstanding the above vehicle impacts are to be provided. This should include video or photographic evidence. A minimum sample of three guide posts shall be tested.

10.2.4 Delineators

Each road edge guide post shall be supplied with either two delineators (one white and one red) or with a single delineator (red, white or yellow). Road edge guide posts must be installed as specified in the MUTCD.

Delineators shall be affixed so that they are weatherproof and vandal resistant. The delineators shall be centrally located and placed so that the top of the reflector is between 50 mm and 100 mm from the top of the post. Type 1A Class material shall be rectangular with a minimum area of 100 cm² and minimum width of 50 mm. Type A Corner cube material shall be circular (80 mm diameter) in configuration.

For rigid road edge guide posts, the delineators shall consist of either:

- a) Type A (corner cube) material which conforms with the requirements of AS/NZS 1906.2, or
- b) Prismatic lens sheeting which meets the requirements of Class 1A material, as defined in AS/NZS 1906.2.

As stated in Clause 5 of Annexure MRTS14.1.

For flexible road edge guide posts, the delineators shall consist of prismatic lens sheeting which meets the requirements of Class 1A materials, as defined in AS/NZS 1906.2. Corner cube or rigid backed delineators that can be damaged by vehicular impact shall not be used on flexible road edge guide posts.

10.3 Construction

10.3.1 Location

Road edge guide posts shall be located as shown in the design documentation and/or as determined from Standard Drawing 1356.

10.3.2 Installation

Road edge guide posts may be installed by excavation and backfilling of a post hole or by driving, depending on the post material and the manufacturer's recommendations.

10.3.3 Delineators

On all carriageways, a red delineator shall be affixed to the face of the road edge guide post on the left-hand side of the carriageway and a white delineator shall be affixed to the face of the road edge guide post on the right hand side of the carriageway, as seen from oncoming traffic. On divided carriageways, no delineators shall be affixed to the face of the guide post facing away from oncoming traffic.

Only Road Edge Guide Posts which have been accepted for use by the Department of Transport and Main Roads shall be installed on Department of Transport and Main Roads Infrastructure.

10.4 Guide post warranty

The period of warranty for guide posts shall be a minimum of five years. During the period of the warranty, the supplier shall, without delay and at no cost to the Principal, correct all defects and omissions covered by the warranty by way of repair, replacement or modification or other means. The warranty must be provided to the Department of Transport and Main Roads in writing. When a product fails this Technical Specification under the warranty period, the supplier is required to replace the product at no cost to the Principal.

11 Fencing

11.1 General

Clause 11 describes the work to be carried out where fencing is required to be installed under the Contract.

11.2 Scope

Details of the fencing required to be erected under the Contract are stated in Clause 6.1 of Annexure MRTS14.1.

11.3 Material requirements

11.3.1 General

Material requirements shall be as shown in the design documentation, or where not so shown, as shown on Standard Drawings 1600, 1601, 1602, 1603 and 1604.

11.3.2 Hardwood timber posts

In accordance with Building Timbers: *Properties and Recommendations for their Use in Queensland*, all hardwood timber posts shall be durability Class 1 or 2 and shall either have the sapwood removed from the section in the ground and to a distance of 100 mm above the ground or the sapwood shall be treated, to H5 level, with a fixed salt preservative of the CCA (Copper Chromium Arsenic) type to the requirements of the Queensland *Timber Utilisation and Marketing Act 1987*.

11.3.3 Softwood timber posts (excluding Cypress Pine)

Softwood timber posts and fence droppers shall have no exposed heartwood, except on the ends, and the heartwood content shall not be greater than 10% of the cross-section area. All softwood posts shall be treated, to H5 level, with a fixed salt preservative of the CCA type to the requirements of the Queensland *Timber Utilisation and Marketing Act 1987*.

11.3.4 Cypress pine

Cypress pine posts shall be completely free from sapwood.

11.3.5 Steel posts, stays and rails

Steel posts, stays and rails shall comply with the requirements of AS 1163 and galvanised in accordance with AS/NZS 4680.

11.3.6 Galvanised fencing wire (plain and barbed)

Plain and barbed fencing wire shall comply with the requirements of AS 2423.

11.3.7 Galvanised chainwire

Galvanised chainwire shall comply with the requirements of AS 2423.

11.3.8 Galvanised wire netting

Galvanised wire netting shall comply with requirements of AS 2423.

11.3.9 Welded mesh

Welded mesh shall comply with the details shown in the design documentation.

11.3.10 Steel posts (Y-Section)

Unless shown in the design documentation as galvanised, steel posts (Y-section) shall be supplied with a bronze coloured coating. Where galvanising is specified, galvanising shall be in accordance with AS/NZS 4680.

11.4 Construction

Fencing shall be constructed in the locations and to the details shown in the design documentation.

Minimum clearing only shall be carried out to allow for construction of the fence. Localised excavations shall be constructed where necessary.

Strainer posts or strainer assemblies shall be located at every change in horizontal direction and to the maximum spacings shown in the design documentation.

In undulating country, fencing shall be erected so that the post tops follow a smooth line, wherever possible. Wires shall be strained in accordance with the manufacturer's recommendations and tied to the strainer posts and/or assemblies, intermediate posts and droppers with approved ties.

Special treatments at water crossings and grids, where necessary, shall be constructed to the details shown in the design documentation or, where not shown, be made secure against stock.

12 Gates

12.1 General

Clause 12 describes the work to be carried out where gates are required to be installed under the Contract.

12.2 Scope

Details of the gates required to be erected under the Contract are stated in Clause 6.1 of Annexure MRTS14.1.

12.3 Material requirements

12.3.1 Gate frame

Gate frames shall be constructed to the details shown in the design documentation, or where not so shown, to the details shown on Standard Drawings 1600, 1601, 1602 and 1603, as applicable.

Gate frames shall be manufactured from round hollow section complying with AS 1163 and galvanised in accordance with AS/NZS 4680.

Fabrication shall be carried out in accordance with the requirements of MRTS78 *Fabrication of Structural Steelwork*.

12.3.2 Mesh

Mesh shall comply with the requirements shown in the design documentation.

12.3.3 Other fittings

Other fittings shall be manufactured from steel complying with AS/NZS 3678, AS/NZS 3679.1 and AS/NZS 3679.2, as appropriate and hot-dipped galvanised in accordance with the requirements of AS/NZS 4680.

12.4 Construction

Gates shall be installed in the locations shown in the design documentation.

Erection details and clearance dimensions shall be as shown in the design documentation or, where not so shown, on Standard Drawings 1600, 1601, 1602 and 1603, as applicable.

13 Supply of road sign faces

13.1 General

Clause 13 describes the work to be carried out for the supply of regulatory, warning, direction and information sign faces under the Contract. For the purposes of this Technical Specification, the term "sign face" shall include the sheet metal substrate, attached stiffeners and colour and/or reflective sheetings and/or coatings but not support frames or posts.

13.2 Sign face layout

All legend elements, including letters, numerals, symbols, colours and borders in all sign faces shall conform to the Manual of *Uniform Traffic Control Devices* and the Drawings.

Dimensional tolerances shall conform to the requirements detailed in AS 1743. Legends and lettering shall conform to AS 1744.

13.3 Material requirements

13.3.1 Sign substrate

13.3.1.1 General

The sign substrate shall be manufactured from aluminium except that regulatory parking signs (see Clause 13.3.1.6) may be manufactured from zinc/aluminium coated steel and temporary signs (see Clause 13.3.1.7) may be manufactured from zinc/aluminium coated steel, colorbond steel or corflute.

Other materials may be considered but evidence of the full approval of the department will be provided to the Administrator prior to their use. **Hold Point 3**

The sign substrate shall be free of cracks, tears and other surface blemishes and the edges shall be true and smooth.

Tolerances on the overall dimensions of the sign substrate for signs other than guide signs and signs that are individually designed shall be ± 3 mm or 0.25% of the largest dimension, whichever is the greater. For guide signs and other signs that are individually designed refer to Clause 13.4.1. The maximum allowable warp, twist or other departure from flatness of the sign substrate shall be 2.5 mm/m in any direction.

13.3.1.2 Aluminium sheet

Aluminium sheet sign substrate shall be fabricated from 1.6 mm thick aluminium alloy sheeting, alloy type 5251, temper H38, or similar in accordance with the requirements of AS/NZS 1734 and stiffened where required in accordance with Clause 13.3.2.

13.3.1.3 Aluminium blade section

Fingerboards, geographical feature and street name signs which use the 200 mm aluminium blade section shall be fabricated from alloy type 6063, temper T5, or similar. Signs which require single-sided section either 200 mm or 300 mm deep may be constructed from aluminium plank boards.

13.3.1.4 Aluminium plank boards

Aluminium plank boards (200 mm and 300 mm deep sections) shall be manufactured from an extruded aluminium section, alloy type 6060, temper T5 or similar.

13.3.1.5 Flood depth indicators

Flood depth indicators shall be manufactured from an extruded aluminium rectangular hollow section, nominal size 200 mm x 38 mm x 3 mm, alloy type 6063, temper T5 or similar.

13.3.1.6 Regulatory parking signs

Regulatory parking signs may be fabricated from 1.2 mm thick zinc/aluminium coated steel complying with the requirements of AS 1397 and stiffened in accordance with Clause 13.3.2.

13.3.1.7 Temporary signs

Signs classified as temporary signs in the MUTCD may be manufactured from 1.0 mm thick hot-dipped zinc coated, aluminium/zinc coated or colour bonded steel complying with the requirements of AS 1397.

Temporary signs used at roadworks may be manufactured using 6 mm corflute that has been UV treated for external use.

13.3.2 Stiffener rails

Stiffener rails shall be manufactured from an extruded aluminium section, alloy type 6061 or 6063, temper T6 to the dimensions shown on Standard Drawing 1369. The section properties of stiffener rails shall be equal to or greater than those stated on Standard Drawing 1369. The section type shall be as shown on the drawings.

13.3.3 Coatings

13.3.3.1 General

The class of sign material for the legend and the background shall comply with the minimum standards stated in Clause 13.3.3.2 of this Technical Specification.

All signs of a similar type shall be manufactured from the same materials and the finish coating density shall be consistent.

13.3.3.2 Retroreflective sheeting

13.3.3.2.1 Requirements

Retroreflective sheetings shall comply with AS/NZS 1906.1 and be either Class 1100, Class 400 or Class 400T.

Product categories shall only be used as specified in Table 13.3.3.2.1 following.

Table 13.3.3.2.1 – Minimum class of sign material

Sign Type	Sign Number	Class of Sign Face Materials	
		Legend	Background
Regulatory Signs			Screened
STOP	(R1-1)	Class 400	Class 400
GIVE WAY	(R1-2)	Black non reflective	Class 400
Roundabout	(R1-3)	Black non reflective	Class 400
Pedestrian Crossing	(R3-1)	Black non reflective	(fluorescent yellow-green)
All other Regulatory Signs		Class 400	Class 400
Warning Signs			
All Warning Signs		Class 400	Class 400
Roadworks		Black non reflective	Class 400
Special Purpose Signs		Black non reflective	Class 400
Hazard Markers		Black non reflective	Class 400
Flood Gauge Markers		Black non reflective	Class 400
Guide Signs			
Advance, Intersection, Reassurance Direction Signs and Advance Lane Signs		Class 400	Class 400
Tourist and Service Signs		Class 400	Class 400
Geographical Feature and Street Name Signs		N/A	Class 400
Freeway Signs			
(white on standard green background; black on white background; white on blue background; black on yellow background; white on red background)			
General application		Class 400	Class 400
Overhead and gantry application		Class 1100	Class 1100
Traffic Instruction Signs		Class 400	Class 400

The sheeting surface shall be compatible with transparent and opaque screening inks and show no loss of the colour coat with normal handling, cutting and application. The class and manufacturer of retroreflective sheeting shall be able to be determined by inspection using unaided sight.

A certificate, issued by the manufacturer of the retroreflective sheeting and endorsed by the sign face fabricator, stating that the retroreflective material complies in all respects with the requirements of AS/NZS 1906.1 (including the service life requirements) shall be included in the quality records.

13.3.3.2.2 Rotational sensitivity

Sheeting shall be tested for rotational sensitivity as per AS/NZS 1906.1.

13.3.3.2.3 Durability tests

The test procedures for durability assessment are set out in AS/NZS 1906.1. Outdoor accelerated weathering testing shall be located at a site near the coast of North Queensland within 40 km of latitude 19°30'S and longitude 146°50'E or a location that has similar atmospheric conditions.

13.3.3.3 Non-reflective coatings

13.3.3.3.1 Non-reflective sheeting

Non-reflective material used for figures, letters, symbols and borders shall be of uniform density and compatible with the background material, both in application and durability, and shall be compatible with both the sign substrate material onto which it is applied and with any retroreflective sheeting applied over the top of the material.

13.3.3.3.2 Paint

All paints used on signs shall be of premium quality from a reputable manufacturer. Paints shall be approved by the manufacturer for the relevant application and exposure conditions.

Pre-primed and pre-painted material, such as colour bonded steel or aluminium, yellow in colour as specified in AS 1743, shall be used for temporary signs. Alternatively, temporary signs shall receive at least one coat of yellow full gloss enamel paint applied in accordance with the paint manufacturer's recommendations.

13.3.3.3.3 Screening inks and electro-cut films

Screening inks and electro-cut films shall be of an approved brand and shall be compatible with the substrate surface and the retroreflective sheeting, non-reflective sheeting or paint, whichever has been used. The screening ink or electro-cut film shall be applied using materials and techniques recommended by the sheeting manufacturer, where appropriate.

13.3.3.4 Security branding

As an optional security measure, a transparent screen-printed brand (customer logo or lettering) that has minimum impact on the retroreflective performance of the sign may be added (typically 1.4% black ink and 98.6% toner). It shall not exceed 75 mm square and have a minimum spacing of 350 mm.

Other security branding methods such as laser cutting of the aluminium substrate are also permitted, provided sign integrity is maintained. Laser cutting of the substrate shall not exceed 75 mm square, and shall be limited to a single location adjacent the sign edge.

13.3.3.5 Sign face material properties

The sign face or sheeting shall remain in good condition except for accidental damage or vandalism for the period specified in Clause 13.4.12.2, or if not stated there refer to AS 1906.1:

- a) no evidence of cracking; crazing; peeling; lifting from the substrate; delamination blistering; chalking; wrinkling; bubbling; or edge shrinkage greater than 2 mm
- b) no evidence of colour change or fading when compared to the supplied manufacturer's samples or new materials within the period compatible with the class or type of material
- c) the sign is effective for its intended purpose when viewed from a moving vehicle under normal day or night driving conditions by a driver with normal vision.

13.4 Fabrication

13.4.1 General

Sign faces shall be fabricated in accordance with the requirements of the *Design Guide for Roadside Signs*.

Signs shall be constructed to the size specified in the Contract.

For guide signs and other signs that are individually designed, the tolerance on dimensions shall be:

- a) ± 50 mm for signs less than 2.44 square metres in area
- b) ± 100 mm for signs larger than 2.44 square metres in area.

13.4.2 Message, shape, size, layout, colours

The sign message, shape, size, layout and colours shall be as indicated by the Drawings in conjunction with the latest issue of the *Manual of Uniform Traffic Control Devices*.

13.4.3 Substrate preparation

13.4.3.1 General

After completion of the substrate sheet metal works and before the application of retroreflective sheeting, non-reflective sheeting or paint, the sign panel shall undergo one of the pre-treatments detailed in Clauses 13.4.3.2 and 13.4.3.3.

13.4.3.2 Aluminium panels

The aluminium panel shall be thoroughly cleaned and degreased and shall be mechanically abraded in accordance with the sheeting manufacturer's recommendations.

Chemical treatment shall not be used.

13.4.3.3 Zinc/Aluminium coated steel panels

The zinc/aluminium coated steel panel shall be thoroughly cleaned and degreased and shall be primed with an approved primer in accordance with the paint manufacturer's recommendations.

Alternatively, if the zinc/aluminium steel sheeting material has been shop primed by the sheeting manufacturer, the panel shall be thoroughly cleaned and degreased.

13.4.3.4 Corflute panels

The corflute panel shall be prepared in accordance with the sheeting manufacturer's recommendations.

13.4.4 Sheeting application

Retroreflective and non-reflective sheeting shall be applied to the face of the sign panel in a manner specified by the sheeting manufacturer.

All letters, arrows, symbols and borders shall be applied by:

- a) a silk screening process
- b) pre-cut retroreflective or non-reflective material
- c) electro-cut translucent film, or
- d) digital printing.

Silk screening may be accomplished either before or after application of the sheeting to the sign blank. If required, retroreflectorised signs shall be clear coated in accordance with the retroreflective sheeting and/or ink manufacturer's recommendations.

13.4.4.1 Digital printing

Digital printing technologies may be used for manufacture of signs. If using digital printing, only matched component inks and printer devices recommended by the retroreflective sheeting manufacturer shall be used. The ink and any protective coating shall be compatible with the background material, both in application and durability.

13.4.5 Sign panel size and joints

In general, signs panels of size up to 2400 mm x 1200 mm shall be manufactured from one sheet of substrate material. Larger sign panels shall be manufactured either:

- a) as modular panels which can be erected as separate sections and joined together without the need for on-site riveting, or
- b) by joining a number of panels together in accordance with the provisions of Clause 13.4.9.

Modular panel signs shall be constructed in accordance with the typical details contained in the *Design Guide for Roadside Signs*.

Plank boards shall have the planks in the horizontal direction.

13.4.6 Provision for mounting signs

In general, sign faces shall be manufactured with stiffener rails for support and for mounting purposes. Stiffener rails shall comply with the requirements of Clause 13.4.7.

Signs up to both 950 mm in width (measured horizontally) and 1,000 mm in depth shall be provided with square holes for mounting instead of stiffener rails. Square holes shall comply with the requirements of Clause 13.4.8.

13.4.7 Stiffener rails

13.4.7.1 Location of stiffener rails

Stiffener rails shall be mounted horizontally and spaced equally.

Signs up to both 950 mm in width (measured horizontally) and 1000 mm in depth do not require stiffener rails unless specified. Signs that are wider than 950 mm measured horizontally and less than 1000 mm in depth require a minimum of two stiffener rails. Signs narrower than 950 mm in width measured horizontally and greater than 1000 mm in depth require stiffeners spaced as per Table 13.4.7.1.

Warning signs that are equal to and greater than 750 mm x 750 mm, shall include a minimum of three stiffener rails.

Stiffener rails shall be mounted horizontally and spaced equidistant (normally multiples of 25 mm). Type 1 and Type 2A stiffener rails (Standard Drawing 1369) or equivalent shall be used for signs greater than 1200 mm in depth as specified. Signs less than 1200 mm in depth, where the stiffener is non-structural, can use Type 1 stiffeners or any stiffener that is compatible with the standard fittings.

The maximum stiffener spacing for single panel signs shall be 500 mm and that for modular panel signs shall be 575 mm.

The maximum panel overhang between stiffener and the top or bottom of the sign shall be 150 mm. The maximum distance between the end of the stiffener rail and the edge of the sign shall be 50 mm.

Information on stiffener rails for sight boards is given in Standard Drawing 1452.

Table 13.4.7.1 – Sign depth and stiffener requirements

Signs of Normal Construction		Signs of Modular Construction	
Sign Depth (mm)	Minimum Number of Stiffeners	Sign Depth (mm)	Minimum Number of Stiffeners
300 – 800	2†	300 – 1300	N/A
825 – 1300	3†	1325 – 1400	4
1325 – 1800	4	1425 – 1925	5
1825 – 2300	5	1950 – 2400	6
2325 – 2800	6	2425 – 2600	7
2825 – 3300	7	2625 – 3125	8
3325 – 3800	8	3150 – 3600	9
3825 – 4300	9	3625 – 3800	10
4325 – 4800	10	3825 – 4325	11
4825 – 5300	11	4350 – 4800	12
5325 – 5800	12	4825 – 5000	13
5825 – 6300	13	5025 – 5525	14
6325 – 3800	14	5550 – 6000	15
6825 – 7300	15	6025 – 6200	16
7325 – 7800	16	6225 – 6725	17
7825 – 8300	17	6725 – 7200	18
		7225 – 7400	19
		7425 – 7925	20
		7950 – 8400	21

† Required only for signs wider than 950 mm and warning signs in accordance with Clause 13.4.7.1.

13.4.7.2 Fixing sign panels to stiffeners

Fixing of sign panel substrate sheets to stiffener rails shall be accomplished by one of the following methods:

- a) self-piercing riveting systems
- b) 4.8 mm to 5 mm diameter monel or stainless steel pop rivets, or
- c) 4.0 mm diameter blind aluminium head pop rivets.

The heads of rivets shall be coloured to match the surrounding material.

The maximum spacing of mechanical fixings shall be 200 mm and the distance from the first fixing to the edge of the stiffener shall not be greater than 30 mm nor greater than that specified by the supplier of the fixing system. An additional fixing shall be installed 20 mm from the first fixing.

The maximum spacing may be slightly increased for proprietary fixing systems provided that the manufacturer's recommendations are followed exactly. Information on stiffener rail fixing to sign panel for sight boards is given in Standard Drawing 1452.

13.4.8 Square holes for mounting signs

Square holes provided for mounting as given in Clause 13.4.6, shall be 11 mm square to accept the square section of a 10 mm diameter cup head bolt.

Holes shall be cleanly punched in the vertical axis of sign panels at the spacings stated in Table 13.4.8 and placed an equal distance from the top and bottom of the sign panel.

Supply of a suitable washer shall be included with any twist type fasteners to avoid damage to the sign sheeting and failure of the substrate by tightening of the bolts.

Table 13.4.8 – Number and spacing of square holes

Sign Depth (mm)	Number of Holes	Hole Spacing (mm)
< 250	1	-
250 – 350	2	200
350 – 550	2	300
550 – 800	2	500
800 – 1000	2	750

13.4.9 Panel sheet joints

Where signs are of such a size as to require more than one sheet of substrate material, all joints shall comply with the following requirements:

- a) sign substrate sheets shall be butted together with a maximum gap of 1 mm at any point along the joint. Overlapping plates shall not be permitted
- b) all vertical joints shall be constructed to ensure no penetration of light. This may be achieved by either:
 - i. complete coverage of the sign and any joints by the reflective sheeting, or
 - ii. a backing strip of the same material as the substrate. The backing strip shall not be installed between the stiffener rails and the back surface of the sign substrate.

The minimum width of the backing strip shall be 50 mm for rivet systems and for high bond adhesive tape systems with 18 mm x 50 mm strips at right angles to the joint at not more than 100 mm centres.

Continuous high bond adhesive tape systems with a minimum width of backing strip of 25 mm may be used, provided that adequate strength is achieved to resist handling, transport and erection stresses.

- c) at horizontal joints, the extrusion used as stiffener rails shall be used as a backing strip and the requirements for stiffener rails shall apply.

Signs that are less than a full sheet size as listed in Table 13.4.9 shall be manufactured without joints.

Signs that are greater than the basic sheet sizes may be manufactured in accordance with the above requirements, using the minimum length of join possible.

Table 13.4.9 – Plate sheet sizes

Plate Sheet Sizes	Width (mm)	Depth (mm)
Common	1200 (2400)	2400 (1200)
Common	900 (1800)	1800 (900)
Not Common	3000 (750)	750 (3000)
Not Common	1800 (1200)	1200 (1800)

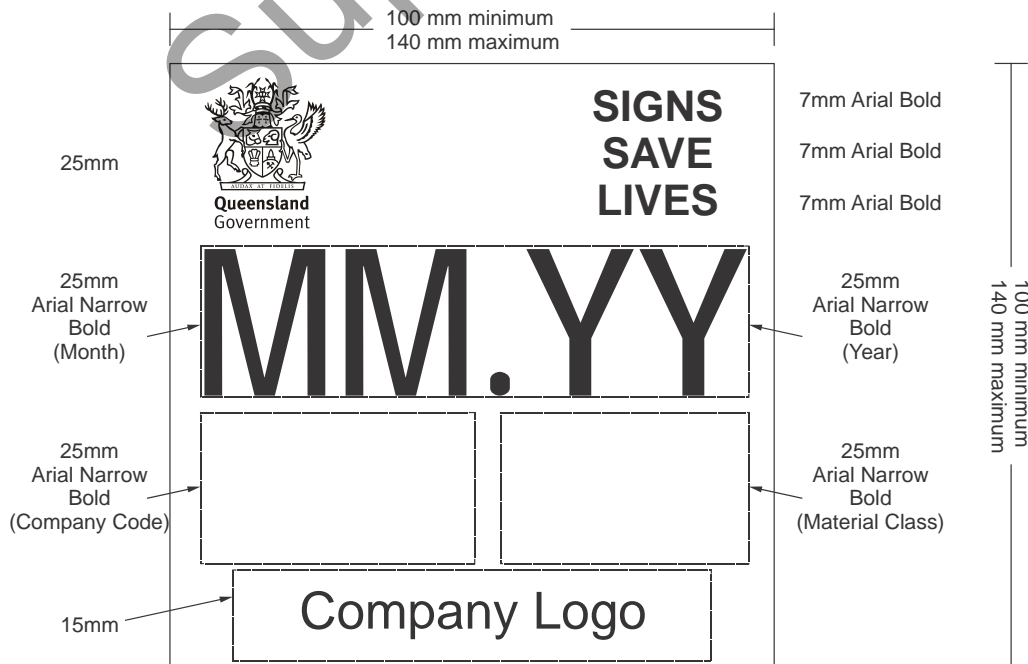
Signs made of more panels than the minimum possible shall not be accepted. Vertical or horizontal panels less than 300 mm shall not to be used except where required for modular sign construction, unless the panel weighs more than 20 kg.

13.4.10 Reference marking

All signs shall have painted, imprinted or indelibly marked onto the substrate on the reverse side of the sign in the lower right hand corner, the following:

- a) The department’s corporate logo of size minimum 25 mm high in the format shown in Figure 13.4.10. The dimensions of the reference marking shall be a minimum of 100 mm x 100 mm and maximum of 140 mm x 140 mm. When a marker size greater than 100 mm x 100 mm is used, the size of all information, excluding the company logo shall remain as shown in Figure 13.4.10.
- b) The month and year of manufacture.
- c) The class and manufacturer’s code of material used as background on the sign (codes - 3M, Ni, Ki, St, Re); or other approved system for identifying the manufacturer and sheeting supplier.
- d) The class of material used as background on the sign (400, 1100).
- e) The legend “Signs Save Lives”.

Figure 13.4.10 –Layout and minimum dimension of sign label



The markings detailed in above shall be black. The lettering in (b), (c) and (d) shall be 25 mm high and located so as to be visible after the sign is erected and not in a position likely to be obscured by stiffener rails or mounting posts. The legend described in (e) shall be located next to the corporate logo in a clear location and shall not exceed the height of the logo.

Signs which are double-sided, e.g. fingerboards, shall have the same information detailed above painted, imprinted or indelibly marked onto one side of the sign in a location such that it is unobtrusive but not obscured after erection. The size of the reference marking for these signs shall be reduced to that required to fit, provided that the details are legible. The legend described in (e) above may be deleted.

13.4.11 Packing

Sign faces shall be suitably crated and/or packed to avoid damage during transport and handling.

Each sign shall be separated from adjacent signs to prevent damage to the sign surface.

If necessary, large signs shall have temporary stiffeners connected during transport.

13.4.12 Warranty

13.4.12.1 General

Where so stated in Clause 7.1 of Annexure MRTS14.1, a performance warranty statement from the sign panel manufacturer shall be included in the quality records.

The warranty shall cover the complete sign panel, including all components thereon or attached, except for the sign face or sheeting, and shall guarantee the sign panel against any defects caused by failure of the components for a period of at least 20 years from the date of manufacture.

Responsibility for failure shall be limited to the following:

- a) poor workmanship
- b) use of unapproved materials
- c) inappropriate use of approved materials
- d) incorrect construction including fastenings.

13.4.12.2 Retro-reflective sheeting (screen printing and digital printing)

A performance warranty statement from the retro-reflective sheeting manufacturer shall be included in the quality records. Retro-reflective materials must retain a photometric performance of at least the percentage shown above throughout the warranty period and, for non-reflective material, must retain integrity and effective colour and appearance. The warranty must include the full cost of sign replacement or repair, including all labour and materials involved. Any replaced or repaired signs must be covered by the remainder of this warranty period. Minimum warranty periods are contained in Table 13.4.12.2.

The warranty shall include the requirement that, if a sign needs to be replaced due to defects in the retro-reflective sheeting, and the sign manufacturer is no longer in business, the manufacturer of the retro-reflective sheeting shall undertake the replacement or repair, including all labour and material involved at the time of replacement. The full replacement warranty period for Classes 400 and 1100 shall not be less than 10 years.

The sign manufacturer shall provide certification confirming acceptance of this condition signed by an authorised corporate officer of the retro-reflective sheeting manufacturer.

Table 13.4.12.2 – Warranty period for sign face materials for screen printing and digital printing

Sign Face Material	Sign Warranty Period (No of years, from date of manufacture)	Retro-reflective properties (% of new value retained)
Class 1100	10	80
Class 1100 (white with EC overlay film)	12	80
Class 1100 screen printed	10	80
Class 1100 fluorescent reflective orange	3	80
Class 1100 fluorescent reflective yellow and yellow green	10	80
Class 400	12	80
Class 400 (white with EC overlay film)	12	80
Class 400 screen printed	10	80
Class 400T sheeting for temporary roadwork signs	3	80

13.4.12.3 Limitations of warranties

Warranties shall not apply to signs damaged by vandalism, the effect of improper maintenance and cleaning practices and accidental damage caused by vehicle accidents or other events.

14 Installation of road signs

14.1 General

This Clause describes the work to be carried out for the installation of regulatory, warning, hazard, direction and information signs under the Contract.

14.2 Materials and fabrication

14.2.1 Fabrication

14.2.1.1 Registered fabricator

Steelwork used to support road signs shall be fabricated only by an approved fabricator. The requirements of registration are outlined in document BCM-P-011. For copy of this document refer to contract details in Clause 1.

To be registered as an approved fabricator of steelwork, a fabricator shall:

- a) Operate a 3rd Party certified quality system to the requirements of AS/NZS ISO 9001. The system shall be audited by the department to ensure that fabricators are working as stated in their system requirements and the system conforms to the requirements of the department's contracts, and
- b) Demonstrate technical conformance to MRTS78 *Fabrication of Structural Steelwork*.
- c) Registration as an approved fabricator shall be reviewed periodically or earlier if unsatisfactory performance is reported.

This clause states that all steel fabrication shall be undertaken by a Transport and Main Roads Registered Fabricator. Structures branch is responsible for the approval of the fabricators on the departmental Approved Supplier List.

The list of approved suppliers is updated on a regular basis and it is recommended that before a contract commences, the Administrator obtains the current list of registered fabricators. For information regarding registered fabricators refer to the departmental website, www.tmr.qld.gov.au. Steelwork shall be fabricated only by an approved fabricator.

14.2.1.2 Fabrication standard

Except where otherwise stated in this Technical Specification, all fabrication shall be carried out in accordance with the requirements of MRTS78 *Fabrication of Structural Steelwork*.

14.2.1.3 Welding personnel

All welders shall:

- a) Satisfy conditions A & B of Clause 4.12.2 of AS/NZS 1554.1.
- b) For SP welding, have a trade qualification, or demonstrate competence equivalent to a trade qualification, and
- c) Welding personnel who do not conform to the requirements of (b) then the following shall be met:
 - i. welders shall be permitted to undertake only fillet welds up to a maximum of 8 mm
 - ii. a representative of Transport and Main Roads Bridge Construction Maintenance and Asset Management shall be present when macro samples are prepared to show conformance with Clause 4.12.2 (b) of AS/NZ 1554.1. The fabricator shall be responsible for covering all costs associated with witnessing the production of the macro samples; **Hold Point 4** and
 - iii. welder re-certification is required every 12 months and the department reserves the right to withdraw welder certification if welding is below the department's requirements.

14.2.2 Materials general

All steel used for the fabrication of components and supports shall comply with the relevant Standard. These include (but not limited) to the following:

- a) hot-rolled section - AS/NZS 3679.1
- b) mild steel plate - AS/NZS 3678
- c) cold-formed section - AS/NZS 4600, and
- d) hollow sections - AS/NZS 1163 Grade LO.

Fabrication of steel members shall conform to the requirements of MRTS78 *Fabrication of Structural Steelwork*.

All steelwork shall be hot-dipped galvanised after fabrication in accordance with the requirements of MRTS78 *Fabrication of Structural Steelwork*.

All steelwork used in the manufacture of structural steelwork is required to comply with Australian Standards. This clause outlines the most commonly used Australian Standards used for the supply of the steel sections.

14.2.3 Posts

Posts for road signs shall generally be circular hollow section or rectangular hollow section unless specifically shown otherwise in the design documentation.

For posts with a total area of attached signs less than 1.0 m² with a maximum sign width of 1000 mm, posts shall be 60.3 OD x 2.9 mm CHS Grade C350 LO to AS/NZS 1163 and they shall comply with the details for low risk or frangible support posts with the base deformed to prevent rotation as shown on Standard Drawing 1368. Footings shall comply with Standard Drawing 1363. The location and height of signs shall comply with the requirements of the *Manual of Uniform Traffic Control Devices*.

For other signs, the size of posts and numbers of posts for each sign shall be as shown in the design documentation. CHS and RHS shall be Grade 250/350/450 LO to AS/NZS 1163 as shown in the design documentation.

The spacing of posts and footings for posts shall be as shown in the design documentation.

Slip bases and fuse plates for posts, where required, shall be fabricated in accordance with the details shown on Standard Drawings 1365 and 1368.

All posts shall be hot-dipped galvanised in accordance with the requirements of MRTS78 *Fabrication of Structural Steelwork*.

The top of posts shall be fitted with a hot-dipped galvanised steel cap.

14.2.4 Connection straps

Connection straps for installation of multi-post signs shall be fabricated from steel to the dimensions and in accordance with the requirements shown on Standard Drawing 1364.

Connection straps for installation of single-post signs shall be fabricated from steel to the dimensions and in accordance with the requirements shown on Standard Drawing 1368.

14.2.5 Brackets

Brackets for installation of fingerboards, geographical feature and street name signs shall be fabricated in accordance with the requirements shown on Standard Drawing 1295.

14.2.6 Fixings

Bolts, nuts and steel washers shall be hot-dipped galvanised and shall conform to the requirements of MRTS78 *Fabrication of Structural Steelwork*.

Bolts for slip bases shall be high strength bolts, Grade 8.8, and shall be supplied with a nut and five washers per bolt.

In special circumstances and where shown on the Drawings, stainless steel bolts, nuts and washers shall be used.

14.2.7 Sign frames

Sign frames shall be fabricated in accordance with the details shown in the design documentation.

The size of the frame shall be checked prior to fabrication to ensure that it can be hot-dipped galvanised after fabrication. The fabrication details shown in the design documentation shall not be amended unless it can be proven that a frame is too large to allow hot-dipped galvanising in Queensland. Double dipping shall be allowed.

14.2.8 Anchor bolts

Anchor bolts for cantilever and gantry signs shall be fabricated as shown in the design documentation. Only metric threads shall be used. All anchor bolts shall be provided with one nut and one steel washer.

Anchor bolts, nuts and washers shall be hot-dipped galvanised.

Anchor bolts shall be provided with a substantial steel template for use in locating the anchor bolts during placement of concrete.

14.2.9 Handling, transport and storage

All sign components shall be handled, transported and stored in such a manner as to prevent damage to members and/or coatings.

Steel slings and tie downs shall not be used during handling and transport.

Sign posts and frames shall be stored on the Site on timber packing well clear of the ground and shall be kept free of dirt, grease and other foreign matter. Components shall be so arranged as to be free draining.

Sign faces shall be stored vertically on edge either in a rack or in such a way that they are supported vertically. Any banding around signs shall be cut and removed on delivery to site.

Signs stored indoors may be left in their original transport packaging provided the storage area is ventilated and the packaging is not wet. Signs stored outside shall be unwrapped from their transport packaging.

Direction and information signs shall be stored avoiding pressure points on sign faces and allowing air circulation between sign faces to prevent a build-up of moisture.

14.3 Construction of footings

Concrete footings for road sign posts shall be constructed:

- a) where specific details for individual signs are shown in the design documentation, in accordance with such details
- b) for circular hollow section and rectangular hollow section posts, in accordance with the details shown on Standard Drawing 1363, or otherwise.

Holes for sign footings shall be excavated to a minimum size as shown in the design documentation. Circular holes shall be excavated using an earth auger.

Anchor bolts for cantilever and gantry signs shall be assembled into the positioning template which shall be held firmly in place during placement of the concrete.

Concrete shall comply with the requirements of MRTS70 *Concrete*.

Unreinforced concrete shall not be less than Normal Class N20/20 and reinforced concrete shall not be less than Special Class S32/20.

For frangible support posts, the Administrator can substitute the nominated concrete (Normal Class N20/20) concrete with a TMR approved proprietary bagged concrete product which has a 28 day compressive strength of not less than 40MPa. The proprietary bagged concrete shall be mixed, placed and cured as per the manufactures requirements.

Steel reinforcing shall comply with the requirements of MRTS71 *Reinforcing Steel*.

For low risk or frangible support posts, are generally installed in locations with very small volumes of concrete required to install the sign.

For these low risk signs, the department is prepared to allow installers to use a proprietary bagged product which can be mixed at the installation site, and therefore, reduce the cost of opening a concrete batch plant for a small load of concrete.

The departmental approved proprietary bagged products can be found under the approved *Product Index for Bridges and Other Structures* on the departmental website.

14.4 Erection of signs

14.4.1 General

Erection of road signs shall be a **Witness Point 1**

14.4.2 Location

Signs shall be erected at the locations shown in the design documentation or, where not so shown, in accordance with the requirements of the *Manual of Uniform Traffic Control Devices*.

The location of posts, transverse to the road centreline shall be in accordance with the details shown in the design documentation.

Orientation of signs shall be in accordance with the requirements of Clause 1.12.5.3 of Part 1 of the *Manual of Uniform Traffic Control Devices*.

14.4.3 Posts

Sign posts shall be erected true to vertical.

Slip bases, where required, shall be assembled strictly in accordance with the details shown on Standard Drawing 1363, 1365, or 1368 (as required). High strength bolts shall be tensioned as detailed on the relevant Standard Drawing.

14.4.4 Frames

Frames for cantilever and gantry signs shall be erected onto the anchor bolts on temporary packers set to the required level. Final adjustments shall be made so that the sign column is vertical. Once vertical the anchor bolts shall be snug tensioned.

The base plates shall be packed with cement mortar consisting of one part of type GP cement and three parts of clean sharp sand with sufficient water added to form a dry packing mortar. All materials shall comply with MRTS70 *Concrete*. The edges of the mortar shall be trimmed neatly to a constant level.

Once the mortar has achieved the required strength, the temporary packers shall be removed and the nuts on the anchor bolts shall be re-tightened.

The mortar where the temporary packers were located shall be repaired with cement mortar consisting of one part of type GP cement and three parts of clean sharp sand with sufficient water added to form a dry packing mortar. All materials shall comply with MRTS70.

14.4.5 Sign faces

When all other erection has been completed, sign faces shall be installed on the posts and/or frame. Sign faces shall be attached to posts or frames at all intersections between the stiffener rails and the post or frame.

Stiffener rails shall be attached to posts with saddles and cup head bolts and nuts. Saddles are not required where sign faces are attached to frames.

Where sign faces are supplied in sections for modular erection, sections shall be connected together with hexagonal-headed bolts, cup head bolts, plates, nuts and washers.

Extreme care shall be taken during erection of sign faces so that the coatings are not damaged and the substrate is not dented.

15 Project signs

15.1 Introduction

Clause 15 applies to the installation, maintenance and removal of project signs.

15.2 Scope

Details of the project signs required to be erected under the Contract are stated in Clause 8 of Annexure MRTS14.1.

15.3 Materials

Signs shall comply with Clause 15.3 and 15.4 of this Technical Specification. Posts and brackets shall comply with Clause 14 of this Technical Specification.

15.4 Erection of project signs

The location of project signs (lateral clearance and mounting height) shall be in accordance with Part 1 Clause 1.12 and Part 2 Figure 2.4 of the *Manual of Uniform Traffic Control Devices*.

The longitudinal location of project signs shall be as shown on the Drawings or, where not so shown, as directed by the Administrator. The erection of signs shall be carried out in accordance with Clause 14.

15.5 Maintenance of project signs

Project signs shall be maintained in good order throughout the Contract.

15.6 Removal of signs

Where so stated in Clause 8 of Annexure MRTS14.1 and on completion of the Works, the project signs and supports shall be carefully removed. Footings shall be removed and holes backfilled and compacted to a standard similar to the adjacent material.

16 Contractor's information signs

Information signs and/or supplementary plates to project signs may be installed.

The location, number and legends of these signs shall comply with Transport and Main Road's policy. Details of such signs shall be submitted to the Administrator at least 14 days prior to commencement of manufacture. **Milestone**

Information signs shall not be manufactured until expiration of the 14 day period. **Hold Point 5**

All of the above signs and supplementary plates shall be removed within 14 days of the Date of Practical Completion.

17 Grids

17.1 General

Clause 17 describes the work to be carried out where a grid is required to be installed under the contract.

17.2 Fabrication

Grid frames shall be fabricated to the details shown on Standard Drawings 1565.

All steel fabrication shall be carried out in accordance with the requirements of MRTS78 *Fabrication of Structural Steelwork*.

Components of grids shall be galvanised in accordance with the requirements of MRTS78 *Fabrication of Structural Steelwork*.

17.3 Precast concrete

Precast concrete barriers and/or components shall be manufactured in accordance with the relevant Standard Drawings and with the requirements of MRTS72 *Manufacture of Precast Concrete Elements*.

17.4 Material requirements

17.4.1 Steel plate and sections

Steel plate shall comply with the requirements of AS/NZS 3678 and shall be a minimum of Grade 250.

Rolled steel sections shall comply with the requirements of AS/NZS 3679.1 and shall be a minimum of Grade 300.

RHS section shall comply with the requirements of AS/NZS 1163 and shall be a minimum of Grade 450 LO. CHS sections for fencing shall comply with the requirements of AS/NZS 1163 and shall be a minimum of Grade 350 LO.

All materials shall be supplied in accordance with the requirements of MRTS78 *Fabrication of Structural Steelwork*.

17.4.2 Bolts, nuts and washers

Bolts shall conform to the requirements of AS 1111, nuts shall conform to the requirements of AS 1112 and flat washers shall conform to the requirements of AS 1237. Bolts, nuts and washers shall be hot-dipped galvanised in accordance with the requirements of AS 1214.

All fasteners with an overall length greater than 40 mm shall comply with the requirements of MRTS78 *Fabrication of Structural Steelwork*.

17.4.3 Included road furniture

Guide posts shall conform to the requirements of Clause 10.

Hazard markers shall conform to the requirements of Clause 14.

Fencing shall conform to the requirements of Clause 11.

Gates shall conform to the requirements of Clause 12.

17.4.4 Concrete

Concrete shall conform to the requirements of MRTS70 *Concrete*. Precast concrete components shall be manufactured in accordance with MRTS72 *Manufacture of Precast Concrete Elements*.

17.4.5 Steel reinforcing

Steel reinforcing shall conform to the requirements of MRTS71 *Reinforcing Steel*.

17.4.6 Cement mortar

Cement mortar shall consist of one part of Type GP cement and three parts of clean, sharp sand with sufficient water added to form a dry packing mortar. All materials shall comply with MRTS70 *Concrete*.

17.5 Construction

17.5.1 General

The grades, sizes and shapes, as relevant, of the concrete structures, steel components, fixtures, fittings and related road furniture shall be shown on Standard Drawings 1353, 1354, 1355, 1561, 1562, 1563, 1564 and 1565.

Grids shall be constructed to the dimensions and other details stated in Clause 9 of Annexure MRTS14.1.

17.5.2 Excavation and backfilling

Excavations shall be carried out in accordance with the requirements of MRTS04 *General Earthworks*.

Where insitu material on or against which concrete abutments and/or slabs are to be constructed is other than rock, the material shall be compacted as for material at the bottom of excavations in accordance with the requirements stated in MRTS04 *General Earthworks*.

Backfilling to abutments and wing walls shall be carried out using selected excavated material in accordance with the requirements stated in MRTS04 *General Earthworks*.

17.5.3 Concrete work

Concrete abutments and slabs shall be constructed without foundation bedding.

Concrete shall be placed, compacted and finished in accordance with the requirements of MRTS70 *Concrete*. Steel reinforcing shall be placed in accordance with the requirements of MRTS71 *Reinforcing Steel*.

Prior to placing the concrete, all holding-down bolt assemblies and bed rail, where required, shall be securely fixed into their final positions so that they are not displaced during placement of concrete.

17.5.4 Precast components

Precast components shall be installed as indicated on the certified Engineering drawings.

17.5.5 Installation of grid frame

The grid frame shall not be supported by the concrete abutments until three days after the placement of the concrete or until the concrete has reached 50% of the specified 28 day characteristic strength, whichever is the lesser.

17.5.6 Installation of fencing

Fencing shall be constructed in accordance with the details shown on Standard Drawings 1353 and 1561 and the requirements of Clause 11.

Gates, where required, shall be installed in accordance with the details shown on Standard Drawing 1353 and to the requirements of Clause 12.

17.5.7 Installation of road furniture

Guide posts shall be installed in accordance with the requirements of Clause 10.

17.5.8 Reinstatement

Following construction of the grids, any disturbed pre-existing formation and/or pavement shall be reinstated to at least the same standard which existed prior to commencement of construction.

Additionally, any pre-existing fencing shall be reinstated to at least the same standard which existed prior to commencement of construction.

17.5.9 Trafficking of grid

Traffic shall not use the grid until 28 days after the placement of the concrete or until the concrete has reached the specified 28 day characteristic strength and a minimum of seven days after placement whichever is the lesser.

18 Road safety barrier systems

18.1 General

Unless expressly specified otherwise in the project design documentation only road safety barriers/systems and/or end treatments that are assessed and accepted for use on state-controlled roads in Queensland shall be used. Barrier Systems which are accepted for use on state-controlled roads in Queensland are listed in the Department of Transport and Main Roads document *Road Safety Barrier Systems, End Treatments and Other Related Road Safety Devices*. This document is updated periodically.

For information regarding registered suppliers and approved products refer to the departmental website, www.tmr.qld.gov.au.

Road safety barriers/systems and end treatments are classified as either “public domain” or “proprietary”.

Wherever there is scope in the contract for the Contractor to select a product or device the Design Criteria/Performance Standards are specified in Clause 11 of Annexure MRTS14.1.

18.2 Public domain road safety barriers and end treatments

Public domain road safety barriers and road safety barrier end treatments are barrier systems details for which are provided on Department of Transport and Main Roads Standard Drawings.

Public domain road safety barriers and road safety barrier end treatments shall be installed in accordance with the Standard Drawings and as shown in and required by the project documentation. Any conflict shall be referred to the contract administrator for determination.

18.3 Proprietary road safety barriers and end treatments

Proprietary road safety barrier systems and road safety barrier end treatments are barrier systems that are subject to intellectual property rights within Australia.

Proprietary road safety barrier systems and road safety barrier end treatments shall be installed in accordance with the supplier's/manufacture's installation manual and as shown in and required by the project documentation. Any conflict shall be referred to the contract administrator for determination.

19 Concrete road safety barrier (public domain)

19.1 General

Clause 19 describes the work to be carried out where public domain concrete road safety barrier is required to be constructed under the Contract.

19.2 Material

19.2.1 Concrete

19.2.1.1 General

Concrete shall conform to the requirements of MRTS70 *Concrete*.

19.2.1.2 Placed concrete

Concrete placed by conventional means shall be Class S40/20.

19.2.1.3 Fibre reinforced concrete

Extruded barriers shall use fibre reinforced concrete.

Fibre reinforced concrete shall consist of Class S32/20, reinforced with nominal 50 mm virgin polypropylene fibrillated fibres incorporated at the rate of 0.9 kg/m³.

19.2.2 Steel reinforcing

Steel reinforcing shall conform to the requirements of MRTS71 *Reinforcing Steel*.

19.2.3 Prestressing strand

Prestressing strand shall conform to the requirements of MRTS73 *Manufacture of Prestressed Concrete Members and Stressing Units*.

19.2.4 Cement mortar

Cement mortar shall consist of one part of Type GP cement and three parts of clean, sharp sand with sufficient water added to form a dry-packing mortar. All materials shall comply with MRTS70 *Concrete*.

19.2.5 Steel plate and sections

Steel plate shall comply with the requirements of AS/NZS 3678 and shall be a minimum of Grade 250.

Rolled steel sections shall comply with the requirements of AS/NZS 3679.1 and shall be a minimum of Grade 300.

19.2.6 Bolts, nuts and washers

Bolts shall conform to the requirements of AS 1111, nuts shall conform to the requirements of AS 1112 and flat washers shall conform to the requirements of AS 1237. Bolts, nuts and washers shall be hot-dipped galvanised in accordance with the requirements of AS 1214.

19.2.7 Electrical conduit and pits

Electrical conduit and cable pits shall comply with the requirements of MRTS91 *Conduits and Pits*.

19.2.8 Compressible filler

Compressible filler shall consist of a bitumen-impregnated fibrous material.

Approved products are listed in Clause 10.1 of Annexure MRTS14.1. Alternative products may be submitted to the department for approval.

19.2.9 Joint sealant

Joint sealant shall be a polyurethane, elastomer-based two-component product suitable for application in vertical joints using a dispensing gun.

Approved products are listed in Clause 10.2 of Annexure MRTS14.1. Alternative products may be submitted to the department for approval.

19.2.10 Delineators

Delineators shall comply with the requirements specified in Clause 10.2.4 of MRTS14 *Road Furniture* for delineators on rigid road edge guide posts.

19.3 Fabrication

Cover assemblies for light poles and cable pits shall be fabricated to the details shown on Standard Drawing 1469.

Cast-in anchor assemblies shall be fabricated to the details shown on Standard Drawing 1467.

Angle connectors and reinforcing connectors shall be fabricated in accordance with Standard Drawing 1473.

All steel fabrication shall be carried out in accordance with the requirements of MRTS78 *Fabrication of Structural Steelwork*.

Steelwork shall be hot-dipped galvanised in accordance with the requirements of AS/NZS 4680.

All bolts shall be hot dip galvanised in accordance with the requirements of AS 1214.

19.4 Construction

19.4.1 General

Concrete road safety barrier shall be constructed in the locations shown on the Drawings and to the details shown on Standard Drawings 1458, 1466 to 1473 inclusive and 1486.

19.4.2 Surface preparation

The surface on which concrete road safety barrier is to be placed shall be prepared by trimming, if required, and sweeping to provide a smooth, even surface for the extrusion machine to travel.

Where dowels are required, a 70 mm diameter hole shall be cored in the existing surface 300 mm long x 24 mm diameter 500N dowel bars shall be installed in the hole and set in cement mortar.

19.4.3 Conduits and pits

Where required, electrical conduit shall be installed longitudinally in the location shown on Standard Drawing 1468. Conduit shall be securely anchored to the existing surface so that it is not displaced during concreting operations.

Where required, cable pits shall be installed in the locations shown in the design documentation.

Conduit and cable pits shall be installed in accordance with the requirements of MRTS91 *Conduits and Pits*.

19.4.4 Formwork

Formwork shall be provided for barrier terminal end sections, barrier cast against walls and piers and any other location where discrete casting of barrier is required.

Compressible filler shall be placed against existing walls and/or piers against which half-section barrier is to be cast.

Anchor bolts or anchor assemblies for connection of steel beam guardrail to barrier terminal ends shall be held securely in place on the formwork so that they are not displaced during placement and compaction of concrete.

19.4.5 Steel reinforcing

Steel reinforcing shall be installed in the locations shown on Standard Drawings 1468, 1470 (includes Steel Schedules) and 1473.

19.4.6 Extruded of concrete barriers

Extruded concrete road safety barrier shall be constructed using a proprietary concrete extruding machine. The machine shall be capable of extruding concrete barrier of the profile shown on Standard Drawing 1468 to the lines and levels shown in the design documentation.

The finished wall surfaces shall be smooth, without surface cracks and other imperfections. Curing of the extruded barrier shall be in accordance with MRTS70.

An initial test section of concrete road safety barrier at least five metres long (and preferably the minimum length nominated in the Standard Drawings) shall be constructed. The test section of barrier shall be inspected for conformance to this Technical Specification and, if conformance is established, further extruded barrier may be constructed. **Hold Point 6**

Subject to satisfying the requirements of the Technical Specification, the test section may be part of the Works.

The concrete barrier shall be terminated and restarted at each road lighting pole location and at each cable pit. The ends of the concrete barrier at such locations shall be perpendicular to the longitudinal grade of the pavement.

19.4.6.1 Concrete

Unless noted otherwise on the drawings, the concrete for extruded concrete road safety barriers shall consist of Class S32/20 concrete compliant with MRTS70 with the following additional requirements:

- a) reinforced with nominal 50 mm virgin polypropylene fibrillated fibres incorporated at the rate of 0.9 kg/m³
- b) specified slump of 10 mm to 20 mm with an acceptance tolerance of ± 10 mm.

Testing and acceptance of concrete for strength shall be in accordance with MRTS70 *Concrete*.

The specified slump for extruded concrete is critical to suit the process and equipment used. Some variation on the specified slump may be required and can be accepted by the administrator but generally the process requires concrete with a slump between 0 and 20 mm.

19.4.7 Placed concrete barriers

Concrete in barrier terminal end sections, barrier cast against walls and piers and any other location where discrete casting of barrier is required shall be placed and compacted in accordance with the requirements of MRTS70 *Concrete*.

19.4.7.1 Expansion joints

Expansion joints in extruded concrete road safety barrier shall be provided at maximum intervals of 100 metres of continuous extrusion and at the junction between extruded barrier and terminal end sections. Expansion joints shall generally not be required where light poles are included in the line of the barrier.

Expansion joints shall be installed vertical, using compressible filler and 1 metre long x 16 mm or 24 mm diameter round dowel bar as shown on Standard Drawing 1468. The line of the expansion joint shall be perpendicular to the longitudinal grade of the pavement. The external edge of the joint shall be sealed with joint sealant.

19.4.7.2 Contraction joints

Contraction joints shall be provided at maximum intervals of four metres.

Contraction joints shall be formed by saw cutting to a depth of 50 mm right around the external surface of the barrier. The line of the saw cut shall be perpendicular to the longitudinal grade of the pavement.

The time of saw cutting shall be determined so that shrinkage cracking is eliminated but in no case shall be longer than 12 hours after extrusion of the barrier.

19.4.8 Cover plate assemblies

Rolled steel angles for attaching cover plates shall be fixed to the ends of concrete barrier at light pole and cable pit openings using proprietary chemical anchors as shown on Standard Drawing 1469.

The gap between the ends of the barrier and the light pole footing or cable pit shall be filled with cement mortar, formed to the shapes shown on Standard Drawings 1469.

Cover plates shall be installed onto the attaching angles with M12 galvanised button head socket screws.

19.4.9 Tolerances

For in situ construction of concrete road safety barrier (i.e., excluding precast units) the dimensional tolerances provided in AS/NZS 3845 shall apply.

For precast units, unless specified elsewhere in the design documentation, the alignment in plan of the completed barrier shall not deviate from the design alignment by more than ± 20 mm at any point and the height shall not deviate from the design height by more than ± 20 mm at any point. The relative displacement of adjoining units shall not exceed 20 mm.

19.4.10 Delineator spacing

Delineators on concrete road safety barriers shall be mounted at the spacings prescribed in Part 2 of the *Manual of Uniform Traffic Control Devices*. The colour of delineators shall be in accordance with the requirements of the *Manual of Uniform Traffic Control Devices*. Delineators shall conform with the requirements of Clause 19.2.10 and shall be affixed to the barrier via a fixing bracket in accordance with Standard Drawing 1466. The fixing bracket shall be attached to the top of the concrete road safety barrier with one 10 mm diameter masonry anchor with a minimum of 30 mm into concrete.

19.4.11 Precast concrete

Precast concrete barriers and/or components shall be manufactured in accordance with the relevant Standard Drawings and with the requirements of MRTS72 *Manufacture of Precast Concrete Elements*. Precast concrete barriers shall be installed to the line and level shown in the design documentation. Barriers shall be installed to achieve the minimum barrier length as detailed in the design documentation. Individual precast concrete barriers shall be connected together with permanent connectors as specified in the design documentation.

20 Steel beam guardrail and end treatments (public domain)

20.1 General

Clause 20 describes the work to be carried out where a public domain steel beam guardrail and/or end treatment is required to be constructed under the Contract.

20.2 Manufacture

20.2.1 Registered manufacturer

The manufacture of the steel beam guardrail posts, panels components and end treatments shall only be manufactured by a registered manufacturer. The requirements of registration are outlined in document SCM-P-015 (refer Transport and Main Roads website).

An exemption to this is the manufacture of the "W Beam to Thrie Beam Transition Rail (B007)" as shown in Standard Drawing 1481. In this instance, the supplier needs to provide the department the following document with the supplied product:

- copies of material certificates in accordance with the relevant Australian Standards. Testing shall be performed by an ILAC accredited laboratory.

Registration as a manufacturer will be reviewed periodically or earlier if unsatisfactory performance is reported.

For information regarding registered suppliers and approved products refer to the departmental website, www.tmr.qld.gov.au.

Transport and Main Road Structure's section is responsible for the management and administration of the department's Registered Manufacturers list.

The list of registered manufacturers is updated on a regular basis. All tenderers and or contractors should refer to the latest list which can be found on the department's website, www.tmr.qld.gov.au. If the tenderer or contractor proposes to use an unregistered manufacturer, they should ensure that the manufacturer is registered prior to submission of the tender.

20.2.2 Registered manufacturer in Australia

To be registered as an approved manufacturer of Public Domain Steel Beam Guardrail and End Treatments, a manufacturer shall:

- a) to operate a third party quality system certified to AS/NZS ISO 9001. The system will be audited by Transport and Main Roads to ensure that manufacturer is working as stated in their system requirements and the system conforms to the requirements of Transport and Main Roads contracts
- b) demonstrate technical conformance to MRTS14
- c) manufacture the posts, panels, yokes and slip base posts
- d) provide traceability of all materials
- e) maintain records of all products placed on the market for a minimum of 10 years
- f) make available all relevant documentation when product is supplied.

This clause outlines the minimum requirements which must be satisfied for a manufacturer wishing to supply public domain guardrail components in Australia.

Requirements to become an approved manufacturer are outlined in the Department of Transport and Main Roads *SCM-P-015 Registration Scheme – Suppliers and Products for Bridges and Other Structures*.

All manufacturers are required to provide the name and contacts from at least five English speaking referees, who can attest to the quality of the guardrail manufacturer, before any audits are undertaken.

Approval is granted to the manufacturer and not the supplier.

20.2.3 Registered manufacturer – outside Australia

To be registered as an approved manufacturer of Steel Beam Guardrail and End Treatments, a manufacturer shall:

- a) Operate a third party quality system certified to AS/NZS ISO 9001. The system will be audited by an Auditor acceptable to Transport and Main Roads. The Auditor shall ensure that the manufacturer is working as stated in their system requirements and the system conforms to the requirements of Transport and Main Roads contracts.
- b) Demonstrate technical conformance to MRTS14. The technical capability shall be audited by an Auditor acceptable to Transport and Main Roads. The Auditor shall ensure that the manufacturer can demonstrate technical conformance to MRTS14.
- c) Manufacture the posts, panels, yokes and slip base posts.
- d) Provide traceability of all materials.
- e) Maintain records of all products placed on the market for a minimum of 10 years.
- f) Make available all relevant documentation when product is supplied.

This clause outlines the minimum requirements which must be satisfied for a manufacturer wishing to supply public domain guardrail components from outside Australia.

Requirements to become an approved manufacturer are outlined in the Department of Transport and Main Roads *SCM-P-015 Registration Scheme – Suppliers and Products for Bridges and Other Structures* on the departmental website via www.tmr.qld.gov.au.

All manufacturers are required to provide the name and contacts from at least five English speaking referees, who can attest to the quality of the guardrail manufacturer, before any audits are undertaken.

Approval is granted to the manufacturer.

20.3 Supplier

20.3.1 Registered supplier

Steel beam guardrail components and end treatments shall only be supplied by an approved supplier. The requirements of registration are outlined in document SCM-P-015. For copy of this document refer to contract details in Clause 1.

To be registered as an approved supplier of Steel Beam Guardrail and End Treatments, a supplier shall:

- a) Operate a third party quality system certified to AS/NZS ISO 9001. The system will be audited by Transport and Main Roads to ensure that manufacturer are working as stated in their system requirements and the system conforms to the requirements of Transport and Main Roads contracts.
- b) Source the posts, panels, yokes and slip base posts from a departmental approved manufacturer.
- c) Source other components used in the supply of guardrail and end terminals to the requirements of this Technical Specification.
- d) Ensure the material test certificates supplied by the Manufacturer match the product supplied.
- e) Maintain records of all products placed on the market for a minimum of 10 years.
- f) Ensure the products supplied comply with the requirements of the departmental Standard Drawings and Technical Specifications.
- g) Ensure the correct products are supplied to the projects and all documentation is correct.

Registration as an approved supplier will be reviewed periodically or earlier if unsatisfactory performance is reported.

This clause states that all guardrail components shall be supplied by a Transport and Main Roads Registered Supplier. Transport and Main Roads Structure's is responsible for the approval and removal of the Suppliers on the departmental Approved Supplier List. An approved guardrail system assumes specific steel strength ductility characteristics and appropriate galvanising. It is important that only the approved products and materials are used.

The list of approved suppliers is a live database which is updated on a regular basis. The tenderer and or contractor should obtain the up to date list. A current list of approved suppliers is available from the departmental website, www.tmr.qld.gov.au.

20.4 Material requirements

20.4.1 Steel components

Steel components shall be manufactured to the details shown on Standard Drawings 1467, 1470, 1474, 1475, 1476, 1477, 1478, 1479, 1480, 1481 and 1482.

All steel components shall be hot-dipped galvanised after manufacture in accordance with the requirements of AS/NZS 4680.

20.4.2 Panels

20.4.2.1 Material requirements

Steel beam guardrail panels shall be manufactured to the detail shown on Standard Drawings 1480 and 1481 from steel conforming to the requirements of AS/NZS 1594 grade HA350.

When tested in accordance with AS 1391, the mechanical properties of the base metal shall conform to the requirements of Table 20.4.2.1(a).

Table 20.4.2.1(a) – Base metal mechanical properties

Property	Limits
Yield Stress, Minimum	340 MPa
Ultimate Tensile Stress, Minimum	450 MPa
Elongation, Minimum	15%

The panel section after rolling shall have a maximum tolerance on camber in any 2,500 mm length of 4.5 mm.

The base metal strip used for fabrication of guardrail panels shall conform to the tolerances listed in Table 20.4.2.1 (b).

Table 20.4.2.1(b) – Base metal tolerances, panels

Property	Tolerance (mm)
Base metal thickness (2.7 mm)	+ 0.21
Mill tolerance on strip width	+ 2.5 – 0

Terminal sections and stiffener plates shall be fabricated from similar material to guardrail panels.

20.4.2.2 Batch marking requirements

All panels shall be hard stamped during the manufacturing process with the following information:

- a) Manufacturer’s unique company identification.
- b) Grade of material and base metal thickness, and
- c) Unique batch number of product which is produced from:
 - i. a single coil of steel
 - ii. identifiable multiple coils of steel used in the manufacture process.

A single batch shall consist of no more than 2000 items.

Materials test certificates shall comply with the requirements of Clause 20.4.5.

Typical view of the hard stamped details on the guardrail panel



20.4.3 Steel posts and blockouts

20.4.3.1 Material requirements

Steel posts and blockouts shall be fabricated from steel conforming to the requirements of AS/NZS 1594 grade HA300.

20.4.3.2 Batch marking requirements

All steel posts and blockouts shall be hard stamped during the manufacturing process with the following information:

- a) Manufacturer's unique company identification.
- b) Grade of material and base metal thickness, and
- c) Unique batch number of product which is produced from:
 - i. a single coil of steel
 - ii. identifiable multiple coils of steel used in the manufacture process.

A single batch shall consist of no more than 2000 items.

Materials test certificates shall comply with the requirements of Clause 20.4.5.

20.4.4 Steel plate, strip, bar and attachments

Steel plate, strip, bar and attachments shall conform to the requirements specified on the Standard Drawings elsewhere mentioned in Clause 22.

Materials test certificates comply with the requirements of Clause 20.4.5.

20.4.5 Material conformance

All the steel manufacturer material test certificates shall be supplied to the Administrator. The steel manufacturer's test certificates shall show the following:

- a) full chemical composition including the carbon equivalence
- b) mechanical test results for yield, tensile and elongation.

The Administrator shall review and approve the material test certificates. **Hold Point 7**

If test certificates are not available, then the Contractor shall submit to the Administrator for approval a proposal for selecting samples for testing of mechanical properties and chemical analysis and in accordance with the appropriate Australian Standard at no expense to the Principal. **Witness Point 2**
Minimum testing requirements are four samples of each production batch.

This clause requires the Contractor to supply the material test certificates for all material used in the manufacture of the guardrail components. This requirement was introduced as the department found that some steel merchants were sourcing materials which did not comply with the requirements of the relevant Australian Standards.

The manufacturer is required to trace the coil of steel to the product manufactured. The Contractor is required to submit the material test certificates with the guardrail components supplied to a project.

20.4.6 Material audit testing

All guardrail posts and panels shall be audit tested by the Administrator using one of the following options.

20.4.6.1 Project testing

All projects shall be supplied with a minimum of two extra posts and two extra panels from each batch of panels and posts supplied to the project.

The Administrator shall randomly select two post and two panels from each batch number for audit testing. **Witness Point 3**

20.4.6.2 Previous project testing

Posts and panels which have previously been project tested can apply to the Administrator for a concession on carrying out the project testing, provided the batch marking numbers match the audit test reports.

20.4.6.3 Testing requirements

The posts and panels shall have the following tests undertaken:

- a) dimensional check with departmental Standard Drawings
- b) full chemical composition including the carbon equivalence
- c) determine the Base Metal Thickness (BMT)
- d) mechanical test results for yield, tensile and elongation.

Installation shall not commence until the Administrator has confirmed the materials tested match the material test certificates supplied for the batch of guardrail components. **Hold Point 8**

Guardrail components which do not match the product supplied shall be rejected and replaced with new guardrail components with a different batch number.

All guardrail posts and panels will be audit tested to ensure the material test certificates match the material supplied.

20.4.7 Fasteners

Hexagonal head bolts and nuts shall be manufactured to the dimensions shown on the Standard Drawings noted in Clause 20.4.1. These fasteners shall comply with the requirements of AS 1111, AS 1112, AS/NZS 1252 as appropriate. These fasteners shall be tested in accordance with the requirements of MRTS78 *Fabrication of Structural Steelwork*.

Mushroom head bolts, product Grade C, shall be manufactured to the details shown on Standard Drawing SD1479 and shall comply with AS/NZS 1390. Mushroom head bolt assemblies designated as Class 4.6 shall have the chemical and mechanical properties outlined in AS 1111.1 and AS/NZS 1112.3. Mushroom head bolt assemblies designated as Class 8.8 shall have the chemical and mechanical properties outlined in AS/NZS 1252. These fasteners shall be tested in accordance with the requirements of MRTS78 *Fabrication of Structural Steelwork*.

Where the length of the bolt, in accordance with AS/NZS 1252, both hexagonal and mushroom head, prevents it from being mechanically tested no assembly test will be required.

Circular washers to conform to AS 1237 and taper washers to conform to AS/NZS 1252.

All fasteners to be hot dip galvanised to AS/NZS 1214.

20.4.8 Delineators

Delineators shall comply with the requirements specified in Clause 10.2.4 and in accordance with the requirements of Standard Drawing 1478.

20.4.9 Cable and Cable assembly

Cable shall be right ordinary lay rope (sZ) conforming to AS 3569 and as detailed on Standard Drawing 1479. Cable assembly (FC01) shall be in accordance Standard Drawing 1479. A NATA certified test certificate outlining the mechanical test results for breaking strength (must withstand 200kN minimum), of the cable assembly shall be included in the quality records.

The test certificate shall be traced back to the individual cable assemblies supplied to the project, via an identification tag.

20.5 Fabrication of guardrail components

20.5.1 Fabrication standard

Except where otherwise stated in this Technical Specification, all welded components shall be fabricated in accordance with the requirements of MRTS78 *Fabrication of Structural Steelwork*.

20.5.2 Welding personnel in Australia

All welders shall:

- a) Satisfy conditions A & B of Clause 4.12.2 of AS/NZS 1554.1.
- b) Welding personnel require macro re-qualification on a 12 monthly basis for each weld procedure undertaken on Transport and Main Roads projects.
- c) For SP welding, have a trade qualification, or demonstrate competence equivalent to a trade qualification.
- d) Welding personnel who do not conform to the requirements of (b) then the following shall be met:
 - i. welders shall be permitted to undertake only fillet welds up to a maximum of 8 mm
 - ii. a representative of Transport and Main Roads Bridge Construction Maintenance and Asset Management shall be present when macro samples are prepared to show conformance with Clause 4.12.2 (b) of AS/NZS 1554.1.

The fabricator shall be responsible for covering all costs associated with witnessing the production of the macro samples. **Hold Point 9**

Transport and Main Roads reserves the right to withdraw welder qualification if welding is below Transport and Main Roads requirements.

This clause outlines the requirements for the staff undertaking the welding of structural steelworks to ensure that the welders are suitably qualified for the welding to be undertaken on departmental projects.

20.5.3 Welding personnel outside Australia

All welding undertaken outside Australia shall:

- a) Satisfy the conditions of Clause 4.12.2 of AS 1554.1. All welding personnel require macro re-qualification on a 12 monthly basis for each weld procedure undertaken on Transport and Main Roads projects.
- b) Have a trade qualification, or demonstrate competence equivalent to a trade qualification subject to approval by Director (Bridge Construction Maintenance and Asset Management).

Transport and Main Roads reserves the right to withdraw welder qualification if welding is below the department's requirements.

This clause outlines the requirements for the staff undertaking the welding of structural steelworks to ensure that the welders are suitably qualified for the welding to be undertaken on departmental projects.

20.6 Installation

20.6.1 General

Steel beam guardrail shall be installed in the locations shown in the design documentation and in accordance with the details shown on Standard Drawings 1467, 1470, 1474, 1475, 1476, 1477, 1478, 1479 and 1482.

Where installation of posts cannot be placed in accordance with the design drawings, it may be necessary to drill additional holes to facilitate installation. In this instance, additional holes shall be drilled either by a magnetic or pneumatic drill and treated in accordance with AS/ANZ 4680. No flame cutting is permitted.

All bolts and nuts shall be securely tightened after installation. Washers shall not be used except where shown on the drawings.

Bolts for slip base plates shall be fastened to the torque specified on Standard Drawing 1476.

Any damage to guardrail components which occurs during the Contract shall be repaired to a finish complying with the requirements of this Technical Specification.

This clause outlines the dimensional requirements for the guardrail and end treatment installation. The overall performance of the guardrail and end treatment relies on the correct installation. Failure to install the guardrail and end treatment correctly could result in the guardrail and end treatment not performing as designed.

20.6.2 Posts for Longitudinal Barrier (excluding public domain end treatments)

Steel posts may be driven or installed by the excavation and backfilling of a post hole. Posts shall not be driven into any asphalt layer or into concrete or into rock or into any pavement layer constructed in accordance with the requirements of Technical Specification MRTS07A *In situ Stabilised Subgrades using Quicklime or Hydrated Lime*, MRTS07B *In situ Stabilised Pavements using Cement or Cementitious Blends*, MRTS07C *In situ Stabilised Pavements using Foamed Bitumen*, MRTS08 *Plant-Mixed Heavily Bound (Cemented) Pavements*, MRTS09 *Plant-Mixed Pavement Layers Stabilised Using Foamed Bitumen* or MRTS10 *Plant-Mixed Lightly Bound Pavements*.

Where a post is to be installed into an asphalt layer or into concrete or into rock or into any pavement layer constructed in accordance with the requirements of Technical Specification MRTS07A, MRTS07B, MRTS07C, MRTS08, MRTS09 or MRTS10 the following procedure shall be used:

- a hole of at least 400 mm diameter shall be excavated or bored to within 300 mm of the bottom of the post or to not less than the underside of the constraining material as described above whichever is the shallowest
- the hole shall be located so that the intended location of the post is aligned either centrally in the hole or closer to the side of the hole closest to the traffic lane from which most errant vehicles will originate
- the post shall be driven to the correct height
- the hole shall be backfilled around and within the open section of the post with clean, well-graded sand compacted so that it does not settle or arch, nor do voids form within the backfill, and
- the top 40 mm shall be completed with a sand-cement mortar.

During the driving of any post, an appropriate packer shall be used to protect the head of the post from damage and no damage shall occur to the post or to any protective coating. Any coating that is damaged during driving shall be repaired in accordance with AS/NZS 4680. The recommended repair for damaged galvanising is to apply two coats of inorganic zinc primer applied by brush.

The method of installation shall be recorded in the quality documentation.

20.6.3 Posts for public domain end treatments

The in-ground part of each of the six slip-base posts comprising a Terminal Type 1 end treatment as depicted on Standard Drawing 1474 (and others) may be driven or installed in a concrete footing. The concrete footing for each slip-base post shall be Class N25/20 concrete of a minimum diameter of 450 mm and of full depth to the bottom of the installed post. Where slip-base posts one and two are installed in a concrete footing, the soil plates may be omitted from these two posts.

Where Terminal Type 1 end treatments are to be installed in bound (i.e. AC or CTB) pavements it may be convenient (to the installer) to drive the slip-base footings. If so, providing that the total bound pavement depth where the post is being installed is not less than 330 mm thick measured from the surface, the soil plates may be omitted from posts one and two. It shall be incumbent upon the contractor/installer to demonstrate that driving posts through the bound pavement does not cause damage to the post which will be detrimental to the performance or the durability of the post. The contractor/installer shall make good any damage to the pavement around the base of the post caused by the driving process.

Otherwise, the installation shall be in accordance with Standard Drawing 1474 and the soil plate shall be installed. Other slip base posts shall be erected strictly in accordance with the details shown on Standard Drawing 1476.

The proposed method of installation of guardrail posts shall be included in the Construction Procedures required under the provisions of Clause 6 of MRTS50.

The soil plate on the Type 2 (departure) terminal as depicted on Standard Drawing 1474 (and others) may not be omitted.

20.6.4 Anchor cables

Anchor cables shall be erected strictly in accordance with the details shown on Standard Drawings 1474, 1476 and 1477. The nuts at both ends of each cable shall be tightened to a torque of 50 Nm.

The test certificate shall be traced back to the individual cables supplied to the project, via an identification tag.

20.6.5 Delineator spacing

Delineators on public domain steel beam road safety barriers shall be mounted at the spacings prescribed in Part 2 of the *Manual of Uniform Traffic Control Devices*. The colour of delineators shall be in accordance with the requirements of the *Manual of Uniform Traffic Control Devices*.

Delineators shall conform with the requirements of Clause 10.2.4 and shall be attached to the barrier in accordance with the detail on Standard Drawing 1478.

The fixing bracket shall be attached to the top of the concrete road safety barrier with one 10 mm diameter masonry anchor with a minimum of 30 mm into concrete.

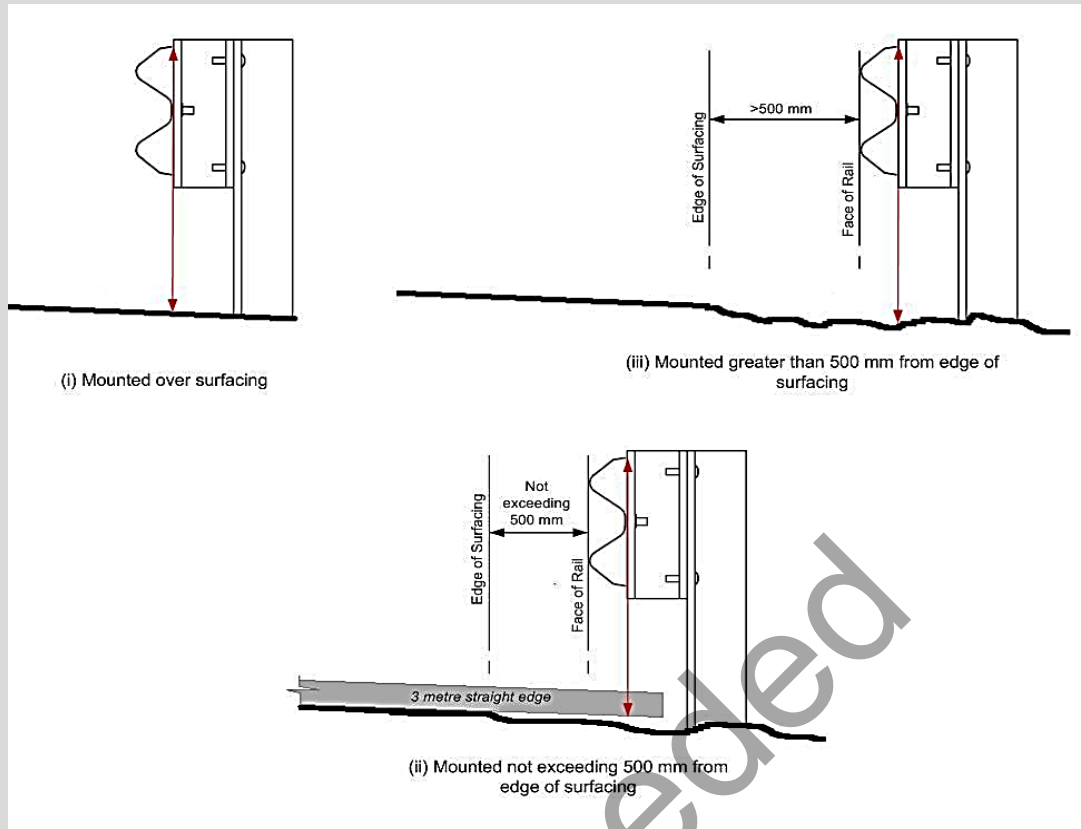
20.6.6 Tolerances

Steel beam guardrail shall be installed to the line and level shown in the design documentation. The tolerance on verticality of post shall be ± 15 mm measured at the top of the post. The tolerance on post height shall be ± 10 mm. The tolerance on rail height shall be ± 10 mm. Height to the top of rail shall be measured at midspan between posts:

- Where the face of steel beam guardrail is located above surfaced pavement, the height shall be measured from the pavement surface to the top of the rail.
- Where the face of steel beam guardrail is located not more than 500 mm beyond the edge of surfacing, a 3 m straight edge shall be lain perpendicular to the alignment of the road centreline to extrapolate the cross slope to meet a point plumb vertically below the back face of the rail. The height shall be measured vertically from this point to the top of the rail.
- Where the face of steel beam guardrail is located beyond 500 mm from the edge of surfacing, the height shall be measured vertically from the ground surface to the top of the rail.

During installation, all elements of the steel beam guardrail shall fit together without the need to enlarge any holes, drill additional holes or modify any component.

How to measure the height of steel beam guardrail. Refer also to Standard Drawing 1474.



20.6.7 Acceptance of installation

Final acceptance of the guardrail installation shall not occur until the Administrator has reviewed that the installation have been installed as per the design documentation and in accordance with the details shown on Standard Drawings and released the Hold Point. **Hold Point 10**

Guardrail components not installed in accordance with the requirements of the design documentation and in accordance with the details shown on Standard Drawings shall be removed and installed correctly.

Steel Quality

It is vital that all steel elements (steel beam, posts, blockouts, fittings etc) comply with the material quality and tolerance requirements. This is to ensure crashworthiness and longevity. Non-compliant steel can lead to rail rupture, post failure and significantly reduce in-service life.

Installation

Not all road safety barriers and end treatments have the same design intent, purpose or performance. Although they are crash tested, their in-service performance depends on proper application and installation as per the Standard Drawings and within the specified tolerances. Improper application or non-compliance installation (i.e. counter to the Standard Drawings and tolerances) can significantly reduce the systems intended performance and compromise the safety benefits.

The below two photographs are examples of incorrect installation.



The first photo (above) depicts frangible elements, slip base posts and tension cables, buried by concrete/median/kerbing level. This prevents the system from functioning and eliminates the intended safety benefits.

The next photograph (below) exhibits the same issue only 10 years later. Posts have been surrounded by concrete affecting system stiffness leading to rail rupture rather than redirection.



21 Proprietary barrier systems and end treatments

21.1 General

Clause 21 describes the work to be carried out where a proprietary road safety barrier system and/or end treatment is required to be installed under the Contract.

Proprietary road safety barrier systems and/or end treatments accepted for use on state-controlled roads in Queensland are identified via Clause 18 of this Technical Specification.

21.2 Manufacture

Proprietary road safety barrier systems and/or end treatments shall be manufactured, fabricated and assembled in accordance with the design and specifications provided by the system and/or device designer for the purpose of getting the system and/or device tested and approved for use. This includes the quality and properties of materials.

The registered supplier of proprietary road safety barrier systems and/or end treatments must keep a signed certificate(s), from the manufacturer, stating that the manufactured / supplied system, device and/or components of a system or device comply with all aspects of the design of the system and/or device. The registered supplier must maintain separation between manufactured / supplied system, device and/or components, and any other materials and/or items to ensure there is no contamination of product. The manufacturer certificates and method of separation are subject to audit.

Once the barrier system and/or end treatment (device) are bundled / assembled for supply to a project, the registered supplier must label or tag the system and/or device with a unique identification number that will be used to link the supplied system and/or device with the required quality documentation.

The installer of proprietary road safety barrier systems and/or end treatments shall provide the following quality document(s) to the Administrator prior to commencement of installation of the system and/or device: **Hold Point 11**

- a signed certificate (from the registered supplier) that the supplied system and/or device has been bundled / assembled correctly in accordance with the design and specifications provided by the system and/or device designer and that the bundling / assembly process only used components supplied from the system and/or device manufacturer.

The certificate must state the unique identification number given to the system and/or device (as above).

21.2.1 Precast concrete barriers

Proprietary concrete barriers shall be manufactured accordance with the requirements of MRTS72 *Manufacture of Precast Concrete Elements*.

If so requested, an installed concrete barrier shall be made available for inspection by the Administrator during the 28 day period described above.

21.2.2 Plastic block outs

Plastic block outs for use in lieu of public domain steel block outs are proprietary components. They may be used only if accepted for use in accordance with Clause 18.1 of this Technical Specification.

The department currently has no detailed Technical Specification for plastic block outs. The use of proprietary plastic block-outs in lieu of public domain steel block-outs will be assessed in accordance with the process described in the document *Road Safety Barrier Systems, End Treatments and Other Related road Safety Devices* as referenced in Clause 18 of this Technical Specification.

Any submission for use of a proprietary plastic block-out for use in lieu of public domain steel block-out as part of a longitudinal steel rail barrier system would need to include, among other things, the following:

- demonstration that the component meets the crash test requirements of Australian Standard AS/NZS 3845
- demonstration that the component can maintain mechanical and elongation properties for a minimum of 20 years
- fabrication drawings which include description of the grade of materials and relevant standards with which the materials are required to comply.

21.3 Design of Proprietary Barrier Systems

Post spacings for proprietary road safety barrier systems and rope tensions (for wire rope barrier systems) are system dependent, details of which are to be determined by the system designer and included in the quality records. Details of the working width of the system (including expected deflection) shall be included in the quality records.

The maximum span between end anchors and between intermediate anchors is proprietary system dependent and design dependent and is to be determined by the system designer and included in the quality records. Wherever there is scope in the contract for the Contractor to select a product or device the Design Criteria/Performance Standards are specified in Clause 11 of Annexure MRTS14.1.

If a specific product is nominated in the design documentation with scope for the use of an alternative product, then the design rationale for selecting that specific product should be documented and made available to the Contractor. This should include among other things:

- a) selected containment capacity
- b) expected deflection and working-width (which should be maintained free from objects)
- c) post spacing
- d) expected maintenance and repair costs
- e) minimum/maximum system length
- f) terminal type and details of any transitions to other barriers
- g) failure (e.g. terminal anchor release) mechanism.

Where words such as “or approved equal” or “or equivalent” are used in the design documentation, the extent to which equivalence is to be demonstrated by the Contractor should be identified by the designer. Where a Contractor/installer has scope to install a system either as an alternative to a nominated variant or from a generic list, then the implications of any such decision need to be made clear to and accepted by the Principal/end user.

21.4 Installation

21.4.1 General

A proprietary road safety barrier system and/or end treatment shall be installed as shown in and required by the design documentation, and in accordance with the requirements of the installation manual.

Where the design is provided by the Principal, any conflict between the design documentation and the supplier's requirements shall be referred to the Administrator for resolution prior to commencement of installation.

Where the design is provided by the Contractor, a complete set of the proprietary product specific design, installation drawings and specifications, as well as evidence and conditions of acceptance for use on state-controlled roads in Queensland shall be provided to the Administrator prior to commencement of installation of the product. **Hold Point 12**. All such documentation shall be included in the quality documentation.

21.4.2 Excavation

Excavation shall be undertaken in accordance with the supplier's requirements, and in accordance with the requirements of MRTS04 *General Earthworks*. Subject to the requirements of supplier, holes for post footings shall be excavated to a minimum size as shown in the design documentation.

21.4.3 Placed concrete

Concrete work shall be in accordance with the requirements of MRTS70 *Concrete*. Steel reinforcing shall be in accordance with the requirements of MRTS71 *Reinforcing Steel*.

21.4.4 Tensioned wire rope

The posts supporting a tensioned wire rope barrier system shall be white.

All ropes shall be tensioned appropriate to the ambient temperature in accordance with the supplier's instructions. Initial tensioning of each rope shall not proceed until at least seven days after pouring the last anchor block or post footing which will be affected by tension in the ropes. Not less than three months after the initial tensioning of the wire rope safety barrier, the contractor shall undertake verification testing by checking the tension in each rope for compliance with the specified requirements **Witness Point 4**. If necessary, the Contractor shall re-tension the ropes to comply with the supplier's specification. Upon completion of the verification of tension and any re-tensioning undertaken, the Contractor shall complete and submit to the Administrator for acceptance a Tension Report. **Hold Point 13**

21.4.5 Delineation

In terms of material and reflectivity, delineation on proprietary road safety barrier systems shall conform to the requirements of Clause 10.2.4 of this Technical Specification for delineation on road edge guide posts.

Delineation on proprietary road safety barrier systems shall be mounted at the spacings prescribed in Part 2 of the *Manual of Uniform Traffic Control Devices*. The colour of delineators shall be in accordance with the requirements of the *Manual of Uniform Traffic Control Devices*.

The reflective area of delineator units and the method of mounting of delineation on proprietary road safety barrier systems shall be as per the supplier's instructions. Exclusively for proprietary wire rope barrier systems, the reflective area of delineator units shall be as large as is practically possible in a single rectangular block.

Where the reflective area of delineator units is less than the minimum requirement prescribed in Clause 10.2.4 of this Technical Specification, then the spacing between adjacent delineators shall be decreased in order to provide not less than an equivalent aggregate reflective area of delineation per linear metre of barrier system.

Commentary on Clause 21.4.5

Part 2 of the *Manual of Uniform Traffic Control Devices* prescribes the spacing requirements for delineators mounted on road safety barrier systems. Where the dimensions of the road safety barrier constrain the size of the delineator unit to be less than that prescribed in Clause 10.2.4 of this Technical Specification, it is appropriate to increase the frequency of delineators in order to provide an equivalent area of delineation.

For example, if the design requirement is 10,000 mm² of delineation at 20 m spacings (which is equivalent to 500 mm² of reflective area per linear metre of barrier), it is acceptable to provide delineators of 5,000 mm² reflective area at not greater than 10 m spacings, or 3,200 mm² at not greater than 6.4 m spacings.

21.4.6 Measurement

21.4.6.1 Height

The height of the system shall be measured in accordance with the supplier's instructions or otherwise measured and recorded vertically from the pavement surface level immediately below the traffic face of the system.

21.4.6.2 Tolerances

A proprietary barrier system or end treatment shall be constructed in accordance with the tolerances specified by the supplier.

Where tolerances are not specified, the alignment on plan of the completed barrier shall not deviate from the design alignment by more than ± 20 mm at any point and the height shall not deviate from the design height by more than ± 10 mm at any point.

21.4.7 Quality Records

The Quality Records for proprietary roadside safety barrier systems and/or end treatments shall include at least:

- i. Evidence and conditions of acceptance for use of the system or device on state-controlled roads in Queensland.
- ii. A copy of the supplier's instructions and any other procedures for the installation and ongoing maintenance and repair.
- iii. Details of the country of manufacture of all components.
- iv. Quality documentation including certification from an appropriately accredited laboratory showing that the supplied components are in accordance with the supplier's specification.
- v. A copy of the detailed design (where the design is not provided by the Principal).

- vi. (For tensioned wire rope) a copy of the Calibration Certificate for the tensioning device. The certificate shall be dated no more than 12 months earlier than the date of installation of the last length of rope to be tensioned.

Where installation spans more than 12 months, separate calibration certificates shall be provided.

22 Supplementary requirements

The supplementary requirements given in Clause 12 of Annexure MRTS14.1 shall apply.

Superseded

Superseded