

Main Roads Technical Standard

MRTS14A

Road Furniture (Steel Work)

SUPERSEDED

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Table of Contents

	Page
1 INTRODUCTION.....	1
2 DEFINITION OF TERMS	1
3 REFERENCED DOCUMENTS	1
3.1 Standards	1
3.2 Standard Drawings.....	2
4 STANDARD TEST METHODS	3
5 QUALITY SYSTEM REQUIREMENTS.....	3
5.1 Hold Points, Witness Points and Milestones.....	3
5.2 Construction Procedures.....	4
6 SURPLUS MATERIAL	4
7 SUPPLY OF ROAD SIGN FACES.....	4
7.1 General.....	4
7.2 Sign Face Layout.....	4
7.3 Material Requirements	5
7.3.1 Sign Substrate	5
7.3.2 Stiffener Rails.....	5
7.3.3 Coatings.....	5
7.4 Fabrication.....	7
7.4.1 General	7
7.4.2 Message, Shape, Size, Layout, Colours	8
7.4.3 Substrate Preparation.....	8
7.4.4 Sheeting Application.....	8
7.4.5 Sign Panel Size and Joints.....	8
7.4.6 Provision for Mounting Signs.....	8
7.4.7 Stiffener Rails.....	9
7.4.8 Square Holes for Mounting Signs.....	10
7.4.9 Panel Sheet Joints.....	10
7.4.10 Reference Marking	11
7.4.11 Packing	11
7.4.12 Warranty	11
8 INSTALLATION OF ROAD SIGNS	12
8.1 General.....	12
8.2 Materials and Fabrication	12
8.2.1 Fabrication	12
8.2.2 Materials General	13
8.2.3 Posts	13
8.2.4 Truss-Type Columns	14
8.2.5 Connection Straps	14
8.2.6 Brackets.....	14
8.2.7 Fixings.....	14
8.2.8 Sign Frames.....	14
8.2.9 Anchor Bolts.....	14
8.2.10 Handling, Transport and Storage.....	14
8.3 Construction of Footings	15
8.4 Erection of Signs	15
8.4.1 General	15
8.4.2 Location	15
8.4.3 Posts and Truss-Type Columns	15
8.4.4 Frames.....	15
8.4.5 Sign Faces.....	16
9 PROJECT SIGNS	16
9.1 Introduction.....	16

9.2	Scope.....	16
9.3	Materials	16
9.4	Erection of Project Signs	16
9.5	Maintenance of Project Signs.....	16
9.6	Removal of Signs.....	16
10	CONTRACTOR'S INFORMATION SIGNS.....	16
11	GRID.....	16
11.1	General.....	16
11.2	Types of Grid.....	17
11.3	Material Requirements	17
11.3.1	Steel Plate and Sections.....	17
11.3.2	Bolts, Nuts and Washers	17
11.3.3	Railway Rails.....	17
11.3.4	Included Road Furniture	17
11.3.5	Concrete.....	17
11.3.6	Steel Reinforcing.....	17
11.3.7	Cement Mortar	17
11.4	Fabrication.....	17
11.5	Construction	18
11.5.1	General	18
11.5.2	Excavation and Backfilling	18
11.5.3	Concrete Work	18
11.5.4	Installation of Grid Frame.....	18
11.5.5	Installation of Fencing	18
11.5.6	Installation of Road Furniture.....	18
11.5.7	Reinstatement.....	18
11.5.8	Trafficking of Grid.....	18
12	CONCRETE TRAFFIC BARRIER	19
12.1	General.....	19
12.2	Material.....	19
12.2.1	Concrete.....	19
12.2.2	Steel Reinforcing.....	19
12.2.3	Cement Mortar	19
12.2.4	Steel Plate and Sections.....	19
12.2.5	Bolts, Nuts and Washers	19
12.2.6	Electrical Conduit and Pits.....	19
12.2.7	Compressible Filler	19
12.2.8	Joint Sealant	19
12.2.9	Delineators	19
12.3	Fabrication.....	20
12.4	Construction	20
12.4.1	General	20
12.4.2	Surface Preparation	20
12.4.3	Conduits and Pits	20
12.4.4	Formwork	20
12.4.5	Steel Reinforcing.....	20
12.4.6	Extrusion of Concrete Traffic Barrier.....	20
12.4.7	Placed Concrete.....	21
12.4.8	Expansion Joints.....	21
12.4.9	Contraction Joints	21
12.4.10	Cover Plate Assemblies.....	21
12.4.11	Delineators.....	21
12.4.12	Precast Concrete Barriers	21
12.5	Propriety Precast Concrete Barriers.....	21
13	STEEL BEAM GUARDRAIL	22
13.1	General.....	22
13.2	Material Requirements	22
13.2.1	Panels	22

13.2.2	Steel Posts and Blockouts	22
13.2.3	Steel Plate, Strip, Bar and Attachments	23
13.2.4	Fasteners	23
13.2.5	Delineators	23
13.2.6	Cable	23
13.2.7	Plastic Block Out	23
13.2.8	Test Certificates	23
13.3	Fabrication	23
13.3.1	Registered Fabricator	23
13.3.2	Fabrication Standard	24
13.3.3	Welding Personnel	24
13.3.4	Steel Components	24
13.4	Installation	24
13.4.1	General	24
13.4.2	Clearance Requirements	25
13.4.3	Posts	25
13.4.4	Anchor Cables	25
13.4.5	Delineators	25
13.4.6	Tolerances	25
14	TENSIONED WIRE ROPE BARRIER SYSTEM	25
14.1	General	25
14.2	General Requirements	25
14.3	Testing	26
14.4	Installation	26
14.5	Delineation	26
15	BARRIER END TREATMENTS	26
15.1	General	26
15.2	Material Requirements	26
15.2.1	General	26
15.2.2	Proprietary Products	26
15.2.3	Fasteners	27
15.2.4	Test Certificates	27
15.3	Fabrication	27
15.3.1	Registered Fabricator	27
15.3.2	Fabrication Standard	27
15.3.3	Welding Personnel	27
15.4	Installation	28
16	STEEL TRAFFIC BARRIERS	28
16.1	General	28
16.2	Material Requirements	28
16.2.1	General	28
16.2.2	Proprietary Products	28
16.2.3	Fasteners	28
16.2.4	Test Certificates	28
16.3	Fabrication	28
16.3.1	Registered Fabricator	28
16.3.2	Fabrication Standard	29
16.3.3	Welding Personnel	29
16.4	Installation	29
17	SUPPLEMENTARY REQUIREMENTS	29

SUPERSEDED

Road Furniture (Steel Work)

1 INTRODUCTION

This Technical Standard applies to the supply and construction of road signs, grids, steel beam guardrail, tensioned wire rope barrier systems, steel traffic barriers and concrete traffic barriers.

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

This Technical Standard forms part of the Main Roads Specifications and Technical Standards Manual.

2 DEFINITION OF TERMS

The terms used in this standard are as defined in Clause 3 of MRTS01 *Introduction to Technical Standards*.

3 REFERENCED DOCUMENTS

3.1 Standards

Table 3 lists documents referenced in this Technical Standard.

Table 3.1 – Referenced Documents

Reference	Title
AS 1111	ISO metric hexagon bolts and screws
AS 1112	ISO metric hexagon nuts
AS 1163	Structural steel hollow sections
AS 1214	Hot-dip galvanized coatings on threaded fasteners (ISO metric coarse thread series)
AS 1237	Plain washers for metric bolts, screws and nuts for general purposes
AS/NZS 1252	High strength steel bolts with associated nuts and washers for structural engineering
AS/NZS 1390	Cup head bolts with ISO metric coarse pitch threads
AS 1391	Cup head bolts with ISO metric coarse pitch threads
AS 1397	Steel sheet and strip – Hot-dipped zinc-coated or aluminium/zinc-coated
AS/NZS 1554.1	Structural steel welding – Welding of steel structures
AS/NZS 1554.4	Structural steel welding – Welding of high strength quenched and tempered steels
AS/NZS 1580.602.2	Paints and related materials – Methods of test – Measurement of specular gloss of non-metallic paint films at 20 degrees, 60 degrees and 85 degrees
AS/NZS 1594	Hot-rolled steel flat products
AS/NZS 1734	Aluminium and aluminium alloys – Flat sheet, coiled sheet and plate
AS 1743	Road signs – Specifications
AS 1744	Forms of letters and numerals for road signs (known as Standard alphabets for road signs)
AS/NZS 1906.1	Retroreflective materials and devices for road traffic control purposes – Retroreflective sheeting
AS/NZS 1906.2	Retroreflective materials and devices for road traffic control purposes – Retroreflective devices (non-pavement application)
AS 2082	Timber – Hardwood – Visually stress-graded for structural purposes
AS 2423	Coated steel wire fencing products for terrestrial, aquatic and general use

Reference	Title
AS 2858	Timber – Softwood – Visually graded for structural purposes
AS 3569	Steel wire ropes
AS/NZS 3678	Structural steel – Hot-rolled plates, floorplates and slabs
AS/NZS 3679.1	Structural steel – Hot-rolled bars and sections
AS/NZS 3679.2	Structural steel – Welded I sections
AS 3730.10	Guide to the properties of paints for buildings – Latex – Exterior – Gloss
AS 3730.13	Guide to the properties of paints for buildings – Primer – Wood – Solvent-borne – Interior/exterior
AS 4100	Steel structures
AS/NZS 4600	Cold-formed steel structures
AS/NZS 4680	Hot-dip galvanized (zinc) coatings on fabricated ferrous articles
NCHRP 350	Recommended Procedures for the Safety Performance Evaluation of Highway Features, TRB, Washington DC (Ross, Sicking, Zimmer & Michie 1993)
	Building Timbers: Properties and Recommendations for their Use in Queensland (Queensland Department of Primary Industries)
	<i>Queensland Timber Utilisation and Marketing Act 1987</i>
	Manual of Uniform Traffic Control Devices – published by Transport and Main Roads
	Design Guide for Road Signs – published by Transport and Main Roads

3.2 Standard Drawings

Table 3.2 lists the Standard Drawings referenced in this document.

Table 3.2 – Referenced Standard Drawings

Drawing Number	Title
1295	Sign – Fingerboard, Geographical Feature and Street Name Signs Bracket Details
1301	Sign – Roadworks Sign Details and Assembly of Crossbars and Supports
1351	Road Furniture – Motor Grid
1352	Road Furniture – Motor Grid with Vermin and Dog Fencing
1353	Road Furniture – Vermin and Dog Fencing at Motor Grid
1363	Traffic Sign – Multiple Traffic Sign Support
1364	Traffic Sign – Connection Strap and Erection Cleat Details
1365	Traffic Sign – Traffic Sign Support Breakaway Post Details (two or more supports)
1366	Traffic Sign – Traffic Sign Support Detail Truss Type Breakaway
1367	Traffic Sign – Traffic Sign Support Detail Truss Type Breakaway Bracing Details
1368	Traffic Sign – Single Traffic Sign Support
1369	Traffic Sign – Details of Sign Stiffening Extrusion
1448	Road Furniture – Motor Grid (RHS Rails)
1449	Road Furniture – Motor Grid (RHS Rails) with Vermin and Dog Fencing
1460	Type F Concrete Barrier -Extruded Median Barrier- Barrier, Reinforcing and Expansion Joint Details

Drawing Number	Title
1461	Type F Concrete Barrier -Extruded Median Barrier- Details of Road Lighting Pole Cover Plates
1462	Type F Concrete Barrier – Transition Between Median Barrier and W Beam Guardrail
1463	Type F Concrete Barrier – Reinforcing Details for Median Barrier Terminal with Lighting
1464	Type F Concrete Barrier – Reinforcing Details for Median Barrier Terminal without Lighting
1465	Type F Concrete Barrier – Fabrication Details for W Beam Guardrail Connection Brackets
1466	Concrete Barriers – Delineator Bracket Details
1467	Concrete Barrier/Bridge Parapet – Cast-In Anchor Assembly for W and Thrie Beam Guardrail Connection
1468	Single Slope Concrete Barrier – Extruded Median Barrier – Barrier, Reinforcing and Expansion Joint Details
1469	Single Slope Concrete Barrier – Extruded Median Barrier – Details of Road Lighting Pole Cover Plates
1470	Single Slope Concrete Barrier – Transition Between Median Barrier and Thrie Beam Guardrail
1471	Single Slope Concrete Barrier – Reinforcing Details for Median Barrier Terminal with Lighting
1472	Single Slope Concrete Barrier – Reinforcing Details for Median Barrier Terminal Without Lighting
1473	Single Slope Concrete Barrier – Precast Concrete Barrier
1474	Steel Beam Guardrail – Installation and Setout
1475	Steel Beam Guardrail – Installation on Bridge and Barrier Approaches
1476	Steel Beam Guardrail – Terminal Components
1477	Steel Beam Guardrail – Posts and Blockouts, Soil and Bearing Plates, Slip Base Plate
1478	Steel Beam Guardrail – W Beam Anchor Bracket Delineation Unit Post on Base Plate Abraham Blockout
1479	Steel Beam Guardrail – Bolts, Nuts, Screws and Washers Cable Assembly with Fasteners
1480	Steel Beam Guardrail – Fabrication Details for W Beam Rails and Rail Components
1481	Steel Beam Guardrail – Fabrication Details for Thrie Beam Rails and Rail Components
1482	Steel Beam Guardrail – W Beam and Thrie Beam Assemblies
1604	Fencing – Galvanized Welded Mesh Fencing

4 STANDARD TEST METHODS

There are no standard test methods referenced by this standard.

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 Standards*.

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

Table 5.1 – Hold Points, Witness Points and Milestones

Clause	Hold Point	Witness Point	Milestone
7.3.1.1	1. Alternative sign face material		
8.2.1.3	2. Welding Personnel		
8.4.1		Erection of road signs	
10	3. Contractor's information signs		Submission of details of information signs (14 days)
11.4	4. Welding for grid fabrication		Submission of welding procedure for grids (7 days)
12.4.6	5. Test section of extruded concrete traffic barrier		
12.5	6. Proprietary precast concrete barrier		Submission of details of proprietary barrier (28 days)
13.2.7	7. Steel beam guardrail – plastic block out		Submission of details of proprietary product (28 days)
13.3.3	8. Welding Personnel		
14.4	9. Provision of documentation for tensioned wire rope barrier system		
15.2.2	10. Proprietary end treatment		Submission of details of proprietary product (28 days)
15.3.3	11. Welding Personnel		
16.2.2	12. Proprietary steel traffic barrier		Submission of details of proprietary product (28 days)
16.3.3	13. Welding Personnel		

5.2 Construction Procedures

Construction procedures which are required to be submitted in accordance with Clause 1 of MRTS50 *Specific Quality System Requirements* are listed in Clause 1 of Annexure MRTS14A.1.

6 SURPLUS MATERIAL

Surplus excavated, removed or demolished material shall be utilised or disposed of in accordance with the requirements of Clause 11 of MRTS01 *Introduction to Technical Standards*.

7 SUPPLY OF ROAD SIGN FACES

7.1 General

Clause 7 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 standard, 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.

7.2 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.

7.3 Material Requirements

7.3.1 Sign Substrate

7.3.1.1 General

The sign substrate shall be manufactured from aluminium except that regulatory parking signs may be manufactured from zinc/aluminium coated steel and temporary signs may be manufactured from zinc/aluminium coated steel or colourbond steel.

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 1**

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 shall be ± 3 mm or 0.25% of the largest dimension, whichever is the greater. The maximum allowable warp, twist or other departure from flatness of the sign substrate shall be 2.5 mm/m in any direction.

7.3.1.2 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 in accordance with Clause 7.3.2.

7.3.1.3 Aluminium Blade Section

Fingerboards, geographical feature and street name signs which use the 200 mm aluminium blade section as detailed on Standard Drawing number 1291 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.

7.3.1.4 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.

7.3.1.5 Flood Depth Indicators

Flood depth indicators shall be manufactured from an extruded aluminium rectangular hollow section, nominal size 150 mm x 38 mm x 3 mm, alloy type 6063, temper T5 or similar.

7.3.1.6 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 7.3.2.

7.3.1.7 Temporary Signs

Temporary signs 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 and Standard Drawing number 1301.

7.3.2 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 number 1369. The section properties of stiffener rails shall be equal to or greater than those stated on Standard Drawing number 1369. The section type shall be as shown on the Drawings.

7.3.3 Coatings

7.3.3.1 General

The class of sign material for the legend and the background shall comply with the minimum standards stated in Clause 2.1 of Annexure MRTS14A.1.

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

7.3.3.2 Retroreflective Sheeting

7.3.3.2.1 Performance

Retroreflective materials shall conform with AS/NZS 1906.1 or shall conform to the requirements in Table 7.3.3.2.1 and thus be considered Class 1X.

Table 7.3.3.2.1 – Minimum optical performance values for Class 1X

Entrance Angle	Observation angle	Minimum CIL/m ² values * for Class 1X (cd/lx.m ²)								
		White	Yellow	Red	Standard Green	Blue	Brown	Fluorescent Yellow green	Fluorescent yellow	Fluorescent orange
4	0.20	500	390	90	50	20	20	400	260	175
	0.33	350	320	75	40	17	17	310	200	100
	0.50	300	210	60	30	15	15	240	180	90
	1.00	80	60	16	8	3.6	3.6	64	48	24
15	0.20	380	265	75	38	19	19	305	190	150
	0.33	350	240	70	35	17	17	280	175	85
	0.50	250	170	50	24	12	12	195	140	70
	1.00	60	45	12	6	3	3	50	30	18
30	0.20	215	162	43	22	10	10	170	130	65
	0.33	175	120	35	17	9	9	140	105	52
	0.50	135	100	27	14	6	6	110	81	41
	1.00	45	34	9	4.5	2	2	36	27	14

* Values specified in the above table are the average of CIL/m² values for 0° and 90° rotation angles, for each entrance angle/observation angle combination

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.

7.3.3.2.2 Rotational Sensitivity

Sheeting shall be tested for rotational sensitivity as stated below.

The average coefficient of retroreflection (RA) for a set of three samples taken from the same roll must not vary more than 20% between RA measured at 0, 45, 90 and 120 degrees of rotation in order to be considered rotationally insensitive. The test shall be conducted at an observation angle of 0.5 degrees and an entrance angle of -4.0 degrees. Calculate the percent difference by dividing the absolute difference between RA (0) and RA (45) by RA (0). Repeat the calculation replacing RA (45) with RA (90) and RA (120). If the average of these three percent differences is less than 20%, the sheeting is considered to be rotationally insensitive. RA (0) is established with the sheeting aligned in its optimum rotation.

For sheeting not meeting the 20% maximum rotational sensitivity requirement, the manufacturer must provide identification marks or other features in or on the sheeting face denoting the optimum orientation of the sheeting. The markings or features must be visible from a minimum distance of 0.6m and must be arrayed in such a manner that they will be readily distinguishable on cut-out legends, symbols, or borders.

The manufacturer must provide fabrication guidelines outlining optimum sheeting orientation upon user request.

When using sheeting that does not meet the 20% rotational sensitivity test, fabricate signs by applying white sheeting for cut-out legends, symbols borders, and route marker attachments, within the parent sign face, in the optimal rotation according to the identification markings; and apply all background sheeting uniformly oriented. When multiple signs are installed for combination usage, (e.g. multiple route markers and/or arrows on a single sign post assembly) signs using rotationally sensitive material shall all be manufactured and installed in the optimal rotation.

7.3.3.3 Non-reflective Coatings

7.3.3.3.1 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.

7.3.3.3.2 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.

7.3.3.3.3 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.

7.3.3.4 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.

7.3.3.5 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 7.4.12.2, or if not stated there refer to AS1906.1.

- 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; and
- 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.

7.4 Fabrication

7.4.1 General

Sign faces shall be fabricated in accordance with the requirements of the Design Guide for Road 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; and

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

7.4.2 Message, Shape, Size, Layout, Colours

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

7.4.3 Substrate Preparation

7.4.3.1 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 7.4.3.2 and 7.4.3.3.

7.4.3.2 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.

7.4.3.3 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.

7.4.4 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 –

- c) a silk screening process;
- d) pre-cut retroreflective or non-reflective material; or
- e) electro-cut translucent film.

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.

7.4.5 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 7.4.9.

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

Plank boards shall have the planks in the horizontal direction.

7.4.6 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 7.4.7

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 7.4.8.

7.4.7 Stiffener Rails

7.4.7.1 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 in width measured horizontally and greater than 1000 mm in depth require stiffeners spaced as per Table 7.4.7.1.

Warning signs that are equal to and greater than 750 mm x 750 mm measured diagonally, shall include 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.

Table 7.4.7.1 – 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 7.4.7.1.

7.4.7.2 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.

7.4.8 Square Holes for Mounting Signs

Square holes provided for mounting as given in Clause 7.4.6, 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 7.4.8 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 7.4.8 – 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

7.4.9 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 covered by 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; and
- 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 7.4.9 shall be manufactured without joins. 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 7.4.9 – Plate Sheet Sizes

Plate Sheet Sizes	Width (mm)	Depth (mm)
Common	1200 (2400)	2400 (1200)

Plate Sheet Sizes	Width (mm)	Depth (mm)
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.

7.4.10 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 100 mm high in the format shown in Figure 7.4.10;
- 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; and
- e) the legend “Signs Save Lives”.

Figure 7.4.10 – The Department’s Corporate Logo



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, eg. 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.

7.4.11 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 by waxed paper of sufficient thickness to prevent damage to the sign surface.

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

7.4.12 Warranty

7.4.12.1 General

Where so stated in Clause 2.2 of Annexure MRTS14A.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; and

d) incorrect construction including fastenings.

7.4.12.2 Retro-reflective Sheeting

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 7.4.12.2.

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 1W and 1X 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 7.4.12.2 – Warranty period for sign face materials

Sign Face Material	Sign Warranty Period (No of years, from date of manufacture)	Retro-reflective properties (% of new value retained*)
Class IX	10	80
Class IX (white with EC overlay film)	12	80
Class IX screen printed	10	80
Class IX fluorescent reflective orange	3	80
Class IX fluorescent reflective yellow and yellow green	10	80
Class 1	12	80
Class 1 (white with EC overlay film)	12	80
Class 1 screen printed	10	80

7.4.12.3 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.

8 INSTALLATION OF ROAD SIGNS

8.1 General

Clause 8 describes the work to be carried out for the installation of regulatory, warning, hazard, direction and information signs under the Contract.

8.2 Materials and Fabrication

8.2.1 Fabrication

8.2.1.1 Registered Fabricator

Steelwork shall be fabricated only by an approved fabricator.

To be registered as an Approved Fabricator of Steelwork, a fabricator shall –

- a) Operate a quality system certified to AS 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*.

Registration as an approved fabricator shall be reviewed periodically or earlier if unsatisfactory performance is reported.

Information regarding approval status can be obtained from –

Department of Transport and Main Roads
Bridge Design
GPO Box 1412
Brisbane, Qld, 4001

8.2.1.2 Fabrication Standard

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

8.2.1.3 Welding Personnel

All welders shall –

- a) satisfy conditions A & B of Clause 4.12.2 of AS 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 Concrete Technology 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 2** and
 - iii) welder re-certification is required every 6 months and the department reserves the right to withdraw welder certification if welding is below the department's requirements.

8.2.2 Materials General

Steel sections and plate used for the fabrication of sign posts, frames and gantries shall comply with the following –

- a) Hot-rolled section, Grade 250 – AS/NZS 3679.1;
- b) Mild steel plate – AS/NZS 3678;
- c) Cold-formed section – AS/NZS 4600; and
- d) Hollow sections – AS 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*.

8.2.3 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 50NB x 3.2 mm CHS Grade C350 LO to AS 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 number 1368. Footings shall comply with Standard Drawing number 1363. The location and height of signs shall comply with the requirements of the MUTCD.

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 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 numbers 1365 and 1368.

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

8.2.4 Truss-Type Columns

Truss-type columns used as sign supports shall be fabricated in accordance with the details shown on Standard Drawings number 1366 and 1367.

The size of truss sections and the number of columns per sign shall be as shown in the design documentation.

8.2.5 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 number 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 number 1368.

8.2.6 Brackets

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

8.2.7 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 5 washers per bolt.

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

8.2.8 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.

8.2.9 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 2 nuts, 2 steel washers and 1 compressible neoprene 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.

8.2.10 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.

8.3 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 number 1363; or otherwise
- c) for truss type columns, in accordance with the details shown on Standard Drawing number 1366.

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 be at least Class 20 MPa/20 and reinforced concrete shall be at least Class 32 MPa/20.

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

8.4 Erection of Signs

8.4.1 General

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

8.4.2 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*.

8.4.3 Posts and Truss-Type Columns

Sign posts and truss-type columns shall be erected true to vertical.

Slip bases, where required, shall be assembled strictly in accordance with the details shown on Standard Drawing number 1365. High strength bolts shall be tensioned as detailed on the Standard Drawing number 1365.

8.4.4 Frames

Frames for cantilever and gantry signs shall be erected onto the anchor bolts after levelling nuts have been set to the required level. One flat washer and one compressible neoprene washer shall be supported by the levelling nut (the neoprene washer last). Final adjustments shall be made using the levelling nuts so that the sign column is vertical.

The base plates shall be packed with cement mortar consisting of 1 part of type GP cement and 3 parts of clean sharp sand with sufficient water added to form a dry packing mortar. The edges of the mortar shall be trimmed neatly to a constant bevel.

When the mortar has cured, the nuts on the anchor bolts shall be tightened.

8.4.5 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, nuts and washers.

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

9 PROJECT SIGNS

9.1 Introduction

Clause 9 applies to the installation, maintenance and removal of project signs.

9.2 Scope

Details of the project signs required to be erected under the Contract are stated in Clause 3 of Annexure MRTS14A.1.

9.3 Materials

Signs shall comply with Clause 9.3 and 9.4 of this standard. Posts and brackets shall comply with Clause 8 of this standard.

9.4 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 8.

9.5 Maintenance of Project Signs

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

9.6 Removal of Signs

Where so stated in Clause 3 of Annexure MRTS14A.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.

10 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 3**

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

11 GRID

11.1 General

Clause 11 describes the work to be carried out where a grid is required to be installed under the contract.

11.2 Types of Grid

There are two types of grid, namely –

- a) railway line rail grids; and
- b) RHS rail grids.

Railway line grids shall conform to Standard Drawings number 1351, 1352 and 1353 as appropriate.

RHS rail grids shall conform to Standard Drawings number 1353, 1448 and 1449 as appropriate.

11.3 Material Requirements

11.3.1 Steel Plate and Sections

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

Rolled steel sections shall comply with the requirements of AS/NZS 3679.1 and shall be Grade 250.

RHS section shall comply with the requirements of AS 1163 and shall be Grade 350 LO.

CHS sections for fencing shall comply with the requirements of AS 1163 and shall be Grade 350 LO.

Certified copies of the steel manufacturer's test sheets showing the chemical properties and results of tensile and elongation tests shall be included in the quality documentation.

11.3.2 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 Clause 6.4 of MRTS78 *Fabrication of Structural Steelwork*.

11.3.3 Railway Rails

Railway rail shall be 22 kg/m section.

11.3.4 Included Road Furniture

Guide posts shall conform to the requirements of Clause 10 of MRTS14 *Road Furniture*.

Hazard markers shall conform to the requirements of Clause 7.

Fencing shall conform to the requirements of Clause 11 of MRTS14 *Road Furniture*.

Gates shall conform to the requirements of Clause 12 of MRTS14 *Road Furniture*.

11.3.5 Concrete

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

11.3.6 Steel Reinforcing

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

11.3.7 Cement Mortar

Cement mortar shall consist of 1 part of Type GP cement and 3 parts of clean, sharp sand with sufficient water added to form a dry packing mortar.

11.4 Fabrication

Grid frames shall be fabricated to the details shown on Standard Drawings number 1351, 1352, 1448 and 1449 as appropriate.

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

All work shall be carried out under the supervision of a welding supervisor who shall be qualified to at least conditions (b) and (c) of Clause 4.11.1 of AS/NZS 1554.4.

At least 7 days prior to commencement of welding, a Welding Procedure Sheet, in accordance with Section 4 of AS/NZS 1554.1 shall be submitted to the Administrator. **Milestone** No welding shall be carried out until expiration of the 7 day period. **Hold Point 4**

Components of grids shall be galvanised in accordance with the requirements of AS/NZS 4680.

11.5 Construction

11.5.1 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 number 1351, 1352, 1353, 1448 and 1449.

Grids shall be constructed to the dimensions and other details stated in Clause 4 of Annexure MRTS14A.1.

11.5.2 Excavation and Backfilling

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

Where in situ 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*.

11.5.3 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.

11.5.4 Installation of Grid Frame

The grid frame shall not be supported by the concrete abutments until 3 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.

11.5.5 Installation of Fencing

Fencing shall be constructed in accordance with the details shown on Standard Drawings number 1351, 1352, 1353, 1448 and 1449 and the requirements of Clause 20.

Gates, where required, shall be installed in accordance with the details shown on Standard Drawing number 1353 and to the requirements of Clause 21.

11.5.6 Installation of Road Furniture

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

Hazard markers shall be installed in accordance with the requirements of Clause 12.

11.5.7 Reinstatement

Following construction of the grid, 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.

11.5.8 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, whichever is the lesser.

12 CONCRETE TRAFFIC BARRIER

12.1 General

Clause 12 describes the work to be carried out where concrete traffic barrier is required to be constructed under the Contract.

12.2 Material

12.2.1 Concrete

12.2.1.1 General

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

12.2.1.2 Poured Concrete

Concrete placed by conventional means shall be Class 40 MPa/20.

12.2.1.3 Fibre Reinforced Concrete

Extruded barriers shall use fibre reinforced concrete.

Fibre reinforced concrete shall consist of Class 32 MPa/20, reinforced with nominal 50 mm virgin polypropylene fibrillated fibres incorporated at the rate of 0.9 kg/m³.

12.2.2 Steel Reinforcing

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

12.2.3 Cement Mortar

Cement mortar shall consist of 1 part of Type GP cement and 3 parts of clean, sharp sand with sufficient water added to form a dry-packing mortar.

12.2.4 Steel Plate and Sections

Steel plate shall comply with the requirements of AS/NZS 3678 and shall be Grade 250 or 300.

Rolled steel sections shall comply with the requirements of AS/NZS 3679.1 and shall be Grade 250 or 300.

12.2.5 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.

12.2.6 Electrical Conduit and Pits

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

12.2.7 Compressible Filler

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

Approved products are listed in Clause 5.1 of Annexure MRTS14A.1. Alternative products may be submitted to the department for approval.

12.2.8 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 5.2 of Annexure MRTS14A.1. Alternative products may be submitted to the department for approval.

12.2.9 Delineators

Delineators shall be installed with a maximum spacing of 10 m.

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

12.3 Fabrication

Cover assemblies for light poles and cable pits shall be fabricated to the details shown on Standard Drawings number 1461 and 1469.

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

Angle connectors and reinforcing connectors shall be fabricated in accordance with Standard Drawing number 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 and AS 1214. The average coating mass shall be not less than 600 g/m².

12.4 Construction

12.4.1 General

Concrete traffic barrier shall be constructed in the locations shown on the Drawings and to the details shown on Standard Drawings number 1460 to 1464 inclusive and 1467 to 1473 inclusive.

12.4.2 Surface Preparation

The surface on which concrete traffic 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 400 Y dowel bars shall be installed in the hole and set in cement mortar.

12.4.3 Conduits and Pits

Where required, electrical conduit shall be installed longitudinally in the location shown on Standard Drawings number 1460 or 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*.

12.4.4 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.

12.4.5 Steel Reinforcing

Steel reinforcing shall be installed in the locations shown on Standard Drawings number 1460, 1463, 1464, 1468, 1470, 1471, 1472 and 1473.

12.4.6 Extrusion of Concrete Traffic Barrier

Extruded concrete traffic 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 numbers 1460 or 1468 to the lines and levels shown in the design documentation.

The finished wall surfaces shall be smooth, without surface cracks and other imperfections.

An initial test section of concrete traffic barrier at least 3 metres long shall be constructed. The test section of barrier shall be inspected for conformance to this standard and, if conformance is established, further extruded barrier may be constructed. **Hold Point 5**

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.

12.4.7 Placed Concrete

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*.

12.4.8 Expansion Joints

Expansion joints in extruded concrete traffic 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 Drawings number 1460 or 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.

12.4.9 Contraction Joints

Contraction joints shall be provided at maximum intervals of 4 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.

12.4.10 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 Drawings number 1461 or 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 number 1461 or 1469.

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

12.4.11 Delineators

Delineators shall be installed in the locations and to the spacings shown in the design documentation.

Delineators shall be assembled to a fixing bracket as shown on Standard Drawing number 1466.

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

12.4.12 Precast Concrete Barriers

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.

12.5 Propriety Precast Concrete Barriers

All propriety precast concrete barrier products shall be specifically designed, manufactured and tested in accordance with NCHRP 350 for the purpose of arresting errant vehicles at the posted speed and in the prevailing conditions.

An application to use propriety products, other than those detailed on the Drawings, shall be made to Transport and Main Roads Director (Traffic Engineering and Road Safety) at least 28 days prior any ordering or purchasing of such products. **Milestone**

The following information shall be supplied with the application described in the preceding paragraph –

- a) documentary evidence that the product complies with the requirements of NCHRP 350; and
- b) fabrication drawings outlining the grade of materials and relevant standards with which the materials are required to comply and the lengths of the various components used in the product.

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.

Proprietary products shall not be delivered to the project until expiration of the 28 day period. **Hold Point 6**

Information regarding approval status can be obtained from –

Department of Transport and Main Roads
Traffic Engineering and Road Safety
GPO Box 1412
Brisbane QLD 4001

13 STEEL BEAM GUARDRAIL

13.1 General

Clause 13 describes the work to be carried out where steel beam guardrail is required to be constructed under the Contract.

13.2 Material Requirements

13.2.1 Panels

Steel beam guardrail panels shall be manufactured to the detail shown on Standard Drawings number 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 13.2.1-A.

Table 13.2.1-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 13.2.1-B.

Table 13.2.1-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.

13.2.2 Steel Posts and Blockouts

Steel posts and blocks shall be fabricated from steel conforming to the requirements of AS/NZS 1594 grade HA300. Blockouts shall be fabricated from steel conforming to the requirements of AS/NZS 1594 grade HU300.

13.2.3 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 17.

13.2.4 Fasteners

Hexagonal head bolts and nuts shall be manufactured to the dimensions shown on Standard Drawings and shall comply with the requirements of the AS 1111, AS 1112, AS 1237, AS/NZS 1252 and AS/NZS 1390, as appropriate.

Mushroom head (C) bolts shall be manufactured to the details shown on Standard Drawing number 1479.

Circular washers shall conform to the requirements of AS 1237.

All fasteners shall be hot-dipped galvanised in accordance with AS 1214.

13.2.5 Delineators

Delineators shall comply with the requirements specified in Clause 10.2.4 for delineators on rigid road edge guide posts.

13.2.6 Cable

Cable shall be right regular lay rope conforming to AS 3569 as shown on Standard Drawing number 1479. A NATA certified test certificate outlining the mechanical, chemical and elongation properties of the cable shall be included in the quality records.

13.2.7 Plastic Block Out

Plastic block out shall be propriety products specifically designed, manufactured and tested in accordance with NCHRP 350 for the purpose of arresting errant vehicles at the posted speed and in the prevailing conditions.

An application to use proprietary products, other than those detailed on the Drawings, shall be made to Transport and Main Roads Director (Traffic Engineering and Road Safety) at least 28 days prior any ordering or purchasing of such products. **Milestone**

The following information shall be supplied with the application described in the preceding paragraph –

- a) documentary evidence that the product complies with the requirements of NCHRP 350;
- b) documentary evidence that the plastic block out can maintain the mechanical and elongation properties for a minimum of 20 years; and
- c) fabrication drawings outlining the grade of materials and relevant standards with which the materials are required to comply.

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

Proprietary products shall not be delivered to the project until expiration of the 28 day period. **Hold Point 7**

Information regarding approval status can be obtained from –

Department of Transport and Main Roads
Traffic Engineering and Road Safety
GPO Box 1412
Brisbane QLD 4001

13.2.8 Test Certificates

Certified copies of the manufacturer's test sheets for all materials, showing the chemical properties and results of tensile and elongation tests, shall be included in the quality documentation.

13.3 Fabrication

13.3.1 Registered Fabricator

Steelwork shall be fabricated only by an approved fabricator.

To be registered as an Approved Fabricator of Steelwork, a fabricator shall –

- a) Operate a quality system certified to AS 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*.

Registration as an approved fabricator shall be reviewed periodically or earlier if unsatisfactory performance is reported.

Information regarding approval status can be obtained from –

Department of Transport and Main Roads
Bridge Design
GPO Box 1412
Brisbane, Qld, 4001

13.3.2 Fabrication Standard

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

13.3.3 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 Concrete Technology 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 8** and
 - iii) welder re-certification is required every 6 months and the department reserves the right to withdraw welder certification if welding is below the department's requirements.

13.3.4 Steel Components

Steel components shall be fabricated to the details shown on Standard Drawings number 1462, 1465, 1467, 1470, 1474, 1475, 1476, 1477, 1478, 1479, 1480, 1481 and 1482.

Steel components shall be fabricated in accordance with the requirements of AS 4100 and AS/NZS 4600.

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

All steelwork to be fabricated in accordance with MRTS78 *Fabrication of Structural Steelwork*.

13.4 Installation

13.4.1 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 number 1462, 1465, 1467, 1470, 1474, 1475, 1476, 1477, 1478, 1479, 1480, 1481 and 1482.

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 number 1476.

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

13.4.2 Clearance Requirements

Fixed object hazards shall not be erected in the hazard free zone nor the clearance zone shown in the design documentation.

13.4.3 Posts

Steel posts may be driven or installed by the excavation and backfilling of a post hole.

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 any protective coating. Any coating damaged during driving shall be repaired in accordance with AS/NZS 4680. The recommended repair for damaged galvanising is to apply 2 coats of inorganic zinc primer applied by brush.

Slip base posts shall be erected strictly in accordance with the details shown on Standard Drawing number 1476.

Where a post is to be installed into a cement-stabilised pavement layer, in an asphalt pavement or in concrete, the following procedure shall be used –

- a) a hole shall be excavated or bored at least 400 mm diameter to within 300 mm of the bottom of the post;
- b) the post shall be located in the hole so that the post is positioned either centrally in the hole or closer to the side of the hole further from the traffic lane from which most errant vehicles will originate and be driven to the correct height;
- c) the hole shall be backfilled around and within the post with clean, well-graded sand compacted so that it does not settle or arch, nor do voids form within the backfill; and
- d) the top 40 mm shall be completed with a sand-cement mortar.

13.4.4 Anchor Cables

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

13.4.5 Delineators

Delineators shall be installed in the locations and to the spacings shown on Standard Drawing number 1356.

Delineators shall be assembled to the mounting plate and attached to the guardrail as shown on Standard Drawing number 1478.

13.4.6 Tolerances

Steel beam guardrail shall be installed to the line and level shown in the design documentation. The tolerance on post height shall be +/- 10 mm. The tolerance on verticality of post shall be +/- 15 mm measured at the top of the post.

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

14 TENSIONED WIRE ROPE BARRIER SYSTEM

14.1 General

Clause 14 describes the work to be carried out where a tensioned wire rope barrier system is required to be installed under the Contract.

14.2 General Requirements

Tensioned wire rope barrier systems shall be proprietary systems designed specifically for the purpose of providing a restraining traffic barrier adjacent to high speed traffic lanes.

The colour of posts supporting the tensioned wire rope barrier system shall be white.

Delineators shall be attached to post caps and shall comply with the requirements specified in Clause 10.2.4 of MRST14 *Road Furniture* for delineators on rigid road edge guide posts.

14.3 Testing

The method of testing the tensioned wire rope barrier system shall be as set out in NCHRP 350.

Tensioned wire rope barrier systems shall have been subject to full scale crash testing and tested successfully to Level 3 as defined by NCHRP 350 or equivalent.

Testing compliance shall be proven by documentary evidence.

14.4 Installation

Tensioned wire rope barrier system shall be installed strictly in accordance with the manufacturer's recommendations.

A complete copy of the manufacturer's installation drawings and specifications, as well as the proof of compliance testing required by Clause 18.3, shall be provided to the Administrator prior to commencement of installation of the barrier system **Hold Point 9**. All documentation shall be included in the quality records

Tensioned wire rope barriers shall be installed in the locations shown in the design documentation and in accordance with the details shown in the design documentation.

The maximum span for end anchor to end anchor shall be as shown in Clause 6 of Annexure MRTS14A.1.

Where a barrier is located within 1.5 metres of the edge of the carriageway, the height to the top of a post shall be measured from the pavement edge level. Where the barrier is not so located, the height to the top of a post shall be measured from the ground level at the base of the post.

Delineators shall be installed on the first full height post in the direction of travel and on at least one in every five posts. If the product specifications require more delineators, then the product specification takes precedence.

14.5 Delineation

Delineations on wire rope barrier systems shall be installed in the locations and to the spacings shown on the drawings. Delineators shall be consistent with the requirements of Clause 10.2.4 of MRTS14.

15 BARRIER END TREATMENTS

15.1 General

Clause 15 describes the work to be carried out where a proprietary barrier end treatment is required to be installed under the contract.

15.2 Material Requirements

15.2.1 General

Barrier end treatments shall be proprietary products specifically designed, fabricated and tested in accordance with NCHRP 350 for the purpose of arresting errant vehicles at the posted speed and in the prevailing conditions.

The type of barrier end treatment shall be as shown in the design documentation.

Crash cushions and attenuators shall be non-gating and redirective.

15.2.2 Proprietary Products

An application to use proprietary products, other than those detailed on the Drawings, shall be made to Transport and Main Roads Director (Traffic Engineering and Road Safety) at least 28 days prior any ordering or purchasing of such products. **Milestone**

The following information shall be supplied with the application described in the preceding paragraph –

- a) documentary evidence that the product complies with the requirements of NCHRP 350; and
- b) fabrication drawings outlining the grade of materials and relevant standards with which the materials are required to comply and the weld sizes and the lengths of the various components used in the product.

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

Proprietary products shall not be delivered to the project until expiration of the 28 day period. **Hold Point 10**

Information regarding approval status can be obtained from –

Department of Transport and Main Roads
Traffic Engineering and Road Safety
GPO Box 1412
Brisbane QLD 4001

15.2.3 Fasteners

All fasteners with an overall length greater than 40 mm shall comply with the requirements of Clause 6.4 of MRTS78.

15.2.4 Test Certificates

Certified copies of the manufacturer's test sheets for all materials, showing the chemical properties and results of tensile and elongation tests, shall be included in the quality documentation.

15.3 Fabrication

15.3.1 Registered Fabricator

Steelwork shall be fabricated only by an approved fabricator.

To be registered as an Approved Fabricator of Steelwork, a fabricator shall –

- a) Operate a quality system certified to AS 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*.

Registration as an approved fabricator shall be reviewed periodically or earlier if unsatisfactory performance is reported.

Information regarding approval status can be obtained from –

Department of Transport and Main Roads
Bridge Design
GPO Box 1412
Brisbane, Qld, 4001

15.3.2 Fabrication Standard

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

15.3.3 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 Concrete Technology 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 11** and
 - iii) welder re-certification is required every 6 months and the department reserves the right to withdraw welder certification if welding is below the department's requirements.

15.4 Installation

Barrier end treatments shall be installed as shown in the design documentation. The area where the barrier end treatment is to be installed shall be prepared in accordance with the details shown in the design documentation and in accordance with the manufacturer's recommendations.

Barrier end treatments shall be installed in accordance with the manufacturer's specifications.

16 STEEL TRAFFIC BARRIERS

16.1 General

Clause 16 describes the work to be carried out where a proprietary steel traffic barrier system is to be installed under the contract.

16.2 Material Requirements

16.2.1 General

Steel Traffic Barriers shall be propriety products specifically designed, fabricated and tested in accordance with NCHRP 350 for the purpose of arresting errant vehicles at the posted speed and in the prevailing conditions.

16.2.2 Proprietary Products

An application to use proprietary products, other than those detailed on the Drawings, shall be made to Transport and Main Roads Director (Traffic Engineering and Road Safety) at least 28 days prior any ordering or purchasing of such products. **Milestone**

The following information shall be supplied with the application described in the preceding paragraph –

- a) documentary evidence that the product complies with the requirements of NCHRP 350; and
- b) fabrication drawings outlining the grade of materials and relevant standards with which the materials are required to comply and the weld sizes and the lengths of the various components used in the product.

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

Proprietary products shall not be delivered to the project until expiration of the 28 day period. **Hold Point 12**

Information regarding approval status can be obtained from –

Department of Transport and Main Roads
Traffic Engineering and Road Safety
GPO Box 1412
Brisbane QLD 4001

16.2.3 Fasteners

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

16.2.4 Test Certificates

Certified copies of the manufacturer's test sheets for all materials, showing the chemical properties and results of tensile and elongation tests, shall be included in the quality documentation.

16.3 Fabrication

16.3.1 Registered Fabricator

Steelwork shall be fabricated only by an approved fabricator.

To be registered as an Approved Fabricator of Steelwork, a fabricator shall –

- a) Operate a quality system certified to AS 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*.

Registration as an approved fabricator shall be reviewed periodically or earlier if unsatisfactory performance is reported.

Information regarding approval status can be obtained from –

Department of Transport and Main Roads
Bridge Design
GPO Box 1412
Brisbane, Qld, 4001

16.3.2 Fabrication Standard

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

16.3.3 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 Concrete Technology 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 13** and
 - iii) welder re-certification is required every 6 months and the department reserves the right to withdraw welder certification if welding is below the department's requirements.

16.4 Installation

The steel barriers shall be installed in the locations and so as to achieve the minimum length as detailed on the Drawings.

The steel barriers shall be installed in accordance with the manufacturer's drawings and specifications.

17 SUPPLEMENTARY REQUIREMENTS

The supplementary requirements given in Clause 7 of Annexure MRTS14A.1 shall apply.