Government of South Australia
Department for Transport, Energy and Infrastructure

PUBLIC TRANSPORT SERVICES

TECHNICAL SPECIFICATION

FOR

TRAIN POINTS AND CROSSINGS

PTS-AR-10-TK-SPE-00000062

STOP **and THINK**

Zero Harm

Document Control

DOCUMENT STATUS

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Contents

1.0 INTRODUCTION AND CONTEXT

1.1 INTRODUCTION

The Department for Transport, Energy and Infrastructure (DTEI) Public Transport Services Division (PTS) owns and operates the Adelaide Metropolitan Passenger Rail Network (AMPRN). This Specification forms part of the engineering management system used to ensure safety and customer service levels are efficiently and effectively supported.

The term “Points and Crossings” is a collective noun used to describe different mechanical structures that permit trains to cross or be directed onto rail tracks other than the rail track on which they are already travelling.

The types of points and crossings found on the AMPRN are:

- Turnouts, Crossovers (back to back turnouts)
- Catch points
- Diamonds
- Single compounds
- Double compounds.

Points and crossings consist of rail components that guide the wheels of the rolling stock including fixed rails, movable rails, guard rails and cast or fabricated “V” and “K” crossings. These are supported by arrangements of bearers, sleepers and fasteners and activated by point machine(s).

1.2 PURPOSE

The purpose of this specification is to describe the requirements for points and crossings for use on AMPRN main line track, depots, yards and stabling roads for train system only.

1.3 SCOPE

This Specification applies to all PTS projects and contractor organisations designing, supplying, installing or maintaining points and crossings on the AMPRN.

1.4 ACRONYMS, DEFINITIONS AND REFERENCED DOCUMENTS

1.4.1 Acronyms

Acronym	Full Name
AMPRN	Adelaide Metropolitan Passenger Rail Network
DTEI	Department for Transport, Energy and Infrastructure
O&M	PTS Operations and Maintenance
PTS	Public Transport Services and Strategic Projects Division
TA	The former Trans Adelaide

1.4.2 Related Documents

Document Number or Abbreviation	Title
AS-1085 Series	Australian Standard-Railway track material
AS 1110	Australian Standard-ISO metric hexagon bolts and screws Product grade A and B
AS 1111	Australian Standard-ISO metric hexagon bolts and screws Product grade C
AS 1204	Australian Standard-Structural Steel; Superseded by AS-3678 and AS-3679
AS 1252	Australian Standard- High strength steel bolts with associated nuts and washers for structural engineering
AS 1830	Australian Standard-Grey cast iron
AS 2074	Australian Standard-Cast steels
AS 1448	Australian Standard- Carbon steel and carbon-manganese steels-Forgings
AS 1554	Australian Standard-Structural steel welding
AS 1831	Australian Standard-Ductile cast iron
AS 3818	Australian Standard- Timber, Heavy structural products
RSA 2007	Rail Safety Act 2007
CP-TS-963	Old code of practice –Points and Crossings-volume 2-train system
PTS-MS-10-EG-PRC-00000032	Approval of Technical Standards and Waivers Procedure
PTS-AR-10-TK-SPE-00000035	Technical Specification for the supply and installation of “In Bearer” point machines

PTS-AR-10-EG-PRC-00203000	Procedure for obtaining type approval for safety critical rail assets
TA's Manual	TA's rail car Wheel Inspection Manual
301-A2-86-2239	Drawing – Allowable Infringements Minimum Structures 1600 mm Gauge
309-A0-2004-143	Turnout- 1in 8 'V' crossing 6000mm curved fixed heel switches, 60 kg AS rail - 1600 setting out diagram
310-A0-2004-145	LH- crossover – 1 in 8 'V' crossings 6000mm curved fixed heel switches, 60 kg AS rail - 1600 setting out diagram
325-A1-2009 sheet 2464	Cast insert details 1 in 8 60 kg AS rail
RISSB	RISSB Glossary of Railway Terminology - Guideline

2.0 REQUIREMENTS

The requirements of this Specification are:

2.1 GENERAL

All points and crossings shall comply with the following specifications:

2.1.1 Gauge

i) The broad gauge of AMPRN's rail tracks shall be 1600 mm.

ii) The standard gauge of AMPRN's rail tracks shall be 1435 mm.

iii) Points and crossings shall be designed for the back to back dimension of wheel sets to be 1524 ± 1mm for the broad gauge and shall allow for maximum flange height of 45 mm.

iv) The profile of rolling stock wheels shall comply with TA's rail car Wheel Inspection Manual.

v) Point and crossings shall be designed for the back to back dimension of wheel sets to be 1389 ± 1mm for the standard gauge and shall allow for a maximum wheel flange height of 45 mm.

vi) The dimension from the running rail gauge face of the 'V' or 'K' crossing to the working face of the check rail shall be 1555 ± 1 mm for the broad gauge.

vii) The dimension from the running rail gauge face of the 'V' or 'K' crossing to the working face of the check rail shall be 1390 ± 1 mm for the standard gauge.

2.1.2 Flange way

i) The width and depth of the flange way through crossings and check rails shall be 45 ± 1 mm.

ii) The design switch toe opening shall be a minimum of 115 mm on single gauge turnouts.

iii) The throat of the switch, when open, shall be not less than 50 mm.

2.1.3 Check rail and crossing nose

i) Check rails shall be flared, either with a bend in the rail or by planing, with a lead-in angle of 1 in 18 and a flare opening of 90 mm (i.e. flare is 810 mm long).

ii) Check rails shall be at the same top of rail level as the running rail.

iii) The crossing nose shall be 14 mm wide; the distance from the theoretical point of the crossing to the actual point shall be 14 times the crossing number.

iv) The standard crossing nose design for 1 in 8, 60kg AS rail shall comply with drawing number 325-A1-2009 sheet 2464 and others shall be adjustable appropriately.

2.1.4 Speed

a) The speed through running line points and crossings shall be in accordance with the approach signalling aspects, the trackside speed boards or published speed indications. However, permissible speeds must never exceed the theoretical speed.

b) On main line straight track the design of points and crossings shall be suitable for a minimum speed of 110 km/h.

c) On siding or stabling yard the design of points and crossings shall be suitable for a minimum speed of 35 km/h.

2.2 TYPICAL STANDARD TURNOUT GEOMETRIC LAYOUT

a) Standard lead data for various existing AMPRN's crossing geometry is shown in Appendix B.

b) Left hand turnout -1 in 8 'V' crossing 60 kg AS rail shall comply with TA's drawing 309-A0-2004-143, "SETTING OUT DIAGRAM" and right hand turnout is opposite hand.

c) Left hand crossover- 1 in 8 'V' crossing 60 kg AS rail shall comply with TA' drawing 310-A0-2004-145, "SETTING OUT DIAGRAM" and right hand crossover is opposite hand.

2.3 PROJECT SPECIFIC GEOMETRIC LAYOUT

The geometric layout of all points and crossings shall comply with the design shown in project design brief.

2.4 POINT MACHINES

Points shall be compatible with point machines specified in PTS-AR-10-TK-SPE-00000035 "Technical Specification for the supply and installation of "In Bearer" point machines", unless otherwise approved.

2.5 MATERIAL AND MANUFACTURING SPECIFICATIONS

2.5.1 Material specifications

All the components in the points and crossings manufactured from rail shall use head hardened rail.

All the material used in the points and crossings shall comply with the following specification:

a) Rail

i) Steel Rails shall comply with AS 1085 Part 1: Steel rails.

ii) In addition to AS1085 Part 1, the straightness when measured with a two-meter straightedge at any point shall not vary by more than 1 mm.

iii) Rails to be curved shall conform to the straightness requirements before bending. Curved or set rails must be free of twist when sitting free on a plane.

iv) Structural steels shall comply with AS 1204: Structural Steels.

b) Rail bearers

Type of rail bearers either timber, concrete or steel shall be in accordance with specific project design brief.

i) Precast concrete bearers shall comply with AS 1085 Part 14: Prestressed concrete sleepers.

ii) Steel bearers shall comply with AS 1085 Part 17: Steel sleepers.

iii) Timber bearers shall comply with AS 3818.1, Timber- Heavy structural products – visually graded – general requirements and AS 3818.2, Timber - Heavy structural products - visually graded, Part 2: Railway track-timbers.

c) Fastenings

Type of fastenings shall be in accordance with specific project design brief.

Some of available standard fastenings are as follows:

i) Fish Plates shall comply with AS 1085 Part 2: Fishplates.

ii) All fishbolts and nuts shall conform to the relevant drawings and shall comply with AS 1085, Part 4: Fishbolts and nuts.

iii) All spring washers shall comply with AS 1085 Part 7: Spring washers.

iv) For components like switch plates, crossing plates, check rail plates or other type of special plates for points and crossing shall require design approval.

v) Isometric hexagon precision bolts and screws shall comply with AS 1110.

vi) Isometric hexagon commercial bolts and screws shall comply with AS 1111.

vii) General Grade high strength steel bolts with associated nuts and washers shall comply with AS 1252 High strength steel bolts with associated nuts and washers for structural engineering.

viii) For insulated and non insulated applications, resilient fastening assemblies shall comply with AS 1085 Part 19: Resilient fastening assemblies.

<u>For timber bearer</u>

i) Sleeper Plates shall comply with AS 1085 Part 3: sleeper plates.

ii) Dog spikes shall comply with AS 1085 Part 8: Dogspikes.

iii) Spring fastening spikes shall comply with AS 1085 Part 13: Spring fastening spikes for sleeper plates.

iv) Screw spikes and threaded inserts shall comply with AS 1085 Part 18: Screw spikes and threaded inserts.

v) Rail anchors with non-resilient fastenings shall comply with AS 1085 Part 10: Rail anchors. (Essential)

<u>For concrete bearer</u>

i) Screw spikes and threaded inserts shall comply with AS 1085 Part 18: Screw spikes and threaded inserts.

2.5.2 Castings

i) Grey Iron Castings

All grey iron castings shall comply with AS 1830: Grey cast iron Grade H241.

The castings shall be embossed to indicate the crossing and rail section for which they are intended and any other feature if applicable.

ii) Carbon Steel Castings

All steel castings shall comply with AS 2074: Cast steels Grade C3.

The castings shall be embossed to indicate the crossing and rail section for which they are intended and any other feature if applicable.

iii) Ductile Iron Castings

All ductile iron castings shall comply with AS 1831: Ductile Cast Iron.

iv) Manganese Steel Castings

- All manganese steel castings shall comply with AS 2074 Grade H1A.
- The castings shall be embossed to indicate the crossing or other unit for which they are intended and shall have the heat number clearly stamped or embossed on an upper surface.
- Specified manganese steel inserts shall be depth hardened by the use of flexible sheet explosive. The areas specified on the relevant drawings shall attain a minimum surface Brinell hardness number of 330.
- One hardness survey shall be taken on each hardened area. This reading shall be at the intersection of lines 25 mm from and parallel to the gauge and guard edges.
- In the event of any hardness survey not complying with the specification, two additional surveys shall be taken, one on either side of the original impression, within 25 mm distance and parallel with the gauge or guard edge. If both these surveys comply with specifications, the original survey shall be disregarded. Distortion resulting from the depth hardening process shall be rectified before the final assembly.

2.5.3 Forgings

i) All steel forgings shall comply with AS 1448: Forgings.

ii) Forgings shall be free from distortion, scale and other imperfections.

2.5.4 Welded Junction Rails

i) Welded junction rails are used to connect different rail sections together that cannot be joined by aluminothermic welding.

ii) Welded junction rails shall be fabricated from Australian Standard rails of the weight described. The welded junctions shall be 7 metres in length with the 60 kg AS rail section being 3 metres and the 53 kg AS rail and 47 kg AS rail being an equal length of 2 metres. The ends of the

welded junctions shall be left un-drilled. The 60 kg AS rail - 53 kg AS rail welded junctions shall be 12 metres long with both sections being 6 metres in length.

iii) The flange of the larger rail shall be cut back to the width of the flange of the smaller rail. The web of the larger rail shall be forged so that the flange can be pressed up at a slope if 1 in 8 or flatter in order that the two-flange underside will line up.

2.5.5 Welding and Cutting

i) All the welding of structural components excluding rail shall be done in strict accordance with the requirements of AS 1554 part 1: Structural steel welding - Welding of steel structure.

ii) The welding of rail shall be done in strict accordance with AS 1085 Part 20: Railway track material - Welding of steel rail.

iii) Cutting shall be done in an approved manner. All materials other than rails and fishplates, which are cut using an oxy-acetylene or oxy propane flame, shall be ground smooth and all burnt metal shall be removed.

iv) Rails and Fishplates shall not to be flame cut.

2.5.6 Drilling and Machining

i) All holes for drilling and machining shall be accurately set out using templates or gauges, which conform to the centres and dimensions shown on the drawings and to the tolerances, set out in this specification.

ii) Incorrectly drilled holes in rail components shall not be plugged and re-drilled. Other components shall not be plugged and redrilled without approval.

iii) The running surfaces of all cast inserts shall be machine finished.

iv) All machined components shall be machined accurately to the dimensions and sections shown on the relevant drawings.

v) Any sharp edges and burrs shall be removed.

2.5.7 Fitting

i) All parts required for the works shall be to the correct forms, dimensions and angles, and shall be fitted with accuracy to the dimensions and within the tolerances shown on the relevant drawings and this specification.

ii) Unless otherwise specified, cast blocks shall be finished to fit accurately over 90 per cent of their fitting faces. Any block which permits the insertion of a 0.5 mm feeler gauge between the rails and fitting faces of the cast blocks shall not be used in the final assembly.

iii) The design of rail parts and blocks shall allow for variations in rail size tolerances.

2.5.8 Bending, Curving, Setting and Twisting of Rails

i) Rails shall only be curved, bent or twisted in machines approved by authorised personnel. Curved or set rails must have no twist when sitting free on a level surface.

ii) Rails shall not be heated above 175°C when bending.

2.5.9 Riveting

i) All rivets shall be hydraulically or pneumatically riveted and shall be heated uniformly from head to point before riveting.

ii) Over heating of rivets shall not be allowed and all mis-shaped rivets shall be replaced by proper rivets.

2.5.10 Assembly of 'V' and 'K' Crossings

i) V and K crossings' components shall be fitted together on the platform and shall be shown to be correct to the satisfaction of the authorised personnel. The running edges shall be to true alignment at a depth 16 mm below the top surface of the rails and is to be specified on the relevant drawings.

ii) Epoxy resin filler (Araldite K105 or approved equivalent) shall be applied to the fitting faces of the manganese inserts and blocks.

iii) Rails and blocks shall be free of scale, rust and contaminants prior to application of the epoxy resin filler. Excess filler shall be removed from the rail and blocks.

iv) Fastenings shall be inserted with all heads on the one side of crossings wherever practical.

v) All crossings, including rail bound manganese steel crossings, shall be assembled utilising 25.4 mm high tensile swage lock fastenings, unless otherwise specified. Swage lock fastenings shall be tightened commencing from the nose of the crossing, alternating in each direction towards the openings.

vi) Tensioning of swage lock fastenings shall be carried out in two stages. First stage is nip up the assembly so all matching components are in contact with each other. Final tensioning shall only perform after epoxy filler is cured.

vii) All sharp edges shall be ground off the ends of swage lock fastenings after installation.

2.5.11 Rail Insulated Joints

i) Rail insulated joints shall be in accordance with AS 1085 Part 12: Railway track material - Insulated joint assemblies

ii) Epoxy bonded Insulated Joints are to be incorporated into the final assembly of the diamonds and turnout. Insulated Joints are to form part of the closure rails. Insulated Joints are to be manufactured using a 15 degree angled joint and swage lock fastenings.

2.6 TOLERANCES

Except where otherwise shown on drawings and in this specification the following tolerances shall be permitted.

2.6.1 Manufactured Rails

i) Where rails are to be cut to length the maximum out of square tolerance for the ends is 1 mm.

ii) Rails required to be curved to a specified radius shall be formed to an even radius. The maximum deviation from the specified radii is - 10% of the correct versine for that radius, measured over a 3-

metre cord length at any point. Where offset dimensions are given, the rail position shall be within +2,-0 mm of that position in addition to meeting the above radius specification.

iii) The position of holes in rails shall be +1,-0 mm horizontally and +1,-0 mm vertically of that specified on the drawings. The size of drilled holes shall be +0.5,-0 mm of that specified.

iv) The surface roughness value of machines or planed surfaces shall be better than 12.5 µm (N10).

2.6.2 Crossings

Following are the tolerances shall be permitted.

i) Flange way widths and depths, ±1 mm.

ii) Nose width, ±1 mm.

iii) Positions of fishbolt holes, ±1 mm.

iv) Size of fishbolt holes, ±1 mm.

v) Relative lengths from nose to adjacent 'V' ends of 'V' crossings, +2,-0 mm variation.

vi) Relative lengths from point of intersection to ends of 'K' crossings, +2,-0 mm variation.

vii) Alignment of running edges and surfaces, measured from a fine taut line, +1,-0 mm deviation.

viii) Overall lengths, ±2 mm.

2.7 FINISHES AND IDENTIFICATION

2.7.1 Stamping

i) All crossing, fixed gauge components shall be clearly and legibly stamped for identification with minimum 15 mm letters and numerals.

ii) Crossings shall be stamped on the head and within 300 mm of the end of the wing rail with the weight of rail and angle of crossing i.e. "60 kg", "1 in 8", also the initials of the manufacturer shall be stamped in this same location. Switch assemblies shall be stamped on the heel block with the initial of manufacturer.

2.7.2 Corrosion Protection

i) The surfaces of all materials coated shall be brushed clean and shall be dry before corrosion protection is applied.

ii) All components shall be coated with one coat of relevant “environmentally friendly” protective coating. Coating shall be done after final inspection.

2.7.3 Lubrication or Oiling

After inspection, the sliding surfaces of the points and crossings shall be lubricated with one application of dry film lubricant available for points and crossings (DTEI known lubricant is ROCOL switch plate spray).

2.8 QUALITY ASSURANCE AND RE-WORKING

i) There shall be a QA system that complies with relevant ISO 9000 standards (ISO 9001-Quality systems-Model for quality assurance in design, development, production, installation and servicing).

ii) There shall be staff or group suitably qualified in quality assurance to ensure QA during all processes.

iii) Quality plan shall be developed to ensure compliance with the specification and related drawings and the quality of material used.

iv) Quality plan shall detail the key elements in the provision of the services, the type and frequency of inspection, checks and audits to be carried out and delegated authority.

v) There shall be effective and continuous monitoring of quality of all manufacturing processes which affect the quality and acceptability of the final product.

vi) All the tests required by this specification and/or the Australian Standard specifications or other approved specifications shall be carried out in compliance with standards.

vii) All re-work shall be done with consultation and approval of authorised or nominated personnel.

2.9 LOGISTICS AND THROUGH LIFE SUPPORT

2.9.1 Warranty period

The warranty period shall be 2 years.

2.9.2 Spare parts

Spare parts and technical support shall be readily available.

2.9.3 Technical data supplied

i) Technical data shall be supplied in hard copy and electronic copy.

ii) Technical data shall consist of engineering drawings, test certificates, operator manuals, maintenance procedure and schedules, training material, spare parts listings, design failure mode and effect analysis, material safety data sheet and any other relevant technical data.

2.10 VERIFICATION PROVISIONS

2.10.1 Type approval

i) Process

The points and crossings shall be subject to Type Approval by PTS if not already in service within the AMPRN in a similar use.

ii) Evidence

Type approval evidence shall be provided prior to supply of points and crossings.

2.10.2 Test and installation documentation

Documentation to be provided with the point and crossings shall include at least:

i) Installation and commissioning procedures.

ii) Site Acceptance Test plan, results and certification.

APPENDIX A- DEFINITIONS

Defined Term	Definition
Points and Crossings	Track structures which provide for one track to join or cross another. (RISSB Guideline)
Crossing	A track component that enables a wheel travelling along one rail to pass through the tail of a track which crosses its path. The most common types are “V” and “K”. Sometimes called the ‘Frog’. Crossing angle: The angle of approach between the two roads of a turnout or diamond crossing. Welded crossing: A crossing utilizing a hardened, machined block in the wheel transfer area. Extension wing and running rails are welded to the machined block utilizing specialized techniques. Fabricated crossing: A crossing manufactured from machined and set rails separated by blocks and suitably fastened as a unit. V crossing: A crossing comprising a nose and two wings. Typical V crossing is shown in figure A1. K crossing: A crossingwork comprising two opposite noses, a running wing rail and a guard wing rail. K crossings are used in diamond crossingwork assemblies. Typical K crossing is shown in figure A2. Crossing number: Crossings may be designated by a number which refers to the cotangent of the splay angle or rate of slope. (Commonly referred as angle). (RISSB Guideline)
Check rail	Rails placed in track inside the running rail at particular locations which comes into contact with the back of the wheel flange to guide wheels through points and crossings, on curves and through flangeway gaps in streets. (RISSB Guideline)
Type Approval	A formal statement given by PTS that declares the suitability of an item to be used within the AMPRN system
Specification	Means this document

Figure A.1: Typical 'V' crossing assembly (shown for fabricated type)

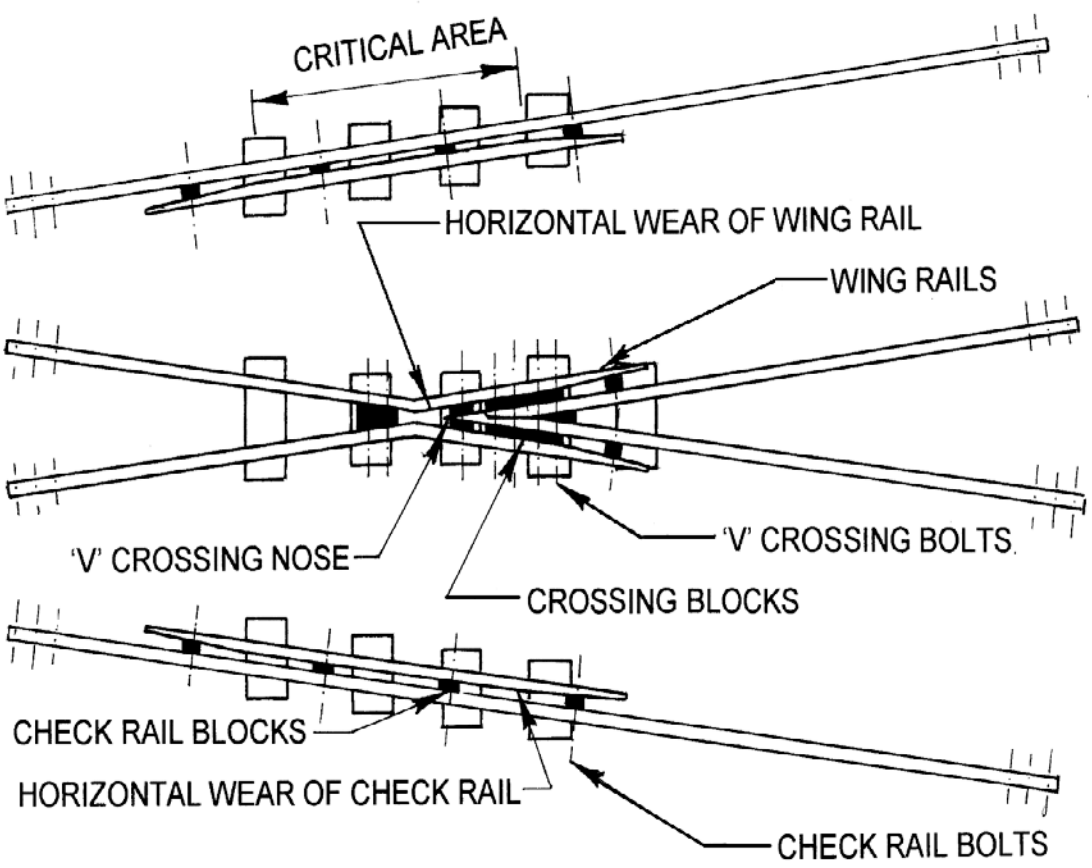
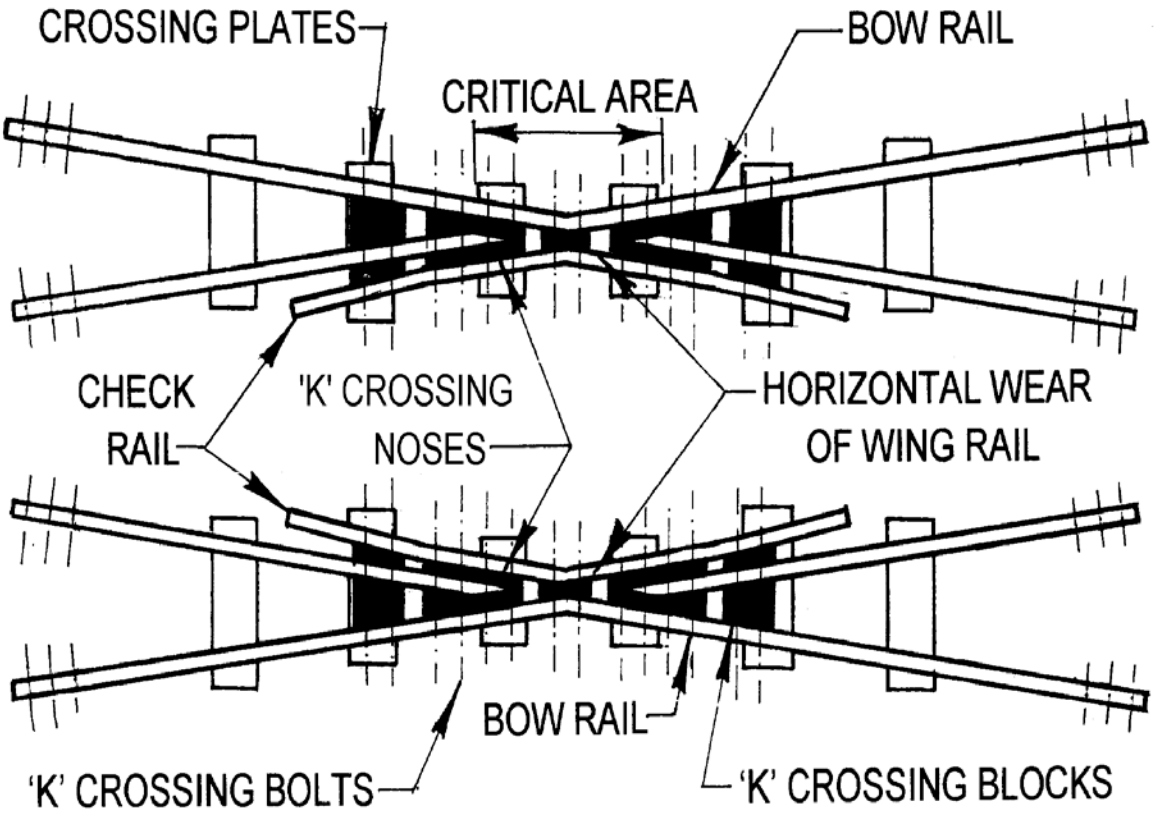


Figure A.2: Typical 'K' crossing assembly (shown for fabricated type)

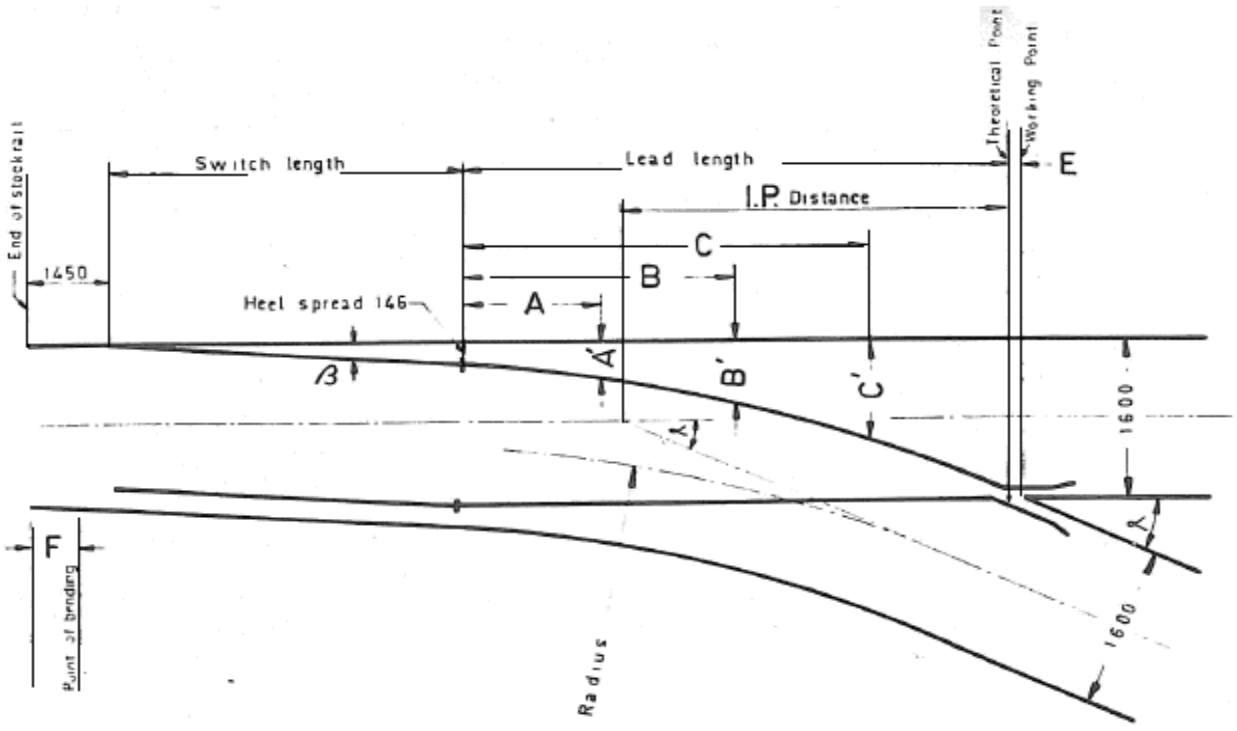


APPENDIX B- STANDARD LEAD DATA FOR BROAD GAUGE

Table B.1: LEAD DATA

CROSSING NUMBER	CROSSING ANGLE α	SWITCH LENGTH	LEAD LENGTH	RADIUS	I.P. DISTANCE	E	A	A□	B	B□	C	C□
8	7˚10´00˝	4571	18730	196579	12775	112	4700	342	9400	651	14100	1073
8	7˚10´00˝	6000	16334	183050	12775	104	4000	386	8000	689	12000	1081
8	7˚10´00˝	6095	19682	191485	12775	112	5000	323	10000	631	15000	1069
8.75	6˚33´06˝	4571	20130	238160	13977	111	5100	353	10200	669	15300	1095
8.75	6˚33´06˝	6095	21232	230737	13977	111	5200	321	10400	613	15600	1023
8.75	6˚33´06˝	9142	22462	225711	13977	111	5300	287	10600	553	15900	943
12	4˚46´34˝	6095	27472	450555	19183	168	6900	353	13800	666	20700	1085
12	4˚46´34˝	9142	29562	431842	19183	168	7400	320	14800	620	22200	1048
15	3˚49´14˝	6095	32625	736742	23987	210	8200	375	16400	696	24600	1108
15	3˚49´14˝	9142	35613	688056	23987	210	8900	336	17800	642	26700	1063
ALL MEASUREMENTS ARE IN MILLIMETRES												

Figure B.1: STANDARD CROSSING GEOMETRY FOR BROAD GAUGE



SWITCH LENGTH IN MM	SWITCH ANGEL β	DIMENSION F IN MM
4571	1˚42´40˝	1132
6095	1˚17´00˝	1026
9142	0˚51´20˝	814