SECTION 7 ROAD FURNITURE

CONTENTS

7 ROAD FURNITURE

7.01 SCOPE

The works covered by this Section of the Specification comprise the supply and installation of guide posts and the construction of safety barrier systems, including safety barriers, terminals, transitions, and delineation. The work to be carried out under this Specification does not include construction of clear areas behind safety barrier systems.

Guide posts and safety barrier systems shall be erected at the locations specified using the type shown on the Drawings.

7.02 STANDARDS

Work carried out and testing performed under this Section of the Specification shall comply with the requirements of the following Standards to the extent that they are relevant and not overridden by the Specification.

Australian Standards

AS 1012.1	Sampling of Fresh Concrete
AS 1012.8	Method for Making and Curing Concrete Compression, Indirect Tensile and Flexure Test Specimens, in the Laboratory or in the Field
AS 1012.9	Method for the Determination of the Compressive Strength of Concrete Specimens
AS 1111	ISO Metric Hexagon Commercial Bolts and Screws
AS 1112	ISO Hexagon Nuts, Including Thin Nuts, Slotted Nuts And Castle Nuts
AS 1143	High Temperature Creosite for the Preservation of Timber
AS 1163	Structural Steel - Hollow Sections
AS 1214	Hot Dip Galvanised Coatings on Threaded Fasteners
AS 1252	High Strength Steel Bolts with Associated Nuts and Washers for Structural Engineering
AS 1304	Welded Wire Reinforcing Fabric for Concrete
AS 1311	Steel tendons for Pre-stressed Concrete –7- Wire Stress Relieved Steel Strand
AS 1379	The Specification for the Manufacture of Concrete
AS 1442	Hot-rolled Carbon Steels and Carbon-Manganese Steels
AS 1554	Code for Welding in Building
AS 1594	Hot-rolled Steel Flat Products
AS 1604	Timber – Preservative Treated – Sawn and Round
AS 1627.1	Degreasing of Metal Surfaces
AS 1627.4	Abrasive Blast Cleaning of Steel Surfaces

AS 1627.5	Pickling Steel Surfaces
AS 1742	Manual of Uniform Traffic Control Devices
AS 1742.2	Traffic Control Devices for general use
AS 1743	Road Signs
AS 1744	Standard Alphabets for Road Signs
AS 1906.1	Retroreflective Materials and Devices for Road Traffic Control Purposes Markers (retroreflective and non)
AS 1906.2	Retroreflective Devices (non pavement applications)
AS 2009	Glass Beads for Traffic Markings
AS 2082	Visually Stress-Graded Hardwood for Structural Purposes
AS 3569	Steel wire ropes
AS 3600	Concrete structures
AS 3610	Formwork for concrete
AS 3679	Structural steel
AS 3750.9	Paints for steel structures - Organic zinc-rich primer
AS 3750.16	Paints for steel structures - Waterborne primer and paint for galvanized, zinc / aluminium alloy-coated and zinc-primed steel
AS 3799	Liquid membrane-forming curing compounds for concrete
AS 3845	Road safety barrier systems
AS 3972	Portland and blended cements
AS 4680	Hot-dip galvanised (zinc) coatings on fabricated ferrous articles

RTA Specifications

RTA G35	Environmental Protection (Management Plan)
RTA G36	Environmental Protection (Management System)

Other Documents

Manufacturer’s recommendations for each proprietary safety barrier system or device as specified.

Testing

A Testing Authority shall be employed by the Contractor to carry out all testing. The Authority shall hold a current NATA (National Association of Testing Authorities) Registration for the relevant tests, and a copy of results shall be forwarded to the Superintendent without delay.

7.03 DEFINITIONS

DELINEATOR:	The small retroreflectors or panels of retroreflective sheeting that are attached to guideposts, or in the case of traffic barriers to a mounting plate to provide a coherent pattern of delineation of the edges of the carriageway as an aid to night driving.
DEPARTURE TERMINAL:	A terminal for a safety barrier system of a type which is used only at the departure end with respect to the direction of flow of traffic.
DEVICE:	A generic term used to refer to a safety barrier, a terminal or a transition. In this context a device is usually part of a safety barrier system.
FLEXIBLE GUIDE POST:	A guide post that deflects when impacted by a vehicle and then returns to the vertical position, without maintenance intervention.
GUIDE POST	Posts used to mark the edge of the road carriageway. They assist the road user by indicating the alignment of the road ahead, especially at horizontal and vertical curves, and under some circumstances, by providing a gauge with which to assess available sight distance.
LEADING TERMINAL	The approach end of a safety barrier system with respect to the direction of flow of traffic.
MANUFACTURER'S RECOMMENDATIONS:	The specification and drawings for a specified proprietary safety barrier system or device, prepared by or for the manufacturer, detailing the components, the system or device, and the methods and/or procedures for installation.
NESTED RAILS	Two or more steel rails erected together (one inside the other) to increase stiffness. Nested rails share bolts.
ROAD SAFETY BARRIER SYSTEM:	A roadside device that provides a physical restriction to penetration of a vehicle in a way that reduces the risk to vehicle occupants pedestrians and other traffic.
RIGID GUIDE POST:	A guide post which either fails by fracturing or remains intact and straight, but not vertical, when impacted by a vehicle.
SAFETY BARRIER:	That part of a safety barrier system other than terminals and transitions.
SAFETY BARRIER SYSTEM:	A longitudinal structure whose prime purpose is to restrain and/or redirect in a controlled manner vehicles which are out of control. A safety barrier system includes one or more safety barriers with associated terminals and transitions.
SEMI-FLEXIBLE GUIDE POST:	A guide post which fails by bending when impacted by a vehicle, and can be straightened with maintenance intervention.
TERMINAL:	A device to protect vehicle occupants from injury in an impact with the end of a safety barrier. The end section of a safety barrier system. Terminals may be leading terminals or departure terminals.
THRIE BEAM:	The triple corrugated beam component of a non rigid road safety barrier system.
TRANSITION:	A connecting device to provide effective continuity of the protection offered by a safety barrier between safety barriers of different properties or dimensions. The part of a safety barrier system with varying properties such as stiffness and dimensions, between and linking safety barriers with different properties or dimensions. A transition may be also link or connect a safety barrier to a fixture.

7.04 GUIDE POSTS

7.04.1 Materials

(i) Posts

Timber posts shall be cut from Select Grade hardwood and conform with AS 2082, treated in accordance with AS 1604**.** Timber Posts shall be straight, sound and free from knots, pipes, wanes, gum vanes or other imperfections. Timber posts shall be rectangular in cross section having the dimensions 100mm x 50mm and shall be 1400mm in length. The bottom ends of posts shall be square and tops sloped to shed water.

The sawn surfaces of timber posts shall be smooth and free from obvious saw marks

All posts in a particular section of road shall be of the same design.

(ii) Delineators

Delineators shall be Type A retroreflectors complying with the requirements of AS 1906.2. Alternatively, , delineators shall be made from Class 1 retroreflective sheeting in accordance with AS 1743. Where sheeting is used, red delineators shall be 100mm x 50mm and white delineators shall be 100mm x 25mm. Retro-refiective sheeting intended for fixing to timber posts shall be backed by light gauge aluminium.

7.04.2 Installation

(i) General

Installation of guide posts includes the following as applicable:

- removal and disposal of existing guide posts;
- supply of guide posts;
- setting out of guide posts;
- excavation for guide post holes, the supply, placement and compaction of backfill; and
- erection or driving of guide posts.

(ii) Location

The location of guide posts shall be as indicated on the drawings *or* in accordance with *AS1742.2.*

Guide posts shall be placed at the edge of the road formation with the wide face presented to oncoming traffic.

Unless shown on the drawings or otherwise specified the guide posts shall be placed at a uniform distance from the pavement edge in accordance with the following:

(a) where the carriageway shoulder is adjacent to an embankment or at the surrounding natural surface level, the guide posts shall be placed so that their inside edge is in line with the outside edge of the shoulder

(b) where the carriageway shoulder is located in a cutting the guide posts shall be placed on the pavement side of the table drain in such a manner as not to impede the flow of water in the drain.

(iii) Installation

Posts shall be firmly embedded in the ground to the following depths

Timber posts - 500mm,

Flexible composite posts - 350mm

The height of completed guide posts shall be within the range 990mm to 1020mm above the adjacent ground level. Posts shall be vertical and tops shall be at a uniform grade to match the road grade.

Timber posts shall not be driven. Flexible composite posts shall be erected in accordance with the Manufacturers' recommendations.

Backfill material shall be compacted for the full depth of the posts up to ground level. Unless otherwise specified, the density of the compacted backfill shall not be less than that of the adjacent shoulder pavement.

The portion of guide post to be below ground level shall be immersed for one hour in creosote, conforming to AS 1143, which has been heated to 90°C.

Where guide posts are to be installed on concrete pavements the Contractor shall submit to the Superintendent the details of the proposed installation method, including driving and fixing the guide posts to the concrete. Typically the fixing shall take the form of a fixed or demountable base plate which is attached to the pavement using hot-dipped galvanised steel anchors.

All timber above ground level shall be painted with pink primer and any holes, cracks or other minor surface imperfections shall be stopped with white putty. This work shall be followed by painting with a suitable undercoat followed by a white, gloss enamel finish coat.

Painted surfaces shall be thoroughly dry before the next coat is applied. Paints shall be handled and applied in accordance with the manufacturer’s directions.

(iv) Delineators

Following erection and painting, fix Type A retroreflectors to timber posts using one-way, anti-theft screws Fix delineators to composite posts using back-to-back pop rivets. Where sheeting is used, fix delineators to timber posts with approved epoxy adhesive or double clouting. Fix sheeting to composite posts in accordance with post and sheeting manufacturers' recommendations. Locate delineators on the post centreline with tops 50mm below the top of post.

The guide posts shall be installed so that drivers will see only the following array of coloured delineators when approaching in the appropriate direction of travel:

(a) a red delineator on each guide post on their left hand side;

(b) a white delineator on each guide post on their right hand side on two-way carriageways; and

(c) a white delineator on each guide post on their right hand side on one-way carriageways and medians separating traffic travelling in opposite directions.

Guide posts installed on two-way carriageways are required to be fitted with two delineators (one red delineator on the face visible to drivers in the lane nearest to the guide post and one white delineator on the opposite face).

7.04.3 Removal and Disposal of Existing Guide Posts

Where required, existing guide posts are to be removed as specified or shown on the drawings, or directed by the Superintendent.

All holes left after the removal of existing guide posts shall be backfilled and compacted in layers of maximum depth of 150 mm to the relative compaction of the surrounding shoulder material. Imported backfill material shall have similar characteristics to the shoulder material.

All existing guide posts removed by the Contractor shall be removed from site or otherwise disposed of in accordance with local environmental requirements. Existing guide posts manufactured from recyclable materials shall be recycled.

7.04.4 Installation Tolerances

The Contractor shall install each guide post within the maximum installation tolerances shown in Table 7.1

Table 7.1

Component	Attribute	Tolerance
Guide Post	Verticality	Within 3^{o} from the true vertical position.
	Height	Within 25 mm of the uniform profile height (nominally 1000 mm.).
	Location (plan)	Within 200 mm longitudinally of the design spacing and 100 mm transversely of the plan position with reference to the control line for the road.

7.05 NON RIGID SAFETY BARRIER SYSTEMS

7.05.1 Components

All steel components for non-rigid road safety barrier systems, including W-beam and Thrie-beam, shall be in accordance with AS 3845 and steel wire rope (SWR) proprietary safety barrier systems shall be in accordance with the manufacturers specification and shall be of the type as shown on the drawings.

Unless stated otherwise in the manufacturer's recommendations for a specified proprietary safety barrier system or device, the surfaces of all ferrous metal components including posts, blockout pieces, rail elements, anchor plates, connectors and terminal pieces shall, after fabrication, be treated in accordance with AS 1627.4 or AS 1627.5, and finished by hot dip galvanising in accordance with AS 4680.

All ferrous bolts, nuts and washers shall be galvanised in accordance with AS 1214.

Timber posts are to be used only in W-beam terminal sections, as detailed on the drawings and shall be of the timber type, grade, and treatment level in accordance with AS 3845. All surfaces shall be smooth and free from obvious saw marks.

Hold Point 7.1	
Process Held:	Construction of non rigid safety barrier system.
Submission Details:	At least five (5) working days prior to the proposed construction of the non rigid safety barrier the Contractor shall submit verification that the components proposed conform to the requirements of this Specification and supporting technical literature and assembly instructions where appropriate.
Release of Hold Point:	The Superintendent will inspect the documentation and components as appropriate prior to authorising the release of the Hold Point.

7.05.2 End Treatment Of Road Safety Barriers

Both approach and departure ends of the road safety barrier shall be constructed with leading and trailing terminal sections at locations shown and as detailed on the drawings.

The approach and departure ends of double sided road safety barriers shall have terminal sections as detailed on the drawings.

Non-rigid road safety barrier connections to rigid road safety barriers or bridge parapets shall be as detailed on the drawings.

7.05.3 Erection

(i) General

Construction of non-rigid road safety barrier shall comply with AS 3845 except where explicit departures are detailed on the drawings.

Road safety barriers shall be erected after the construction of the base on concrete pavements and after the placing of the initial layer of asphaltic concrete or sprayed seal on a flexible pavement, unless otherwise approved by the Superintendent.

The Contractor shall peg, or on hard ground mark with paint, the start and finish points and line of safety barriers, transitions and terminals including the line of flare if applicable, in accordance with the drawings, at least two (2) days before commencing construction.

Underground cables and ducts laid in the road safety barrier area shall be located prior to the erection of posts and all care must be taken not to damage such cables and ducts.

Hold Point 7.2

Process Held:	Construction of non-rigid safety barrier system.
Submission Details:	At least two (2) working days before the proposed commencement of installation of posts or assembly of components or devices, whichever is earlier, the Contractor shall submit verification that the line of the non-rigid safety barrier is set out.
Release of Hold Point:	The Superintendent will inspect the site prior to authorising the release of the Hold Point.

(ii) Posts

All posts shall be set vertically in the ground at the positions shown on the drawings.

(a) General

The safety barrier posts are to be located as shown on the drawings.

The top of the post shall be 710mm, 805mm or 865mm as appropriate for W-beam, Thrie-beam or modified blockout Thrie-beam respectively, above the ground level, unless otherwise shown on the drawings. On terminal ends, the level of the posts shall be such as to conform to the extended crossfall of the main pavement unless otherwise shown on the drawings.

When erected in position the posts shall be on a smooth line both horizontally and vertically with the tops of posts within ±20mm of the heights specified above.

(b) Erection of Steel Post

Steel posts shall be erected by driving, or by other means, in accordance with the requirements for foundation posts in AS 3845. The open section of the post shall point in the same direction as adjacent traffic. The posts are to be firm in the ground and any movement at ground level shall not exceed 3mm in any direction when force tested in accordance with AS 3845.

The posts shall not have any obvious deformation as a result of driving. Any damage to posts is to be repaired within twenty four (24) hours using an organic zinc-rich primer in accordance with the repair requirements of AS 4680.

Any post which has been excessively damaged will be rejected by the Superintendent and shall be replaced.

(c) Erection of Timber Posts

The safety barrier posts are to be located as shown on the drawings. The top of the posts shall be 710mm ±20mm above the ground level, unless otherwise shown on the drawings. On terminal ends the level of the posts shall be such as to conform to the extended crossfall of the main pavement, unless shown otherwise on the drawings.

When erected in position the posts shall be on a smooth line both horizontally and vertically.

The section of the timber posts to be cast into a reinforced concrete footing shall be wrapped in 12mm thick polystyrene foam sheeting before concrete casting.

Concrete used in the footings for timber posts shall have a minimum compressive strength of 32MPa at 28 days and shall conform with the requirements of Section 15 of this Specification .

Concrete footings shall be 600mm diameter, and shall have tolerances of minus zero or plus 50mm. Overbreak and excessive depth shall be filled with 32MPa concrete.

Wire fabric reinforcing shall be as detailed on the drawings.

The surface area of the posts which will be above ground shall be painted with two coats of grey acrylic paint.

(d) Installation of Posts - Difficult Sites

If, in the opinion of the Contractor and for reasons outside the Contractor's control, it is not feasible to install posts at the specified depth or location, the Contractor shall submit to the Superintendent a proposal for a different method of supporting the safety barrier.

(iii) Erection of Safety Barrier Rails

Steel blockout pieces shall be erected with the open section pointing in the same direction as adjacent traffic.

All rail laps shall be in the same direction as adjacent traffic such that approach rail ends are not exposed to traffic.

Stiffening pieces, 300mm long, shall be used on intermediate posts.

Road safety barrier rails and blockout pieces shall be handled and erected in such a manner that no damage occurs to the galvanising. Any minor damage occasioned to the galvanising shall be repaired within 24 hours using an organic zinc-rich primer in accordance with the repair requirements of AS 4680.

Any road safety barrier rails or blockout pieces which have been excessively damaged will be rejected by the Superintendent and shall be replaced.

Road safety barrier rail attachment bolts and splice bolts are to be tightened initially such that the barrier can be erected. Adjustments are then to be made to the rails using the slotted holes provided to produce a smooth regular line, free of any kinks or bumps. The overall line of the top of the safety barrier rails is to visually conform with the vertical alignment of the road pavement.

When the alignment both vertically and horizontally is obtained the splice bolts are to be fully tightened. The bolt head (not the shoulder) should be in full bearing with the rail.

(a) Curving Steel Rail

Steel rail shall be factory curved where a radius of less than 45 m is specified. Curving shall be carried out in such a manner that the galvanising is not damaged.

The curve radius shall be clearly marked in a permanent manner on the rear face of factory curved steel rail

(b) Delineators

Delineators complying with AS 1906.2 shall be fixed with brackets to the road safety barrier, to the details and at the locations shown on the drawings beginning at the first post and then in accordance with Table 7.2

Table 7.2

Radius of Curve (m)	Spacing of Reflectors on Barrier (post number)
30 - 90	3rd post
90 - 180	5th post
180 - 275	8th post
275 - 365	11th post
over 365 (including straight road)	16th post

Delineators shall be so arranged that drivers approaching from either direction will see only red reflectors on their left side, and white reflectors on their right.

7.06 RIGID SAFETY BARRIERS

7.06.1 Manufacture

(i) Detailing

Unless otherwise specified or authorised, concrete safety barriers shall be constructed from precast reinforced concrete units to the dimension and details shown on the drawings in accordance with the requirements for rigid road safety barrier systems in AS 3845.

Where not otherwise specified, reinforcement shall be provided to the extent and details necessary to accommodate handling and shrinkage stresses.

A minimum of two (2) recessed lifting points shall be provided in each unit.

(ii) Location of Manufacture

Precast concrete units may be supplied by a manufacturer, or may be manufactured by the Contractor, at a location proposed by the Contractor, such location to be advised to the Superintendent within fourteen (14) days of the date of the Letter of Acceptance, or other location as approved by the Superintendent.

The Contractor shall provide where specified in the Contract, at the precast yard, suitable office space and facilities for use by the Superintendent during the time units are being manufactured.

(iii) Procedures

Fourteen (14) days before commencing manufacture of the precast concrete units, the Contractor shall submit to the Superintendent for approval all details of the methods to be used in manufacture, including handling, transport, storage and erection of the units program of manufacture and delivery of units and details of the Quality System in use by the precaster. If the precast concrete units are to be cast on site the relevant Quality System documentation is to be submitted.

Hold Point 7.3

Process Held:	Manufacture of rigid safety barrier precast concrete units.
Submission Details:	At least ten (10) working days before the proposed commencement of manufacture of precast concrete units the contractor shall submit details of the methods used in manufacture, transport, storage, erection and a program for manufacture and delivery.
Release of Hold Point:	The Superintendent will inspect the documentation and may inspect the precast yard prior to authorising the release of the Hold Point.

During manufacture of precast units, the Contractor shall give at least twenty four (24) hours notice to the Superintendent so that each of the following stages may be inspected for compliance with this Specification:

- moulds and forms (including dimensions)
- reinforcement and fixing
- prestressing operations
- concrete placement
- finishes
- dimensions

The Superintendent may check precast units prior to transportation from the precasting yard..

The Contractor shall provide records for each precast unit. These records shall be available for inspection by the Superintendent during the progress of the Works. The records shall be kept in a suitable file at the precast yard, until delivery of the units. At least two (2) days before the proposed installation of the precast units the records shall be submitted to the Superintendent for approval to allow the precast unit(s) to be incorporated into the Works.

No addition or alteration shall be made to the records without the approval of the Superintendent. Alterations when made may be initialled by the Superintendent.

The records shall contain the following information:

- The unit number or other identification mark.
- Date and time of casting.
- Concrete temperature and ambient temperature.
- Date and time of lifting from the mould.
- Quality and type of concrete materials.
- Details of curing prior to lifting from mould.
- Details of curing while stacked in the casting yard.
- The date of transport to the Site.
- A nonconformance report shall be prepared for any defects which appear in the precast unit as a result of manufacture or handling and the date on which the defect was observed. Any nonconformances reports should be noted in the records.

- Remedial work to repair defects as detailed in the approved disposition of any nonconfomance reports including, , the location and description of repair work and the date on which the work was carried out.

Hold Point 7.4

Process Held:	Installation of rigid safety barrier precast concrete units.
Submission Details:	At least two (2) working days before the proposed installation of any precast concrete units, the Contractor shall submit the records for each unit and verification that all nonconforming work has been rectified..
Release of Hold Point:	The Superintendent will inspect the documentation and may inspect the precast units prior to authorising the release of the Hold Point.

(iv) Formwork and Casting

All precast units shall be cast in individual forms in the horizontal position.

Surfaces, including external chamfers, that will be exposed to the external environment in their final position shall be cast against the forms and be subject to the additional provisions of this Specification regarding defects. Formwork to produce the required finish shall be steel formwork complying with the requirements for Class 1 formwork described in AS 3610. Colour control shall be in accordance with AS 3610.

The formwork shall be so constructed that it can be stripped and re-assembled as many times as required provided that the unit complies with the tolerances and finish specified.

The dimensions of formwork shall make allowance for changes in dimensions due to shrinkage, elastic shortening and creep, so that the completed unit conforms with the tolerances specified.

Formwork shall be constructed so that movement of the unit resulting from the effects of shrinkage and steam curing is not restrained and so that the unit is not damaged by movement within the formwork.

(v) Concrete and Reinforcement

All units shall be manufactured using approved aggregates of 20mm maximum size and an approved concrete mix for the full thickness of the units.

Cement for all precast units shall be Type A cement in accordance with AS 3972.

The minimum characteristic strength of the concrete shall be 20MPa at 28 days.

Concrete batching equipment shall be kept free from any material which will cause discolouration of the concrete.

All required inserts shall be supplied and cast into the concrete in the positions indicated on the drawings. Cast-in fixings and any associated reinforcement shall be accurately fixed in position and located such that concrete can be thoroughly compacted around them to provide a sound dense encasement.

All wire ties shall be prefabricated. No cutting of wire ties will be permitted over the moulds. All ends of the ties shall be turned into the body of the concrete and shall not project into the cover.

Concrete shall not be placed until all formwork, blockouts, reinforcement, embedded metalwork, including bearing plates, and any other fittings shown on the Drawings and, where applicable, prestressing have been approved by the Superintendent.

Fixing of reinforcement and placement of concrete shall be in accordance with the applicable provisions of the Standard Concrete Specification.

(vi) Curing

Precast units may be moist cured or steam cured in accordance with the requirements of Section 15 of this Specifcation.

(vii) Tolerances

Unless shown otherwise on the drawings, tolerances shall comply with the tolerances set out in this clause. Members not conforming to these tolerances may be rejected by the Superintendent, in which case they shall be removed, if on site, and replaced in accordance with the General Conditions of Contract.

Measurements will be made as close as practicable to twenty eight (28) days after casting and precast units shall be supported at the positions specified for stacking.

(a) Cross-Section

- Cross-sectional dimensions shall be accurate to within + 0mm and -4mm.

(b) Length

- The overall length shall be accurate to within ± 5mm.

(c) Twist

- 0.5° per metre length of member.
- Straightness of edges and Length/1000 flatness of surfaces
- The maximum allowable deviation from the required profile in the horizontal plane shall not exceed ± 5mm.

(d) Warp

- Up to 5m diagonal: 7mm
  Over 5m diagonal: 10mm
- Squareness of corners (measured diagonally) 5mm
- Core holes, etc., diameter or ± 4mm side dimensions
- Location of openings, cored ± 5mm holes etc

(viii) Handling of Completed Units

The Contractor shall be responsible for the design and provision of all equipment required for removing units from their moulds and the lifting, handling, transportation, storage and erection of the units. No lifting or supporting of units will be permitted until completion of curing.

Methods of removing units from their moulds shall be such that:

(a) inserts and lifting eyes shall be as shown on the drawings unless specified otherwise; and

(b) the units are not overstressed.

Care shall be taken in removing units from their moulds so that the concrete will not be damaged. The use of crowbars or other levering devices exerting pressure on the concrete to loosen the forms will not be permitted.

Lifting devices shall be in accordance with the provisions of AS 3600.

When units are lifted by tackle or crane the weight shall be taken up gradually without snatch.

When units are being lowered they shall not be dropped but shall be let down gently into position without impact.

If the Contractor requires additional lifting eyes to those shown on the drawings their inclusion will be subject to approval of the Superintendent and their cost shall be at the expense of the Contractor.

The Contractor shall be responsible for the safety of operations at all stages during the lifting and handling of the units and shall provide all necessary frames, guys, wedges and other temporary supports.

No superimposed load shall be placed on a unit except where specified.

The position and mode of attachment of slings or other tackle for guiding and controlling the movement of the units during lifting and transportation shall be in accordance with relevant standards and safe work practices.

Temporary supports for units shall be of timber at least 150mm wide and 100mm thick, and shall be such as will not mark or discolour the concrete. These bearers shall support the units over their full width. The ground or space between the bearers supporting the units shall be carefully cleared and levelled so as to prevent the unit from being accidentally supported other than on the bearers. The bearers themselves shall be supported on firm foundations, and every precaution shall be made to prevent subsidence from occurring.

Where stacking of units is acceptable, units shall be separated by timber bearers of minimum dimensions 100mm wide by 80mm high in line vertically at the designed lifting points only. Units shall be arranged symmetrically about the centreline of the stack, one over another so as to leave a space of 600mm on each side of the member to facilitate the taking of measurements.

At all times, and especially during transportation units shall be secured in an upright position by means of suitable packing pieces.

(ix) Marking

The date of casting and the a unique identification number for each unit shall be marked on every precast unit. Marking shall be carried out by stamping or with a durable, water proof marker in a location which remains readily visible until the unit is installed.

(x) Nonconforming Work

All units will be inspected for non conformance and no unit will be accepted if the non conforming items exceed the following limitations and those applicable to Colour Control in accordance with AS 3610.

(a) Hair Cracks

- Visible surface cracks of minute width, not measurable by direct methods except under optical magnification, shall be acceptable.

(b) Cleavage Cracks

- Cracks exceeding 0.2mm in width shall not be accepted.
- Cracks not over 0.2mm in width may be accepted at the discretion of the Superintendent provided that:

  - they will not reduce the strength of the unit to less than the required design strength;

  - they have been sealed to the approval of the Superintendent to ensure the protection of the reinforcement from corrosive influence; and

  - in the opinion of the Superintendent, they do not reduce the visual appearance of the unit to an unacceptable level.

(c) Other Defects

- Stains, changes in texture and defects in appearance other than those permitted by this clause shall not be accepted.

(xi) Repair of Nonconforming Work

Where precast units fail to comply with the specified dimensional and surface finish requirements, the Contractor shall submit a nonconformance report detailing the proposed method of repair, including details of any preparation procedures.

Patching where permitted shall proceed only after the successful repair of small trial areas.

Where repairs are required they shall be carried out in the same order as they are submitted as nonconformance reports. Repairs shall be fully completed within fourteen (14) days of the acceptance of disposition of a nonconfromance report by the Superintendent.

Immediately after removal of formwork, any fins or projections in excess of 3mm shall be removed by chipping and rubbing, or both, with a carborundum stone.

Acid washing of finished concrete surfaces will not be permitted.

(xii) Delivery to Site

No unit shall be delivered to the Site prior to a Release Note having been issued by the Superintendent. The issue of such a note will be dependent on each individual member exhibiting satisfactory workmanship and finish, and complying with the tolerances on dimensions and prestressing force. In addition, concrete strength tests shall satisfy the requirements specified.

Should the Contractor desire that units be delivered to the Site prior to twenty eight (28) days after casting, the following special conditions will apply:

- All required curing shall have been completed.
- Compression tests on cylinders representing units to be delivered may be carried out as specified one day prior to delivery if specified.
- All units which are required for testing at twenty eight (28) days shall be retained in the casting yard.

Units shall be stacked at the Site in such a manner that they may be measured up and inspected for defects without having to be moved.

7.06.2 Installation

(i) Alignment and Levels

Barrier units shall be installed with the vertical axis of the units normal to the cross-fall of the road pavement and to accurate vertical and horizontal lines to obtain a smooth visual appearance.

Where approved by the Superintendent, temporary steel pins may be driven into the pavement to assist alignment.

Where steel dowels are incorporated into the base of each unit, 150mm minimum diameter holes shall be neatly cut in the pavement to a depth equal to the exposed length of the dowel plus 100mm. Following any other necessary base preparation, units shall be installed dry and packed at each corner with packing or other approved means to achieve the required line and level.

The line and level shall be maintained for the extent of the work in a manner which accommodates local irregularities in the pavement levels and limits the thickness of mortar bedding to a minimum of 10mm and a maximum of 30mm.

The Contractor shall peg, or on hard ground mark with paint, the start and finish points and line of safety barriers, transitions and terminals including the line of flare if applicable, in accordance with the drawings, at least two (2) days before commencing installation.

Hold Point 7.5

Process Held:	Installation of rigid safety barrier precast concrete units.
Submission Details:	At least two (2) working days before the proposed installation of the rigid safety barrier the Contractor shall submit verification that the line of the rigid safety barrier is set out.
Release of Hold Point:	The Superintendent will inspect the site prior to authorising the release of the Hold Point.

(ii) Mortar Bedding

Following initial installation and levelling, each unit shall be raised to the extent necessary to allow thorough mortaring of the underside of the base area with a 3:1 sand cement mix mortar. Mortaring frames may be used as required to limit spreading of mortar and to allow screeding to the correct level. Mortar shall penetrate all recesses and the like formed in the base of units to provide keying action to the pavement.

Use additives as specified to achieve accelerated set where barriers are installed under traffic.

Thoroughly clean each unit and adjacent pavement of excess mortar on completion of laying.

Mortar all lifting recesses with cement mortar/PVA emulsion mix on completion of laying.

(iii) Joints

Provide a nominal 3mm gap between adjacent units where no jointing material is specified.

Where dry jointing material is specified, securely bond the material to the erected unit with approved adhesive and firmly butt the following unit against the jointing material. In other cases, jointing is to be carried out as specified or detailed on the drawings. Unless dictated by the road geometry, units installed with uneven gaps or with gaps exceeding 6mm shall be regarded as nonconforming work and a nonconformance report shall be prepared. Changes of level between the tops of adjacent units shall not exceed 3mm.

(iv) Transition Sections

Where new units are to join with a existing installation which incorporates units of different profile, a precast transition section of minimum length 3.0 metres shall be installed between the existing and new standard units. Unless specified, in-situ forming of this transition section will not be permitted.

7.07 MEASUREMENT AND PAYMENT

Payment shall be made for all activities associated with completing the work detailed in this Specification in accordance with the Pay Items 704P1-P2, 705P1-P6 and 706P1-P2 inclusive.

If any pay item, for which a quantity of work is listed in the Contract has not been priced by the Contractor it shall be understood that due allowance has been made in the prices of other pay items for the cost of the activity which has not been priced.

The rate for each pay item for construction of safety barriers, terminals and transitions shall include the supply and installation of delineation.

No additional payment will be made for royalties or the like payable in connection with any product supplied by the Contractor in the performance of the Contract.

The Contractor shall allow in the pay items generally for the costs associated with all testing required to prove conformance of the works as specified.

No additional payment will be made for laps in barrier rails or nested rails when measuring length for payment or the

Unless otherwise specified a lump sum price for these items shall not be accepted.

Pay Item 704P1 Supply and Installation of Guide Posts

The unit of measurement shall be per guide post installed.

This pay item shall include:

(a) supply, set out and excavation of the guide post hole and erection of the guide post including supply, placement and compaction of backfill; or

(b) supply, set out and driving of the guide post including excavation of a pilot hole; or

(c) supply, set out and surface mounting of the guide post on concrete pavements.

A separate pay item shall be included in the Contract for each type of guide post and method of construction.

Pay Item 704P2 Removal of Existing Guide Posts

The unit of measurement shall be per guide post removed.

This pay item shall include the supply, placement and compaction of backfill of material for the reinstatement of the guide post hole and the collection and disposal of the existing guide post.

Pay Item 705P1 Construction of W Beam and Thrie Beam Safety Barriers

The unit of measurement shall be the linear metre of barrier constructed.

This pay item shall include all works associated with set out, supply and installation of W beam and Thrie beam safety barrier excluding transitions and terminals. For measurement purposes a transition or terminal is deemed to commence at the termination of the standard post arrangement (spacing or type) for the W beam or Thrie beam safety barrier.

A separate pay item shall be included in the Contract for each safety barrier type.

705P1.1	W beam – G4
705P1.2	W beam – MB4
705P1.3	W-beam – MB9 (Modified)
705P2.1	Thrie beam – G9
705P2.2	Thrie beam – G9 (Modified)

Pay Item 705P2 Construction of W Beam and Thrie Beam Safety Barriers Transitions

The unit of measurement shall be per transition constructed.

This pay item shall include all works associated with the supply and installation of transitions.

A separate pay item shall be included in the Contract for each safety barrier type.

705P2.1	W beam – Thrie beam transition
705P2.2	W beam – Bridge approach (Long end post)
705P2.3	W-beam – MB9 (Modified)

Pay Item 705P3 Construction of W Beam and Thrie Beam Safety Barriers Terminals

The unit of measurement shall be per terminal constructed.

This pay item shall include all works associated with the supply and installation of terminals.

A separate pay item shall be included in the Contract for each terminal.

705P3.1	Specified End Treatment
705P2.2	Trailing Terminal (TT)
705P2.3	Trailing Slotted Breakaway Cable Terminal

Pay Item 705P4 Construction of Steel Wire Rope Barrier

The unit of measurement shall be the linear metre of barrier constructed.

This pay item shall include supply of all components, installation, wire rope swaging, tensioning of steel wire rope and application of reflectors at the spacings as required in Table 7.2.

This pay item does not include any anchor terminals required.

Pay Item 705P5 Construction of Steel Wire Rope Anchor Terminals

The unit of measurement shall be per anchor terminal supplied and constructed.

This pay item shall include excavation and disposal of surplus material, supply and installation of concrete in accordance with Section 15 of this Specification and supply and installation of any proprietary anchor system components required.

Pay Item 705P6 Removal of Safety Barriers

The unit of measurement shall be the linear metre of safety barrier removed including any terminals or transitions.

Unless otherwise specified the materials removed are the property of the Contractor and removal and disposal of the removed materials is to be included in this pay item.

This pay item shall include the supply, placement and compaction of backfill of material for the reinstatement of post holes. Landscape repair works where required shall be measured and paid in accordance with Section 9 of this Specification.

A separate pay item shall be included in the Contract for each safety barrier type to be removed.

705P6.1 Non-rigid barrier system
705P6.2 Rigid barrier system

Pay Item 706P1 Construction of Concrete Safety Barriers

The unit of measurement shall be the linear of concrete safety barrier system constructed.

This pay item includes all works associated with the manufacture of concrete barriers with incorporation of any blockouts or inserts as specified, supply of record cards and manufacturing details as specified, preparation of the foundation and installation.

A separate pay item shall be included in the Contract for each concrete safety barrier type.

706P1.1 Type F concrete barrier 820mm high (Profile Type 1)
706P1.2 Type F concrete barrier 820mm high (Profile Type 2)
706P1.3 Type F concrete barrier 820mm high (Profile Type 3)
706P1.4 Type F concrete barrier 820mm high (Profile Type 4)
706P1.5 Type F concrete barrier 820mm high (Profile Type 5)

Pay Item 706P2 Construction of Concrete Safety Barrier Transitions

The unit of measurement shall be the linear metre of concrete safety barrier transitions constructed.

This pay item is an extra over rate on Pay Item 706P1.

A concrete barrier transition shall be regarded as any change in shape from the standard section for the concrete safety barrier type as measured under Pay Item 706P1.

A separate pay item shall be included in the Contract for each concrete safety barrier transition type.

706P2.1 6m sloped end terminal
706P2.2 Type F concrete barrier to bridge concrete barrier
706P2.3 Guard fence – bridge approaches (Long end post)

7.08 SCHEDULE OF HOLD POINTS

Hold Points	Clause	Description
7.1	7.05.1	Verification of component for non-rigid safety barrier
7.2	7.05.3	Set out of non-rigid safety barrier
7.3	7.06.1	Manufacture of rigid safety barrier units
7.4	7.06.1	Installation of rigid safety barrier units
7.5	7.06.2	Set out of rigid safety barrier