PART 920

CONSTRUCTION OF TRAM TRACKS

CONTENTS

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1. GENERAL

This Part specifies the requirements for the construction of tram tracks and associated Works.

Reference shall be made to the following documents:

AS 1085.1 Railway Track Material, Steel Rails
AS 1085.3 Railway Track Material, Sleeper Plates
AS 1085.4 Railway Track Material, Fishbolts and Nuts
AS 1085.7 Railway Track Material, Spring Washers
AS 1085.8 Railway Track Material, Dogspikes
AS 1085.9 Railway permanent way material Part 9: Rolled steel clip fastening sleeper plates
AS 1085.10 Railway Track Material, Rail Anchors
AS 1085.13 Railway permanent way material Part 13: Spring fastening spikes for sleeper plates
AS 1085.14 Railway permanent way material Part 14: Prestressed concrete sleepers
AS 1085.16 Railway permanent way material Part 16: Cast steel sleeper plates
AS 2758.7 Aggregates and rock for engineering purposes Part 7: Railway ballast
AS 3818.1 Timber - Heavy structural products - Visually graded Part 1: General requirements
AS 3818.2 Timber - Heavy structural products - Visually graded Part 2: Railway track timbers
AS 4799 Installation of underground utility services and pipelines within railway boundaries.
AS 1029 Low Voltage Contactors
AS 1431 Control Switching Devices for Voltages Up to 650 Vac and 250 Vdc
AS 2205 Methods of Destructive Testing of Welds in Metal
AS 4799 Installation of Underground Utility Services and Pipelines within Railway Boundaries

Railway Authority (TransAdelaide) Code of Practice - Volume Three - Tram System [CP3]:
- CP-TS-972 Part 2 Structure and Application
- CP-TS-974 Part 4 Operational Signage
- CP-TS-975 Part 5 Structural Clearances
- CP-TS-976 Part 6 Track Geometry
- CP-TS-977 Part 7 Structures
- CP-TS-978 Part 8 Stormwater Drainage
- CP-TS-979 Part 9 Earthworks
2. REMOVAL OF EXISTING TRACK WORK

This clause only applies where removal of existing track and associated infrastructure is required.

Track work in ballast shall be unfastened and dismantled into sets of rails, points, crossings, guard rails, closure rails etc. Track work in concrete shall be removed by breaking the concrete, cutting the rails and carting from site.

Platework shall be unfastened and removed from timbers. Bolts and screws shall be unscrewed wherever possible. Material shall be unfastened and handled in a manner which is not detrimental to components, rail, track work or structures.

All surplus track work shall remain the property of the Principal and delivered by the Contractor to the TransAdelaide Materials Holding Yard, Dry Creek, unless otherwise specified in the Contract Specific Requirements.

Prior to completion of the Contract, the Contractor shall clean up all areas and leave them in a condition comparable to that encountered at the time of possession of site. A written release shall be obtained from TransAdelaide and submitted to the Superintendent within 10 days after clean-up.

3. TRACK CONSTRUCTION

3.1 General

The track work, including points and crossings, shall conform to the alignment, levels and cant shown on the Drawings or in the Contract Specific Requirements.

3.2 Structural Clearances

The construction and maintenance of tracks and structures shall enable trams or tram-type vehicles to travel along the tracks with safe clearances between vehicles and adjacent structures or between vehicles on adjacent tracks.

Structural clearances shall be in accordance with TransAdelaide’s Code of Practice CP-TS-975 Part 5 “Structural Clearances”, unless otherwise specified in the Contract Specific Requirements or on the Drawings.

Approval shall be sought from the Superintendent and TransAdelaide for alternative structural clearances.

3.3 Track Geometry

Track geometry for construction shall be in accordance with TransAdelaide’s Code of Practice CP-TS-976 Part 6 “Track Geometry”, unless otherwise specified in the Contract Specific Requirements or on the Drawings.
Approval shall be sought from the Superintendent and TransAdelaide for alternative track geometry.

Track gauge shall be measured between the running edges of the rails at locations 11 mm below the running surface and shall take into account any rail head metal flow. Track gauge for straight track shall be 1435 mm.

Gauge shall be modified as follows:

**TRACK GAUGE**

<table>
<thead>
<tr>
<th>Location</th>
<th>Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straight and curved track &gt; 100 m radius (except turnouts)</td>
<td>Laid neat to gauge</td>
</tr>
<tr>
<td>On curves from 100 m to 50 m radius</td>
<td>3 mm wide</td>
</tr>
<tr>
<td>On curves &lt; 50 m radius</td>
<td>5 mm wide</td>
</tr>
</tbody>
</table>

Track shall be constructed to the tolerances shown in the following table:

<table>
<thead>
<tr>
<th>TRACK GEOMETRY TOLERANCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter</td>
</tr>
<tr>
<td>Centreline location</td>
</tr>
<tr>
<td>Level</td>
</tr>
<tr>
<td>Gauge (open track)</td>
</tr>
<tr>
<td>Gauge, Turnouts (opposite crossings)</td>
</tr>
<tr>
<td>Guard Rail (Check) Flangeway</td>
</tr>
<tr>
<td>Line measured over a 10 m chord</td>
</tr>
<tr>
<td>Twist (3.5 m chord)</td>
</tr>
<tr>
<td>Track Superelevation</td>
</tr>
<tr>
<td>Top (10 m chord)</td>
</tr>
<tr>
<td>Sleeper spacing</td>
</tr>
</tbody>
</table>

Track superelevation ramp shall be applied uniformly over the full length of transitions.

Tangent points shall be stencilled in white paint on the outside of the low leg rail web:
- **TS** (tangent – spiral)
- **SC** (Spiral – curve)

at each end of the curve.

Superelevation values shall be stencilled as above, at 10mm increments through the transition.

### 3.4 Drainage

Drainage construction (cess drains, pipe and box culverts, concrete drainage structures, kerbing, sub-soil drainage and associated items) shall be constructed in accordance with the requirements of Part 205 "Construction of Drainage" and TransAdelaide’s Code of Practice CP-TS-978 “Part 8 Stormwater Drainage”, unless otherwise specified in the Contract Specific Requirements or on the Drawings.

### 3.5 Earthworks

The construction of earthworks (the “formation”) beneath the track structure shall be in accordance with Part 210 "Construction of Earthworks” and TransAdelaide’s Code of Practice CP-TS-979 Part 9 “Earthworks”, unless otherwise specified in the Contract Specific Requirements or on the Drawings.
3.7 **Capping Layer and Ballast**


3.8 **Sleepers**

3.8.1 **General**

The supply and installation of sleepers shall be in accordance with TransAdelaide’s Code of Practice CP-TS-980 Part 10 “Track Support Systems”, unless otherwise specified in the **Contract Specific Requirements** or on the Drawings.

Concrete sleepers shall be manufactured to suit the ‘Pandrol 2100 e-clips’ system (or equivalent approved).

3.8.2 **Handling and Storage**

Sleepers shall be handled and moved into position in such a way as to avoid damage or bruising. Sleepers shall not be subjected to blows from a hammer or any other tool or appliance.

Sleepers shall be stored and stacked in a manner that will prevent damage to shoulders in sleepers.

Any sleepers provided by the Superintendent shall be inspected for quality by the Contractor prior to installation.

3.8.3 **Aligning, Spacing and Laying**

Sleepers shall be laid central to the track and at right angles to the centreline of the track.

Sleepers spacing shall be adjusted to ensure that welded joints are suspended centrally between sleepers.

All sleepers shall be lifted, lined and tamped after installation and fastening of rails.

3.9 **Rails**

3.9.1 **General**

The supply and installation of rails shall be in accordance with TransAdelaide’s Code of Practice:

- CP-TS-981 Part 11 “Rail and Rail Joints”, and
- CP-TS-982 Guard/Check Rails and Buffer Stops”,

unless otherwise specified in the **Contract Specific Requirements** or on the Drawings.

Notwithstanding CP-TS-981 Part 11 “Rail and Rail Joints”, all new rails shall conform to the following criteria:

a) AS50 rail cross section and properties shall comply with AS 1085.1 (1980).

b) Grooved rail be RiA57A.

c) Certification of compliance with relevant standards shall be supplied.

The Contractor shall supply all new rails, unless specified otherwise in the **Contract Specific Requirements** or on the Drawings.

Rail shall not be handled in any manner which is detrimental to the rail, track work, track work components or structures.
3.9.2 Laying of Rails

All rails shall be straight and true prior to laying. Any crippled, deformed or damaged rail shall not be used. The bottom of the rail, the sleeper plate and the bearing surface of the sleeper, as applicable, shall be clear before the rail is laid.

On timber sleeper track, all rails shall be supported on sleeper plates except at turnouts, where plating shall conform to relevant Drawings or as specified in the Contract Specific Requirements.

3.9.3 Rail Cutting

The Contractor shall avoid any unnecessary cutting of rails.

Cutting of rail shall be carried out to ensure conformance to detailed specifications for rail end condition (cutting), proximity of welds (minimum closure lengths), head matching (joint alignment) and requirement for square or staggered joints (position of joints).

Rails shall be cut with an approved rail saw, friction saw or flame cut. Flame cut rail ends shall not be used as final cuts of running rail and must be re-sawn a minimum distance of 25 mm from the flame cut edge.

Rail ends shall be re-sawn if the condition does not comply with the tolerance.

Cuts shall be square to the rail within a tolerance of 2.0 mm over the width and/or height of the rail.

Cutting compound shall be used for cooling and lubrication when a rail saw is used. Cutting compound shall not be used with friction saws.

3.9.4 Drilling of Rails

When necessary to provide holes in the rail web, such holes shall be made only by drilling. Drills shall be sharp and cutting compound should be used for cooling and lubrication.

All holes shall be drilled and chamfered utilising a suitable template for the relevant rail section. Holes shall be parallel throughout their depth, clean and square with the web. No burrs or projections shall be left and the rails shall not be damaged.

Holes shall be 27 mm diameter for 25.4 mm swage lock fastenings. All holes on the same rail end shall be the same diameter. The hole diameter tolerance shall be ± 0.5 mm.

No two holes shall be closer than 127 mm centres.

Incorrectly drilled holes shall be cut out.

Hole positions at rail ends and turnouts shall conform to dimensions specified and shall be within horizontal and vertical tolerances of ± 0.5 mm.

3.9.5 Minimum Rail Closure Lengths

The minimum rail closure length shall be 3.0 m for normal straight and curved track.

Shorter lengths shall not be permitted.

Closure rails shall be cut and laid in such a manner that no gaps are provided at joints.

3.9.6 Rail Joints

(a) Position of Joints

Joints shall be square across the track in straight track and at a change of rail section. The maximum skew at square joints shall be 65 mm.
Joints shall be located midway between sleepers or fastening systems.

Curved track of less than 325 m radius shall have staggered joints. The stagger shall be squared up with the first joints into the straights.

No joint shall be located within 3.0 m of the approach of rigid track construction, i.e. concrete track construction or direct fixation on bridges.

(b) Joint Welding

Rail joints shall be either:
- Flash butt welds
- Aluminothermic welds

Rails joined by flash butt or aluminothermic welds are considered as “continuously welded rail”.

Continuously welded rail on ballasted track shall be ‘destressed’ to prevent buckling of rails.

Rails of like size shall be joined using either flash butt or aluminothermic welds. Rails of different sizes shall be joined with approved aluminothermic welds.

Aluminothermic welded joints shall be constructed in accordance with the manufacturer’s instructions.

Care shall be taken to ensure that the top and running edge of both rails match at each joint. Any misalignment of rail heads caused by the existing rail being worn shall be rectified by grinding or building up the worn rail to line level and gauge using the appropriate weld material creating a 1 in 25 ramp.

Flash butt welds and adjacent heat affected areas of head hardened rails shall be treated to ensure equivalent surface hardness and hardness profile to the primary rail as specified in AS 1085.11, unless specified otherwise in the Contract Specific Requirements or on the Drawings. The provision of details of the heat treatment process shall constitute a HOLD POINT.

Fishplates with fishbolts shall only be used for temporary joints for a maximum period of up to 2 weeks following installation, unless otherwise approved. Fishplate joints shall be designed, supplied and installed by the Contractor in accordance with TransAdelaide requirements.

Kirby type welded joints shall not be permitted, unless otherwise approved by the Railway Authority.

Welding processes must be carried out in accordance with the manufacturer’s specification and in accordance with the tolerances specified in the table below.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak in running surface</td>
<td>0.3 mm over 1.0 m</td>
</tr>
<tr>
<td>Dip in running surface</td>
<td>Not Permitted</td>
</tr>
<tr>
<td>Vertical step in running surface</td>
<td>0.15 mm over 100 mm</td>
</tr>
<tr>
<td>Horizontal step in running surface</td>
<td>+ 0.15 mm over 100 mm</td>
</tr>
</tbody>
</table>

Each weld shall be visually inspected for geometric and surface defects. Each weld shall be ultrasonically tested for internal defects. Inspection of welds and submission of ultrasonic test results shall constitute a HOLD POINT.

3.10 Guard and Check Rails

The supply and installation of guard and check rails shall be in accordance with this Specification, Drawings, and TransAdelaide’s Code of Practice CP-TS-982 “Guard/Check Rails and Buffer Stops”.

3.11 **Tie Bars**

Tie bars, where specified on the Drawings, shall conform to the requirements of AS 1302 or equivalent approved.

Tie bars shall be placed at a minimum interval of approximately 3 metres as shown on the Drawings. Tie bars shall not be placed in the fish plate holes near the ends of the rails.

Where it is proposed not to use sleepers, tie bars shall be adjusted and tightened to keep the rails to gauge.

22 mm tie bars shall be used for junctions or for curves with radius less than 325 m.

18 mm tie bars shall be used for straight track or curves with radius greater than 325 m.

Insulated tie bars shall be designed, fabricated and installed to suit the particular application.

Tie bars to be used in junctions and crossovers shall be fabricated to suit the particular location in the junction or crossover.

Submission of design, fabrication and installation details shall constitute a **HOLD POINT**.

3.12 **Fastenings**

Rail fastenings for concrete sleepers shall be ‘Pandrol 2100 e-clips’ (or equivalent approved) installed in accordance with the manufacturer's instructions, unless otherwise specified in the **Contract Specific Requirements** or on the Drawings.

Rail fastenings for steel sleepers shall be ‘Trak-Lok’ (or equivalent approved) installed in accordance with the manufacturer's instructions, unless otherwise specified in the **Contract Specific Requirements** or on the Drawings.

3.13 **Rail Supports**

Rail at crossings and turnouts which are encased in concrete shall be supported by packers consisting of concrete blocks of minimum size 200 mm x 200 mm x 100 mm with concrete blocks and wedges to achieve line and level, unless otherwise specified on the Drawings.

At tie bar locations, packers shall be placed under the rail, each end of switches and the centre of each crossing, and other locations as deemed necessary by the Superintendent.

3.14 **Concrete**

The design, supply and placement of structural concrete shall be in accordance with Division 3 "Concrete".

3.15 **Rail Stress Control**

Prior to track laying commencing, the Contractor shall provide a procedure for controlling rail stress during construction. The Contractor shall refer to TransAdelaide’s Code of Practice CP-TS-984 Part 14 “Rail Stress Control”.

Submission of this procedure shall constitute a **HOLD POINT**.

3.16 **Curved Track Work**

Rails for permanent curved track work of less than 100m radius shall be head hardened and pre-bent as indicated on the Drawings.

Rails for curved track work of less than 325m radius shall have a check rail adjacent to the inner running rail as indicated on the Drawings.

Extra tie bar holes may need to be drilled in the web of the rails so that tie bars can be fitted correctly (perpendicularly) between the rails.
3.17 Special Work

Special Work is any track work which is pre-fabricated (i.e. bent or assembled) before it can be constructed on site. This includes all switches, crossings and any track work.

Track work for junctions and crossovers shall be pre-fabricated into modules. Typical modules include turnouts, diamonds and H crossings.

A turnout module consists of a pair of switches (including drainage boxes and all working components), one crossing, and connecting rails.

A diamond module consists of four crossings and four closure rails.

The modules and separate rails shall be welded together on site using the appropriate methods as specified.

All points and crossings shall be seated on the appropriate sleeper plates and shall be firmly fastened down onto sleepers by the specified fastenings.

Points and crossings shall be laid in the general plane of the track work, unless otherwise specified.

Track and rail bonding for Special Work shall be in accordance with Clause 6.2

Inspection of special work shall constitute a HOLD POINT.

4. TURNOUTS

4.1 General

The turnout type shall be as specified on the Drawings or in the Contract Specific Requirements, and TransAdelaide’s Code of Practice CP-TS-983 Part 13 “Points and Crossings”.

Crossings shall be fixed with all legs in true alignment.

Inspection of Turnouts prior to operation shall constitute a HOLD POINT.

4.2 Switch Assembly

Points shall be assembled such that the toe and heel end of the switch housings are square when assembled. Switch blades shall bear evenly on all bearing surfaces and shall fit properly in castings before the interconnecting bar is fitted.

All operating components shall be fitted in accordance with the relevant Drawings or as specified in the Contract Specific Requirements such that the switches are in the correct shape and operate as intended.

Suitable spacers shall be used to attain correct gauge between the running edges of the switch housings. Gauge shall be measured at both the toe and heel ends of the switch housing.

Points operating equipment shall be fitted and adjusted to operate correctly.

4.3 Lubrication & Greasing

4.3.1 Spray Lubrication

Bearing surfaces shall be thoroughly cleaned to remove all scale, rust, grease, moisture and other contaminants prior to application of switch plate lubricant. Non-flammable solvents may be used for degreasing with the prior approval of the Superintendent.

‘Rocol Spray Switch Plate Lubricant’ (or similar approved) shall be used to lubricate the slide surfaces of the points and components as detailed below:
• The sliding surfaces of switch housings where the switch moves in the switch housing.
• The underside of switches, and sides of switches around the heel where the switch contacts the switch housing.
• Sliding surfaces of heel block where the heel block contacts the switch.
• Pivoting and bearing surfaces of the operating mechanism components.
• Pivoting and bearing surfaces of the inter-connecting mechanism.

Degreasers and Lubricants shall be applied in accordance with the manufacturer's instructions and recommended safety procedures.

The Contractor shall ensure that the wet lubricant is free from dust and contaminants, including during subsequent operations such as greasing of components.

4.3.2 Grease Lubrication

The hollow areas of the bearing yolk shall be filled with grease following installation of the tumbler. Bearing covers shall be fitted to ensure the components are kept dust free.

5. STRAY CURRENT CONTROL

The track shall be constructed to minimise the effects of stray current. This includes, but is not limited to, the following:

• A 50mm high strength PVC conduit spine laid along the length of the works;
• Insulating direct fixation fasteners on overhead cables;
• Encasing the track slab with an insulating membrane where the rails are embedded in or laid on roadway areas;
• Cross bonding rails to maintain equal potential of all rails in both tracks;
• Insulating impedance bond tap connections from the housing case;
• Insulating switch machines and hand operated switch mechanisms at the switch rods.

All conductive structures within 4 m of the outer rail shall be bonded to the rail track through a non-return diode. The Contractor shall liaise with TransAdelaide for details. The cable shall be 124 mm copper wire securely fixed to the conductive structure and inner rail. Connection shall be as approved by TransAdelaide.

Cabling and Diodes shall be placed in the appropriate conduits and pit in accordance with Part 253 “Supply and Installation of Conduits and Pits”.

For rail tracks encased in concrete, the bonding cable shall be fully welded to the rail.

6 BONDS

6.1 General

Bonds shall be installed to ensure continuity of the electric circuit as well as minimising electrolysis effects.

The Contractor shall bond across all rails, except at track circuit locations whereby the inner rail of adjacent tracks shall be bonded.

Bonds shall conform to details shown on the Drawings or as specified in the Contract Specific Requirements.

Care shall be taken when excavating near bonds connected to electrical assets or negative feeder cables.

All rail connections in concrete track construction shall be welded to the foot of the rail indicated on the Drawings.
Locations of all bond connections when encased in concrete shall be marked on the top of the head of the rail on opposite side to the running edge. Each mark shall consist of 3 straight cuts (known as ‘crow’s foot’) coming to a point at the edge of the rail head - each cut shall be 20 mm long x 2 mm wide x 2 mm deep.

Fish plated joints shall be bonded across the joint.

6.2 Track and Rail Bonding

Track and rail bonds shall be installed at every 5th tram overhead pole and not more than 150 m from adjacent bonds. Overhead poles and bond locations shall be clearly marked in a colour-fast green dot to indicate the bond location.

Track and rail bonds shall be 180 mm² copper cable and with 400 mm² copper cable used at every third bond as shown on the Drawings.

All bonds excavated during track repair or earthworks shall be reinstated.

Individual components of H-crossings, Junctions, Crossovers and Turnouts, shall be bonded to the satisfaction of the Railway Authority. The Contractor shall submit to the Superintendent details of the proposed bonding for these components prior this work occurring.

The Contractor shall notify the Superintendent of any length of track over 150 m that is without track and rail bonds.

Longitudinal bonding shall not be placed in the region of automatic track circuits.

For Special Work, such as junctions, crossovers, and turnouts, bonding shall take place around the special work. The connections shall be made to bridge the straight tracks past either side of the special works. An insulated copper conductor of 400 mm² shall be used to form the long bond. The centre of the two rail bonds shall use the “Wheeze” process at each end of the 400 mm² conductor to form four legs at each end.

Long bonds in concrete track construction shall be encased in concrete with a minimum of 100 mm cover in all directions.

Long bonds in ballasted track shall be placed in a trench with a minimum of 150 mm cover to top of formation and with an orange cable marker tape above the cable.

6.3 Pole Bonding

6.3.1 General

Pole bonds shall be installed at every tram overhead pole that has a feeder cable and electrical equipment mounted on it. Electrical equipment which requires a pole bond includes auto-sectionalising switches, aerial switches and surge diverters.

All pole bonds shall be 120 mm² copper cable as shown on the Drawings.

Locations of poles carrying electrical equipment shall be obtained from TransAdelaide. The Contractor shall notify the Superintendent of any pole bonds not connected to the track at any of these locations.

Substation negative cables shall be attached to the rail with 400 mm² copper cable and shall be installed as shown on the Drawings.

Pole bonds shall only be installed on steel poles. If pole bonding comes to a timber pole then the nearest steel pole shall be used.

All pole bonds excavated during track repair or earthworks shall be reinstated.

The Contractor shall notify the Superintendent of any length of track over 300 m that is without pole bonds.
6.3.2 Testing and Reinstatement of Existing Pole Bonds

For poles that carry sectionalising switches, the sectionalising switch shall be isolated and the permission of the Superintendent shall be obtained prior to the pole bond cable being disconnected.

The pole bond conductor shall be disconnected at the pole and the resistance of the conductor between the pole terminal lug and the rail connection shall be measured.

Testing shall be conducted by a qualified electrical tradesperson or qualified Technical Officer.

The equipment and proposed method for testing shall be approved by the Superintendent prior to any testing being undertaken. Submission of test results shall constitute a **HOLD POINT**. At a minimum, the location, pole number, original cable resistance reading, and final pole bond resistance reading after reinstatement shall be included in the test results.

For a cable resistance that exceeds 0.1 Ohm, the Contractor shall undertake the following procedure:

- If the pole carries underground feeder cables, an aerial switch or a sectionalising switch then a new 120 square millimetre double insulated conductor shall be run between the pole and the rail.
  
  On completion of the cable installation the resistance between the pole and the rail shall be retested and shall not exceed 0.1 Ohm.

- If the pole carries a surge diverter, two new 120 square millimetre double insulated cables shall be run between the pole and the rail, except that the cable to the surge diverter must extend all the way to the surge diverter and not terminate 300 mm above ground level.
  
  On completion of the cable installation the resistance between the pole and the rail and the surge diverter earth cable and the rail shall be retested and shall not exceed 0.1 Ohm.

- If the pole does not carry underground feeder cables, an aerial switch, a sectionalising switch or a surge diverter the Superintendent's advice shall be sought whether to replace the pole bond cable. If the bond cable is to be replaced it shall be done as shown on the Drawings.
  
  On completion of the cable installation the resistance between the pole and the rail shall be retested and shall not exceed 0.1 Ohm.

  If the bond cable is not to be replaced, then it shall be disconnected from the pole and cut 100mm below ground level. At the track end, the cable shall be cut as far away as possible from the rail and abandoned.

For a cable resistance that does not exceed 0.1 Ohm, the Contractor shall undertake the following procedure:

- The cable bond connections shall be reinstated at the rail and the pole as shown on the Drawings.
  
  On completion of the cable installation the resistance between the pole and the rail shall be retested and shall not exceed 0.1 Ohm.

7. **TAMPING**

The Contractor shall tamp, line, regulate and broom the entire length of ballasted track including any crossings and switches.

On completion of tamping, the track shall comply with tolerances specified in Clause 3.3 “Track Geometry”.

The Contractor shall be responsible for arranging the isolation and re-connection of all associated electrical cabling and/or signalling impacted by the tamping works.

Tamping across switches shall be undertaken using an appropriate Switch Tamper.

All obstructions shall be removed prior to tamping and re-instated.
The Contractor shall re-tamp the entire length of ballasted track including any crossings and switches 6 months after Practical Completion.

8. **BUFFERS**

The Contractor shall design, supply and install a tram buffer stoppage system to the satisfaction of the Superintendent and the Railway Authority, and shall meet the following minimum requirements:

- TransAdelaide’s Code of Practice CP-TS- 982 “Guard/Check Rails and Buffer Stops”
- Height 1.8 m
- Width 3.5 m
- Length 3.5 m.

Buffers shall be located as shown on the Drawings.

9. **SIGNALLING**

The Contractor shall design, supply, install test and commission all necessary tram signalling requirements in accordance with the Drawings and the **Contract Specific Requirements**, and TransAdelaide Work Instructions and safe working practices.

10. **TESTING AND COMMISSIONING**

10.1 **General**

On completion of the works and prior to testing and commissioning, the Contractor shall ensure all track grooves, switches and drains are clean and in good working order.

Inspection, testing, commissioning and acceptance of rail tracks and the associated power system shall be undertaken by suitably qualified and experienced persons prior to running of tram services. The Contractor shall refer to this Specification, the relevant TransAdelaide System Procedures, Work Instructions and Codes of Practice for all necessary inspection, testing, acceptance and commissioning requirements.

The Contractor shall develop a Testing and Commissioning Plan prior to the running of any tram services. At a minimum, the Testing and Commissioning Plan shall include:

- programme of inspection and testing activities,
- time, date and the relevant party and qualified persons responsible for inspecting, testing and commissioning,
- procedures and/or methodologies for testing and commissioning of railway assets, including inspections and verification requirements, defect log, defect intervention levels and rectification works,
- test and/or inspection results, certifications and acceptance criteria,
- recording and reporting requirements,
- contingency planning in the event of defective work or failure,
- re-testing and/or subsequent inspection requirements,
- the proposed testing equipment (including hardware and software) to be used including calibration certificates,
- notifications and endorsement requirements,
- access arrangements,
- references to the relevant parts of the Contractor’s plans (i.e. Rail Safety Management Plan and Quality Plans), and
- any other requirements to effect the Plan.
The Contractor and TransAdelaide shall agree and endorse the Testing and Commissioning Plan. The Testing and Commissioning Plan shall be submitted 6 weeks prior to any inspection or testing occurring, and shall approved by the Railway Authority. Submission shall constitute a HOLD POINT.

In developing the Testing and Commissioning Plan, the Contractor shall refer to TransAdelaide System Procedures QP-IS-1001 “Receiving Inspection and Testing” and QP-IS-1002 “In Process Inspection and Testing” for the purposes of inspection, testing, acceptance and commissioning of rail tracks and associated power system.

The Testing and Commissioning Plan shall also include the overhead electrical system; vide Part 930 Overhead Catenary, Clause 5 “Acceptance, Inspection and Testing”.

On completion of inspections and testing, the contractor shall submit to the Superintendent and TransAdelaide all results and reports in a Test and Acceptance Report. Submission shall constitute a HOLD POINT.

All defective work shall be rectified by the Contractor. Additional inspections, re-testing and reporting shall be at the Contractor’s expense.

**10.2 Intervention Levels**

During the Contract and Defect Liability Period, the Contractor shall ensure that all track work complies with the intervention levels as provided in TransAdelaide Code of Practice CP-TS-976 Part 6 “Track Geometry”.

The Contractor shall ensure that all track work complies with the following intervention levels during the Contract and Defect Liability Period.

<table>
<thead>
<tr>
<th>INTERVENTION LEVELS</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line (variation on 10 m chord)</td>
<td>20 mm</td>
</tr>
<tr>
<td>Wide Gauge</td>
<td>10 mm</td>
</tr>
<tr>
<td>Top (variation on 10 m chord)</td>
<td>15 mm</td>
</tr>
<tr>
<td>Superelevation</td>
<td>15 mm</td>
</tr>
<tr>
<td>Twist (over 10 m base)</td>
<td>15 mm</td>
</tr>
<tr>
<td>Twist (over 3.5 m base)</td>
<td>8 mm</td>
</tr>
</tbody>
</table>

All rails with defective welds to be cut out and replaced with a new length of rail and re-welded and tested in accordance with this Specification.

The Contractor shall also refer to the intervention levels for the overhead electrical system; vide Part 930 Overhead Catenary, Clause 5 “Acceptance, Inspection and Testing”.

The Contractor shall immediately notify the Superintendent and TransAdelaide of such defects and rectify any defect that exceeds the following intervention levels:

The Contractor shall develop a ‘defects rectification procedure’ for identifying and repairing the defect. Submission of the procedure shall be approved by TransAdelaide and constitute a HOLD POINT.

If during the course of the Contract and Defect Liability Period a defect caused by the Contractor’s Works becomes apparent requiring immediate rectification, TransAdelaide may undertake such rectification works and notify the Contractor within 12 hours of such defects occurring. Rectification of such defects by TransAdelaide does not negate the responsibility and liability of the Contractor under this Contract.

Methods for defects rectification work shall be addressed in the Railway Asset Maintenance Plan, vide Part 170 Clause 4.2 “Maintenance of Railway Infrastructure”.

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11. **HOLD POINTS**

The following is a summary of Hold Points; vide Part 140 "Quality System Requirements", referenced in this Part:

<table>
<thead>
<tr>
<th>CLAUSE REF.</th>
<th>HOLD POINT</th>
<th>RESPONSE TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clause 3.9.6 (b)</td>
<td>Provision of details of the heat treatment process</td>
<td>1 working day</td>
</tr>
<tr>
<td>Clause 3.9.6 (b)</td>
<td>Inspection of welds and submission of ultrasonic test results</td>
<td>1 working day</td>
</tr>
<tr>
<td>Clause 3.11</td>
<td>Submission of information for tie bars used in junctions and crossovers</td>
<td>7 working days</td>
</tr>
<tr>
<td>Clause 3.15</td>
<td>Submission of rail stress procedure</td>
<td>7 working days</td>
</tr>
<tr>
<td>Clause 3.17</td>
<td>Inspection of Special Work</td>
<td>2 working days</td>
</tr>
<tr>
<td>Clause 4</td>
<td>Inspection of Turnouts</td>
<td>2 working days</td>
</tr>
<tr>
<td>Clause 6.3.2</td>
<td>Submission of pole bonding test results</td>
<td>1 working day</td>
</tr>
<tr>
<td>Clause 10.1</td>
<td>Submission of the Testing and Commissioning Plan</td>
<td>14 working days</td>
</tr>
<tr>
<td>Clause 10.1</td>
<td>Submission of the Test and Acceptance Report</td>
<td>7 working days</td>
</tr>
<tr>
<td>Clause 10.2</td>
<td>Notification of defect and submission of defect rectification procedure</td>
<td>1 working day</td>
</tr>
</tbody>
</table>

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